APPENDIX A – DEED RESTRICTION

DECLARATION
OF
RESTRICTIONS

MADE BY

DYNO NOBEL INCORPORATED,
a Delaware corporation

After recording, please mail to:

Neal Olsen
Dyno Nobel Inc.
Eleventh Floor Crossroads Tower
Salt Lake City, UT 84144-0103

DECLARATION OF RESTRICTIONS

THIS DECLARATION OF RESTRICTIONS (this "Declaration") is made by Dyno Nobel Inc., a Delaware corporation having an address of 161 Ulster Avenue, Ulster Park, New York 12487 ("DNI"), this 18 day of February 2004.

W I T N E S S E T H:

WHEREAS, DNI is the owner of certain real property located in Ulster County, New York, more particularly described in **Exhibit A**, attached hereto and made a part hereof (such real property being hereinafter referred to as the "Site");

WHEREAS, the Site is subject to a Part 373 Permit ("Permit") under New York State Department of Environmental Conservation ("DEC") Hazardous Waste Management Facility regulations (Permit #3-5122-00042/00019) which includes requirements for the implementation of investigations, interim corrective measures and corrective action under Article 27, Title 9, Section 27-0913 and 6 NYCRR 373-2.6;

WHEREAS, DNI's work under the Permit is being overseen by DEC;

WHEREAS, pursuant to the Permit, DNI has implemented investigations, and interim corrective measures and will be implementing corrective actions at the site;

WHEREAS, the Permit for the Site requires implementation of institutional controls restricting future use of the Site, which controls may include restrictive covenants; and

WHEREAS, DNI desires to make known and to declare the covenants, agreements, conditions, easements, reservations, restrictions, and changes which shall be applicable to the Site and binding thereon.

NOW, THEREFORE, DNI, holds and stands seized of the Site upon the following covenants, agreements, conditions, easements, reservations, restrictions and charges, to wit:

1. Purposes:

   (a) to restrict certain use and development activities at the Site so as to prevent any uses of the Site which would:

      (i) interfere with the integrity of the investigations, interim corrective measures and corrective actions implemented pursuant to the Permit,

(ii) potentially could result in adverse environmental and human health consequences resulting from exposure to hazardous substances which may continue to exist at or beneath the Site; and

(b) to provide access to DNI and the DEC and fulfill DNI's commitments under the Permit and corrective action plan.

2. Specific Restrictions on Use: The following restrictions on use apply to the use of the Site and run with the land and are binding upon DNI and its respective successors and assigns:

(a) Use of the Site in a manner contrary to the use and development restrictions set forth herein could result in adverse effects to human health and the environment. All rights in and to the Site are subject to the terms and conditions of this Declaration, as well as any other unrecorded declarations. Use and development of the Site also is subject to applicable Federal, State, and local governmental laws and regulations.

(b) No building, structure or other object shall be built or placed on the Site or any activities taken that would disturb the cap or stabilized contents of any landfill or would otherwise disturb any areas involving interim corrective measures, corrective actions or affected by requirements under the Permit at the Site, except as required by the Permit or corrective action plan, without the prior written approval of DNI and DEC;

(c) There shall be no excavation without taking appropriate steps to ensure the proper handling, treatment and disposal of all contaminated materials and that there will be no release of hazardous substances into the environment;

(d) Permanent caps shall not be disturbed or modified in any manner, and no action shall be taken which shall disturb in any manner the integrity or effectiveness of the permanent cap, except as required by the terms of the Permit or corrective action plan, without prior written approval of DNI and DEC;

(e) No use or activity shall be permitted in, over, under, across, upon or through the permanent cap or which will disturb any portion of the remediation efforts or which will prevent, disrupt or otherwise interfere with the construction, operation, alteration, reconstruction, use, maintenance, repair, replacement, monitoring or inspection of any portion of the remediation efforts implemented in, over, under, across, upon or through the Site, including, without limitation: the collection, containment, treatment and discharge of groundwater; the excavation, dewatering, storage, treatment and disposal of soils and sediment; the long-term monitoring of groundwater, surface water, soils and sediments; and the long-term operation, maintenance, monitoring and inspection of any portion of the remediation efforts, except as required by the terms of the Permit or corrective action plan, without prior written approval of DNI and DEC;

(f) No activities shall be permitted that interfere in any way with the physical integrity of any groundwater monitoring wells at the Site, except as necessary to implement the terms of the Permit or corrective actions plan, without prior written approval of DNI and the DEC;

(g) The use of contaminated groundwater exceeding the State's GA Classification groundwater quality standards shall be prohibited unless it is pretreated to a level protective of human health;

(h) The use of the Site shall be limited to commercial or industrial purposes and such other uses which are akin to industrial uses, such as material and equipment handling, storage and use; provided, further, that the owner and/or occupant of the Site shall not use the property for agricultural, institutional, elder care or child care purposes without the prior written consent of DNI and the DEC;

(i) There shall not be constructed, maintained or used on the Site any residence, school, hospital or non-commercial or non-industrial facility;

(j) All remedial measures and corrective actions, including any institutional and engineering controls conducted or required by the Permit shall be maintained in accordance with the requirements of the Permit, unless DNI's successors and assigns first obtain permission to discontinue such controls from DNI and DEC.

3. Access:

(a) DNI, the DEC, and their respective employees, agents, and contractors shall have the right of ingress and egress from, movement on the Site, and right to perform in, over, under, across, upon and through the Site any and all necessary actions sufficient to conduct, maintain, monitor and secure the integrity of structures associated with remedial and corrective actions, and to take other actions required or authorized by the Permit and to monitor and enforce compliance with the terms of this Declaration. Such activities shall include, but are not limited to the construction, reconstruction, installation, use, alteration, maintenance, repair or replacement of material and equipment necessary to carry out the Permit requirements and of all structures necessary to protect the integrity of the systems, materials, equipment or areas associated with the remedial and corrective actions. Ingress and egress will be at reasonable times upon notice and approval by DNI or its successors and assigns to ensure that safety precautions associated with site manufacturing activities are taken.

(b) All rights of access to the Site at all reasonable times for the following purposes shall run with the land including:

(i) Implementing response and corrective actions identified in the Permit and corrective action plan;

(ii) Verifying any data or information relating to the Site;

(iii) Verifying that no action is being taken on the Site in violation of the terms of this instrument or of any federal, state or local environmental laws or regulations;

(iv) Conducting investigations related to contamination on or near the Site, including, without limitation, sampling of air, water, sediments, soils; and

(v) Implementing additional or new response actions.

4. Enforceability:

(a) The covenants, conditions and restrictions of this Declaration shall be enforceable by DNI, its successors and assigns, and by the DEC;

(b) Such covenants, conditions and restrictions shall run with the land, shall be binding upon any and all successors in interest, and all assignees, lessees, sub-lessees, operators, tenants, licensees, and agents, and any and all persons who acquire any interest in the Site;

(c) Violation of covenants, conditions and restrictions contained herein shall give DNI, and its successors or assigns, and/or DEC, in addition to all other remedies, the right to enter upon the land upon or as to which such violation exists and summarily to abate and remove, at the expense of the owner thereof, any structure, thing or condition that may be or exist thereon contrary to the intent and meaning of the provision of this Declaration;

(d) DNI, and its successors and assigns, and/or DEC shall be entitled to enforce the terms of this Declaration by resort to specific performance or legal process. All remedies available hereunder shall be in addition to any and all other remedies at law or in equity, including CERCLA. Enforcement of the terms of this Declaration shall be at the discretion of DNI, and its successors or assigns, or DEC, and any forbearance, delay or omission to exercise its rights under this instrument in the event of a breach of any term of this Declaration shall not be deemed to be a waiver by DNI, or its successors or assigns, or DEC of such term or of any subsequent breach of the same or any other term, or of any of the rights of such parties under this instrument;

(e) DNI acknowledges that, notwithstanding any other provision of this Declaration, DEC retains all of its access authorities and rights, as well as its right to require land and/or water use restrictions, including enforcement authorities related thereto, under CERCLA, the Solid Waste Disposal Act, as amended, 42 U.S.C. §§ 6901-6992k, and any other applicable statutes or regulations.

5. Miscellaneous:

(a) Damages: DNI, and its successors and assigns shall also be entitled to recover damages for breach of any covenant or violation of the terms of this instrument including any impairment to the remedial action that increases the cost of the selected response action for the Site as a result of such breach or violation.

(b) Modifications. This Declaration may be modified or terminated, in whole or in part, by DNI, provided it files a written Modification or Termination Notice in the Office of the Recorder of Deeds of Ulster County, New York and provided that DNI has obtained written approval from DEC at least thirty (30) days prior to filing such Notice;

(c) Reservation of Rights. DNI hereby reserves unto itself, its successors and assigns, all rights and privileges in and to the use of the Site which are not incompatible with the covenants, conditions and restrictions established herein;

(d) Assignment of Rights: DNI shall be entitled at any time or from time to time to assign all or any portion of the easements, rights, covenants, obligations and restrictions granted hereunder to DEC.

(e) Exercise of Rights: Any of DNI's rights hereunder may be exercised by DNI or by any one or more of DNI's agents, contractors, employees or other designees, which may include, without limitation, DEC. DNI also acknowledges that, in the event of assignment of any of its rights to DEC, any of DNI's rights hereunder may be exercised by DEC as assignee of DNI or by any one or more of DEC's agents, contractors, employees, or other designees.

(f) No Public Access. No right of access or use by the general public to any portion of the Site is conveyed by this instrument.

(g) Public notice: DNI agrees to include in each instrument conveying any interest in any portion of the Site, including but not limited to deeds, leases and mortgages, a notice which is in substantially the following form:

NOTICE: THE INTEREST CONVEYED HEREBY IS SUBJECT TO A DECLARATION OF RESTRICTIVE COVENANTS, DATED ______, 20__, RECORDED IN THE (insert name of records office) ON ______, 20___, IN BOOK ___, PAGE___, IN FAVOR OF, AND ENFORCEABLE BY, THE (insert name of grantee) AND BY THE STATE OF NEW YORK AS THIRD PARTY BENEFICIARY.

Within thirty (30) days of the date any such instrument of conveyance is executed, DNI agrees to provide DEC with a certified true copy of said instrument and, if it has been recorded in the public land records, its recording reference.

(h) Governing Law. The interpretation and performance of this Declaration shall be governed by the law of New York State;

(i) Rules of Construction. Any general rule of construction to the contrary, notwithstanding, this instrument shall be liberally construed in favor of the Declaration to affect the purpose of this instrument and the policy and purpose of CERCLA. If any provision of this instrument is found to be ambiguous, an interpretation consistent with the purpose of this instrument that would render the provision valid shall be favored over any interpretation that would render it invalid;

(j) Severability. If any provision of this Declaration, or the application of it to any person or circumstance, is found to he invalid, the remainder of the provisions of this Declaration, or the application of such provisions to persons or circumstances other than those to which it is found to be invalid, as the case may be, shall not be affected thereby;

(k) Entire Agreement. This Declaration sets forth the entire undertaking and agreement of DNI with respect to rights and restrictions created hereby, and supersedes all prior discussions, negotiations, understandings, or agreements relating thereto, all of which are merged herein;

(l) No Forfeiture. Nothing contained herein will result in a forfeiture or reversion of title in any respect;

(m) Successors. The covenants, terms, conditions, and restrictions of this Declaration shall be binding upon, and inure to the benefit of DNI and the DEC and their respective successors and assigns and shall continue as a servitude running in perpetuity with the Site;

(n) Termination of Rights and Obligations. The rights and obligations of the owner(s) from time to time of the Site under this Declaration terminate upon transfer of the party's interest in the Site, except that liability for acts or omissions occurring prior to transfer shall survive transfer;

(o) Captions. The captions in this Declaration have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon construction or interpretation;

(p) Third-Party Beneficiary: DNI acknowledges that DEC shall be, on behalf of the public, third-party beneficiary of the benefits, rights and obligations declared in this instrument; provided that nothing in this instrument shall be construed to create any obligations on the part of DEC.

(q) Term: The easements, rights, obligations, covenants and restrictions established by this Declaration shall run in perpetuity, except as otherwise expressly provided herein, and unless and until released by DNI.

(r) Notices: Any notice, demand, request, consent order, approval, or communication under this instrument that either part desires or is required to provide to the other shall be in writing and shall either be served personally or sent by first class mail, postage paid, addressed as follows:

DNI:

Dyno Nobel Inc.
Legal Department
Crossroads Tower, Eleventh Floor
Salt Lake City, Utah 84144-0103

DEC:

Commissioner
New York State Department of Environmental Conservation
Division of Solid and Hazardous Materials
625 Broadway
Albany, NY 12233-7251

IN WITNESS WHEREOF, DYNO NOBEL INCORPORATED has caused its common and corporate seal to be affixed to these presents by the hand of its Treasurer, who is duly authorized to execute the Declaration on behalf of the corporation, and the same being duly attested to by its Secretary on the day and year first above written, intending to be legally bound hereby.

ATTEST:

Robert A. Bingham
Vice President/Secretary

[Corporate Seal]

Dyno Nobel Inc., a Delaware corporation

By: ______________________
Brian H. Martin – Vice President

STATE OF ~~DELAWARE~~ Utah KP)
) ss:
COUNTY OF ~~NEW~~ Salt Lake KP)

I HEREBY CERTIFY that on this day before me, an officer duly qualified to take acknowledgement, personally appeared Brian H. Martin, to me known to be the person described in and who executed the foregoing instrument, and acknowledged before me that he/she is the Treasurer of DYNO NOBEL INCORPORATED, a Delaware corporation, and that, being duly authorized to do so, he/she, as such Treasurer executed the same for purposes therein contained for and on behalf of such corporation.

WITNESS my hand and official seal in the County and State last aforesaid this 18 day of February 2004.

____
Notary Public

My Commission expires: 8/15/2005

[Notarial Seal]

KAYE G. PARRISH
NOTARY PUBLIC - STATE OF UTAH
50 S. Main, 11th Fl Crossroads Tower
Salt Lake City, UT 84144
My Comm. Exp. 08/15/2005

EXHIBIT A
TO
DECLARATION OF RESTRICTIONS

EXHIBIT A

TRACT A:

ALL THAT TRACT, PIECE OR PARCEL OF VACANT LAND, situate, lying and being in the Town of Esopus, County of Ulster and State of New York, bounded and described as follows:

BEGINNING at a point on the westerly side of Ulster Avenue, said point being the northeasterly corner of lands of Peter and Wendy Coffey, Liber 2014 Page 16;

1) Thence from said point of beginning along the northerly line of lands of Coffey, north 64 degrees 17' 00" west 132.68 feet to a point;

2) Thence along the westerly line of lands of Coffey south 25 degrees 43' 00" west 41.05 feet to a point on the northerly line of lands of Nancy J. Liese, L. 2578 P. 58, as being Lot 1 as designated on a certain map entitled "Map of Subdivision of lands of William Liese" as filed in the Ulster County Clerk's office on March 13, 1996 as Map no. 10488;

3)Thence along the northerly line of Lot 1, north 64 degrees 17' 00" west 385.07 feet to a point;

4) Thence along the westerly line of Lot 1, south 14 degrees 16' 40" west 154.93 feet to a recovered iron post in a wall corner an the northerly line of lands of Reinhard Jr. and Mary A. Hall, Liber 1353 Page 701;

5) Thence along the northerly line of lands of Hall and along a stone wall north 71 degrees 3' 00" west 538.00 feet to a point on the easterly line of lands of John Ungar, Liber 1929 Page 277;

6) Thence along the lands of said Ungar the following courses and distances: north 20 degrees 34' 13" east 3.56 feet to a point in a stone wall corner;

7)Thence along a stone wall north 71 degrees 38' 00" west 406.39 feet to a recovered angle iron in a stone wall corner;

8)Thence still along said stone wall, north 12 degrees 52' 00" east 193.48 feet to a recovered angle iron in a stone wall corner;

9) Thence partly along a stone wall, north 73 degrees 31' 00" west 453.82 feet to a recovered angle iron on the easterly line of land of Ireco, Inc. Liber 1529 Page 853;

10) Thence along the easterly line of lands of Ireco, Inc. north 12 degrees 36' 11" east 1,000.74 feet to a point on the southerly line of lands of Gabrial Aquilar, Liber 1291 Page 134 and Liber 2017 Page 321;

11) Thence along the southerly line of lands of Aquilar and a stone wall and wire fence, south 72 degrees 40' 34" east 1,354.64 feet to a point in a stone wall corner on the westerly line of lands of Kingston Cablevision, Inc., Liber 1210 Page 1118 and Liber 1290 Page 609;

12) Thence along the westerly line of lands of Kingston Cablevision, Inc. the following courses and distances: along a stone wall south 15 degrees 19' 00" west 414.10 feet to a point;

13) Thence south 43 degrees 34' 00" east 36.80 feet to a point;

New York.

14) Thence south 5 degrees 00' 00" west 324.40 feet to a point at the northwesterly corner of lands of William H. and Nancy J. Liese, L. 2578 P. 66, also being Lot 2 of said subdivision;

15) Thence along the westerly line of lands of said Liesa, south 14 degrees 16' 40" west 213.95 feet to a point;

16) Thence along the southerly line of lands of said Liese, south 64 degrees 17' 00" east 544.95 feet to a point on the westerly side of Ulster Avenue;

17) Thence along the westerly side of Ulster Avenue, south 35 degrees 40' 15" west 50.76 feet to the place of beginning.

All bearing in reference to Magnetic North. Containing 36.694 acres more or less as surveyed by Gerald Brandt, LLS., October 20, 1998, map filed March 13, 1996 as # 10488.

Subject to a fifty (50) foot wide right of way, more particularly described as follows:

Beginning at a point on the westerly line of lands of Peter and Wendy Coffey, Liber 2014 Page 16, said point also being the southeasterly corner of the herein described right of way;

1) Thence from said point of beginning along the northerly line of Lot 1, of the above mentioned subdivision, North 64 degrees 17' 00" West 50.00 feet to a point;

2) Thence through Lot 3, the above described parcel, North 25 degrees 43' 00" East 91.05 feet to a point on the southerly line of Lot 2 of said subdivision;

3) Thence along the southerly line of said Lot 2, south 64 degrees 17' 00" East 50.00 feet to a point;

4) Thence partly through said Lot 3 and partly along the westerly line of lands of said Coffey, South 25 degrees 43' 00" West 91.05 feet to the point and place of beginning.

TRACT B:

ALL THAT PIECE OR PARCEL OF LAND, with the buildings thereon erected, situated in the Town of Esopus, County of Ulster, State of New York and bounded and described as follows:

BEGINNING at the corner formed by the intersection of the Westerly line of the road known as Old 9-W and the Northerly line of the road leading therefrom to the powder plant of Hercules Powder Company; thence along the Westerly line of said Old 9-W North 48° 29' East 280.13 feet to a pipe in the Southerly line of land of George Svirsky; thence along the Southerly line of said last mentioned lands North 58° 30' West 200 feet to a pipe; thence along the Westerly line of said last mentioned lands North 45° 14' East 200 feet to a pipe in the Southerly line of lands of Abraham Schulman; thence along the Southerly line of said last mentioned lands North 64° 29' West 175.55 feet to a point; thence still along the Southerly line of said last mentioned lands North 81° 33' West 452.34 feet to an angle iron; thence along the Westerly line of said last mentioned lands North 10° 56' East 630.11 feet to an angle iron at Stone wall intersections in the Southerly line of lands of Selig Liese; thence along the Southerly line of said last mentioned lands North 71° 49' West 406.39 feet to an angle iron; thence still along said last mentioned lands North 12° 41' East 193.48 feet to an angle iron; thence still along said last mentioned lands North 73° 42' West 453.82 feet to an angle iron; thence still along said last mentioned lands South 12° 31'

West 188 feet to a foundation pipe in the lands of Hercules Powder Company; thence along the said last mentioned lands South 72° 32' East 303.77 feet to a pipe; thence still along the said last mentioned lands South 17° 09' West 373.46 feet to a point; thence still along the said last mentioned lands South 14° 09' East 538.32 feet to a pipe; thence still along the said last mentioned lands South 73° 23' East 553.78 feet to a pipe; thence still along the said last mentioned lands South 10° 11' West 278.67 feet to a monument located in the Northerly line of the aforesaid road leading to the powder plant of Hercules Powder Company; thence along the Northerly line of said road South 81° 05' East 374.65 feet to a monument at beginning. Containing 17.67 acres.

TRACT C-I:

ALL THAT PIECE, PARCEL OR TRACT OF LAND, situate, lying and being in the Town of Esopus, County of Ulster, State of New York, more particularly bounded and described as follows: BEGINNING at a point on the westerly side of Clay Road, running thence North 83 degrees 18 minutes West a distance of 648.0 feet, thence South 7 degrees 29 minutes West a distance of 1119.80 feet to a point, thence North 76 degrees 21 minutes West a distance of 308.20 feet to a pipe set in the Easterly right-of-way line of lands of the New York Central Railroad, West Shore Division, thence along said right-of-way line South 7 degrees 11 minutes West a distance of 1684.30 feet to a point on line of lands of Hercules Powder Company, thence along said lands of Hercules Powder Company South 74 degrees 17 minutes East a distance of 560.42 feet to a point, thence North 12 degrees 4 minutes East a distance of 1189.19 feet to a point, thence North 73 degrees 24 minutes West a distance of 5.36 feet to a point, thence North 12 degrees 3 minutes East a distance of 1470.01 feet to a point; thence South 70 degrees 52 minutes East a distance of 274.42 feet to a point in the Southwesterly side of Clay Road and thence along the Southwesterly and Westerly side of Clay Road the two following courses: (1) North 38 degrees 33 minutes West a distance of 96 feet to a point, and (2) North 2 degrees 57 minutes East a distance of 197.80 feet, to the point or place of beginning. Containing 36.74 acres, be the same more or less. The aforesaid description is taken from a map made by Augustus S. Brinnier, LLS, P.E., dated December 23rd, 1955, and entitled Map of a Portion of the Van Aken Farm, Port Ewen, New York.

ALSO ALL THAT PIECE, PARCEL OR TRACT OF LAND, situate, lying and being in the Town of Esopus, County of Ulster, State of New York, more particularly bounded and described as follows: BEGINNING at a stone monument on the Westerly right-of-way line of lands of the New York Central Railroad, West Shore Division, said point being the Northeasterly corner of lands conveyed by the Hercules Explosives Company to the Hercules Powder Company, by deed dated April 1, 1927, and running thence along the Northerly line of lands of the Hercules Powder Company the following courses and distances: (1) North 76° 06' West 945.78 feet to a monument (2) thence North 18° 39' East 25.16 feet to a monument; (3) thence North 76° 57' West 991.81 feet to a monument on top of Hussey Hill; (4) thence along the top of Hussey Hill and the Easterly line of lands of Joseph Scherer North 20° 57' East 766.02 feet to a monument; (5) thence along the southerly line of lands of Anna Doyle South 76° 03' East 818.40 feet to an old stone marked monument, marked SSN49 and IALN48, said monument also being at a stone wall corner at the Southwesterly corner of lands of Lena Kemler; (6) thence along said stone wall and a wire fence and the Southerly line of lands of Lena Kemler South 76° 03' East 932.47 feet to a monument on the Westerly right-of-way line of lands of the New York Central Railroad, West Shore Division; (7) thence along said right-of-way line and a wire fence South 7° 11' West 774.36 feet to the place of beginning.

CONTAINING:32.60 acres, more or less. The aforesaid description is taken from a map made by Augustus S. Brinnier, LLS, P.E., dated February 3rd, 1960, and entitled Map of Lands of Hercules Powder company, Town of Esopus, Ulster County, New York.

TRACT C-II:

PARCEL 1.

All that piece or parcel of land situated in the town of Esopus, County of Ulster and State of New York.

All that certain farm of land described as follows:

All that certain farm of land described as follows: BEGINNING at a rock marked "D" in the Southwest corner of said farm and running South eighty-two degrees East nineteen chains and seventy links to a stone standing in the ground; thence South ten degrees West thirteen chains and seven links to a stone standing in the ground; thence South eighty-one degrees fifteen minutes east twenty-two chains and ninety links to a stone standing in the ground; thence north eleven degrees thirty minutes east eighteen chains and sixty-one links to a stone standing in the ground by the bars; thence north eighty-one degrees and thirty minutes west eight chains and fifty links to a stone standing in the ground; thence north eighteen degrees west four chains and fifteen links to a winding in the fence; thence north fifteen degrees west four chains and fifty-five links to a winding in the fence; thence north nine degrees east five chains to a stone standing in the ground; thence north eighty degrees thirty minutes west twenty chains and eighty links to a stone standing in the ground; thence north fifty-five degrees east four chains and eighty-six links to a maple tree; thence north eight degrees thirty minutes east ten chains to a stone marked G I F; thence north eighty-three degrees west thirteen chains and sixty-one links to a stone and chestnut tree; thence south eight chains to a walnut tree and stone marked G I F; thence north eighty-four degrees west three chains and thirty-seven links to the south corner of a large rock thence south five degrees west twenty-three chains twelve links to the place of beginning at rock "D", containing about one hundred acres, be the same more or less.

PARCEL 2.

ALSO ALL those two certain lots of land known and distinguished on a map by lots No. 13 and No. 14 of the Huzzle Hill lots and which are bounded as follows: To the east by part of the west bounds of farm now or formerly of Samuel Swarts and by part of the farm now or formerly of John Van Fleit and the farm of Garret I. Freer, deceased; on the south by Lot No. 12; on the west by lots No. 21 and No. 22; and on the north by lot No. 15, containing about twenty acres.

PARCEL 3.

ALSO all that certain lot or farm of land bounded and described as follows, to wit:

BEGINNING at a rock at the foot of Hussey's Hill marked letter "D" on the northwest corner of said farm, and running thence south seventy-nine and one-half degrees east nineteen chains and fifty links to a stone in the wall at the corner of land now or formerly of Freer; thence south eleven and one-half degrees west thirteen chains to a stone; thence south twenty-nine and one-half degrees east six chains and ninety-three links; thence south eleven degrees west twenty chains and twenty-four links to Ephraim Lowe's woods; thence north eighty and one-fourth degrees West twenty-seven chains sixty-five links to Hussey's Hill; then along the same north twenty-eight degrees east six chains; then north eight degrees east fourteen chains six links; then north ten and one-half degrees east eight chains and ten links; then north seventeen degrees east five chains forty-eight links to the place of beginning: containing seventy-seven and four tenths of an acre, more or less, with the privilege of a road not less than one rod in width across the east part of the farm as formerly owned by John Suydam, and north part of the farm as formerly owned by Patrick Kearny from the northeast corner of the farm hereby conveyed at the commencement of the of the fourth course described above and running upon a course south seventy-nine and a half degrees east until it reaches the public highway leading from Amesville to Kingston for the benefit of said farm and lot hereby conveyed.

PARCEL 4.

ALSO all that north part of a wood lot adjoining said farm on the west, beginning at a rock marked "D" and running thence north twelve degrees east three chains six links to a heap of stones; then north eighty-three degrees west eighteen chains fifty links to a stake and stones; thence south eight degrees west fifteen chains fifty links to a rock oak sapling marked; then north eighty-three degrees east to a heap of stones at the foot of the mountain; then northerly along the west bounds of the farm to the place of beginning, containing twenty-three acres, more or less.

PARCEL 5.

BEGINNING at a point in the westerly line of property of the West Shore Railroad Company, said point being in the northeasterly corner of property hereby conveyed and being a continuation of northerly line of land formerly of Garret I. Freer, later of James E. Van Aken and now or formerly of Frank K. Brewster, and running thence westerly in a line with the said northerly line of land now or formerly of Frank K. Brewster sixty-five feet, more or less; thence southerly following the line of an old stone wall, such line being the westerly line of land hereby conveyed six hundred and fifty-nine feet, more or less, to a stump of an old maple tree; thence as the needle pointed March 4, 1845, south fifty-three degrees and thirty minutes west four chains seventy-eight links to a stone set in the ground; thence as the needle then pointed eighty-one degrees thirty-three minutes east four hundred and ten feet more or less to the westerly line of the West Shore Railroad; thence northerly along the westerly side of the West Shore Railroad, nine hundred feet, more or less to the point or place of beginning, containing three acres, more or less;

PARCEL 6.

ALL that certain lot, piece or parcel of land known as a part of lot number fifteen on the east side of Hussey's Hill, containing about ten acres;

Parcel 6 being the same land and premises described in a certain deed from James E. Van Aken to Frank K. Brewster, dated July 22, 1913, and recorded July 24, 1913, in the Ulster County Clerk's Office in Book 444 of Deeds, at page 204.

PARCEL 7.

The right-of-way for ingress and egress and regress to James E. Van Aken, his heirs and assigns, and the occupants of the Freer Farm, situate in the Town of Esopus, Ulster County, N.Y., now or formerly owned by Frank K. Brewster, and his and their servants and any and all other persons for his or their use, benefit or advantage, with the right to pass and repass on foot and with animals and vehicles over the following portions of lands not herein or hereby conveyed, viz: All that certain road way leading from the highway or road from Rondout to Amesville, on the westerly side of said highway nearly opposite the residence formerly of Edwin Van Aken, and running in a westerly direction across the property now or formerly of Dumond and Furmansky to the farm now or formerly belonging to Frank K. Brewster, known as the "Garret I. Freer Farm", and being the roadway as now or formerly used by the said Frank K. Brewster and known as the Freer's Road.

EXCEPTING AND RESERVING from all of the above described lands and premises such portions of same as may have been conveyed to the West Shore Railroad Company and a lot of about one or two acres heretofore conveyed to one Appolonia Propheter.

FOR CLOSING INSTRUMENTS; NOT FOR POLICY: All of Parcel I (Parcel 1 through 7) being the same premises which Hercules Explosives Corporation, a New York corporation by deed dated April 1, 1927, and recorded in the Clerk's Office of Ulster County in Liber 523 of Deeds at Page 145, conveyed to Hercules Powder Company, a Delaware corporation.

PARCEL II

ALL that lot or parcel of land situate in the Town of Esopus, County of Ulster and State of New York, and being the south part of a wood lot on Hussey's Hill, bounded and described as follows:

BEGINNING at the northeast corner of said lot hereby conveyed, and runs thence south eight degrees west four chains to a stake and stones; thence north eighty-three degrees west four chains forty-five links to a stake and stones; thence south eight degrees west ten chains twenty links to the foot of the hill; thence north eight degrees west fourteen chains; thence with a straight line to the place of Beginning, containing twenty-three (23) acres be the same more or less.

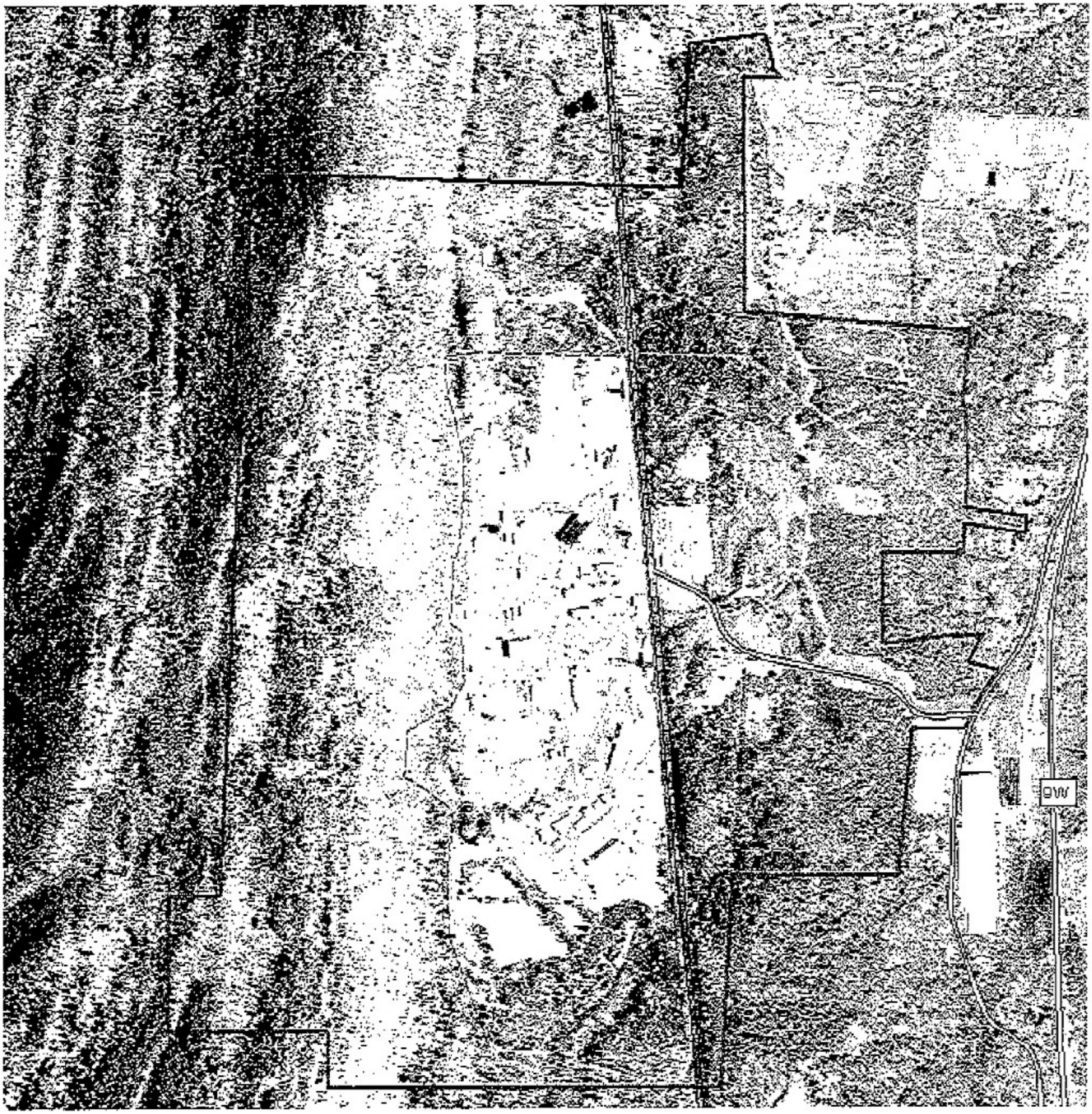
PARCEL III

ALL THAT PIECE OR PARCEL OF LAND situated in the Town of Esopus, County of Ulster and State of New York described as follows:

BEGINNING at a concrete monument set in the ground on the Northwesterly line of the old State Highway leading from Port Ewen to Ulster Park, said monument being in a Southwesterly direction along the said line of said Highway a distance of 513 feet, more or less from the division line of the lands of Morris Svirsky, and the lands of, now or formerly, L. Black: thence curving to the West on a radius of 74.00 feet, a distance of 63.30 feet measured on the chord, to a concrete monument set in the ground; thence, North 81° 45' West a distance of 301.00 feet to an iron spike at the Northwesterly corner of the existing right-of-way granted to Hercules Powder Company by Morris Svirsky and Minnie Svirsky, dated November 29, 1927 and recorded in the Ulster County Clerk's Office in Deed Book 528 at Page 258 and running thence along the Easterly line of lands of the Hercules Powder Company, North 14° 30' East 50.29 feet to an iron pipe in an old fence line; thence along other lands of Morris Svirsky, South 81° 45' East 374.65 feet to an iron pipe on the Westerly side of the old State Highway; thence along the same, South 52° 10' West 31.63 feet to the place of Beginning. Containing 0.48 acres be the same more or less.

As to Tract C: Subject to the burdens and together with the benefits of the easements granted between Consolidated Rail Corporation and Hercules Incorporated by easement recorded 2/19/85 in Liber 1521 cp 1120.

Dyno Nobel Inc
Port Ewen, NY Property Boundary



APPENDIX B - RESPONSIBILITIES OF OWNER AND REMEDIAL PARTY

Responsibilities

The responsibilities for implementing the Interim Site Management Plan ("ISMP") for the Hercules/Dyno Nobel site (the "site"), number 356001, are divided between the site owner(s) and a Remedial Party, as defined below. The owner(s) is/are currently listed as: Dyno Nobel, Inc. (the "owner").

Solely for the purposes of this document and based upon the facts related to a particular site and the remedial program being carried out, the term Remedial Party ("RP") refers to any of the following: certificate of completion holder, volunteer, applicant, responsible party, and, in the event the New York State Department of Environmental Conservation ("NYSDEC") is carrying out remediation or site management, the NYSDEC and/or an agent acting on its behalf. The RPs are:

Hercules LLC
Ian McCary
500 Hercules Road
Wilmington, DE 19808

Dyno Nobel, Inc.
Tina Maniatis, P.E.
6440 S. Millrock Drive, Suite 105
Salt Lake City, UT 84121

Nothing on this page shall supersede the provisions of an Environmental Easement, Consent Order, Consent Decree, agreement, or other legally binding document that affects rights and obligations relating to the site.

Site Owner's Responsibilities:

1) The owner shall follow the provisions of the SMP as they relate to future construction and excavation at the site.

2) In accordance with a periodic time frame determined by the NYSDEC, the owner shall periodically certify, in writing, that all Institutional Controls set forth in a Deed Restriction remain in place and continue to be complied with. The owner shall provide a written certification to the RP, upon the RP's request, in order to allow the RP to include the certification in the site's Periodic Review Report (PRR) certification to the NYSDEC.

3) In the event the site is delisted, the owner remains bound by the Deed Restriction and shall submit, upon request by the NYSDEC, a written certification that the Deed Restriction is still in place and has been complied with.

4) The owner shall grant access to the site to the RP and the NYSDEC and its agents for the purposes of performing activities required under the SMP and assuring compliance with the SMP.

5) The owner is responsible for assuring the security of the remedial components located on its property to the best of its ability. If damage to the remedial components or vandalism is evident, the owner shall notify the site's RP and the NYSDEC in accordance with the timeframes indicated in Section 1-3-Notifications of this ISMP.

6) If some action or inaction by the owner adversely impacts the site, the owner must notify the site's RP and the NYSDEC in accordance with the time frame indicated in Section 1-3- Notifications and coordinate the performance of necessary corrective actions with the RP.

7) The owner must notify the RP and the NYSDEC of any change in ownership of the site property (identifying the tax map numbers in any correspondence) and provide contact information for the new owner of the site property/ies. 6 NYCRR Part contains notification requirements applicable to any construction or activity changes and changes in ownership. Among the notification requirements is the following: Sixty days prior written notification must be made to the NYSDEC. Notification is to be submitted to the NYSDEC Division of Environmental Remediation's Site Control Section. Notification requirements for a change in use are detailed in Section 1.3 of the SMP. A change of use includes, but is not limited to, any activity that may increase direct human or environmental exposure (e.g., day care, school, or park). A 60-Day Advance Notification Form and Instructions are found at http://www.dec.ny.gov/chemical/76250.html.

Remedial Party Responsibilities

1) The RP must follow the SMP provisions regarding any construction and/or excavation it undertakes at the site.

2) The RP shall report to the NYSDEC all activities required for remediation, operation, maintenance, monitoring, and reporting. Such reporting includes, but is not limited to, periodic review reports and certifications, electronic data deliverables, corrective action work plans and reports, and updated SMPs.

3) Before accessing the site property to undertake a specific activity, the RP shall provide the owner advance notification that shall include an explanation of the work expected to be completed. The RP shall provide to (i) the owner, upon the owner's request, (ii) the NYSDEC, and (iii) other entities, if required by the SMP, a copy of any data generated during the site visit and/or any final report produced.

4) If the NYSDEC determines that an update of the SMP is necessary, the RP shall update the SMP and obtain final approval from the NYSDEC. Within 5 business days after NYSDEC approval, the RP shall submit a copy of the approved SMP to the owner(s).

5) The RP shall notify the NYSDEC and the owner of any changes in RP ownership and/or control and of any changes in the party/entity responsible for the operation, maintenance, and monitoring of and reporting with respect to any remedial system (Engineering Controls). The RP shall provide contact information for the new party/entity. Such activity constitutes a Change of Use pursuant to 375-1.11(d) and requires 60-days prior notice to the NYSDEC. A 60-Day Advance Notification Form and Instructions are found at http://www.dec.ny.gov/chemical/76250.html .

6) Prior to a change in use that impacts the remedial system or requirements and/or responsibilities for implementing the SMP, the RP shall submit to the NYSDEC for approval an amended SMP.

7) Any change in use, change in ownership, change in site classification (*e.g.*, delisting), reduction or expansion of remediation, and other significant changes related to the site may result in a change in responsibilities and, therefore, necessitate an update to the SMP and/or updated legal documents. The RP shall contact the NYSDEC project manager to discuss the need to update such documents.

Change in RP ownership and/or control and/or site ownership does not affect the RP's obligations with respect to the site unless a legally binding document executed by the NYSDEC releases the RP of its obligations.

Future site owners and RPs and their successors and assigns are required to carry out the activities set forth above.

APPENDIX C – LIST OF SITE CONTACTS

Site Contact	**Contact Name**	**Contact Phone Number**	**Contact Email Address**
Site Owner:	Dyno Nobel, Inc. Tina Maniatis, P.E.	(801) 922-0913	tina.maniatis@am.dynonobel.com
Remedial Parties: Hercules, LLC Dyno Nobel, Inc.	Hercules, Inc. Ian McCary Dyno Nobel, Inc. Tina Maniatis	(302) 594-5283 (801) 922-0913	ian.mccary@ashland.com tina.maniatis@am.dynonobel.com
Remedial Engineer	Kristin A. VanLandingham, P.E. EHS Support LLC 5976 Thornton Lane Tallahassee, FL 32308	(850) 251-0582	k.vanlandingham@ehs-support.com
NYSDEC DER Project Manager	Mark Domaracki, P.G.	(518) 402-9832	mark.domaracki@dec.ny.gov
NYSDEC DER Supervisor	Kerry Maloney, P.G.	(518) 402-9629	kerry.maloney@dec.ny.gov
NYSDOH Project Manager	Kristin Kulow	(607) 353-4335	kristin.kulow@health.ny.gov

APPENDIX D – MONITORING WELL BORING AND CONTRUCTION LOGS

APPENDIX A

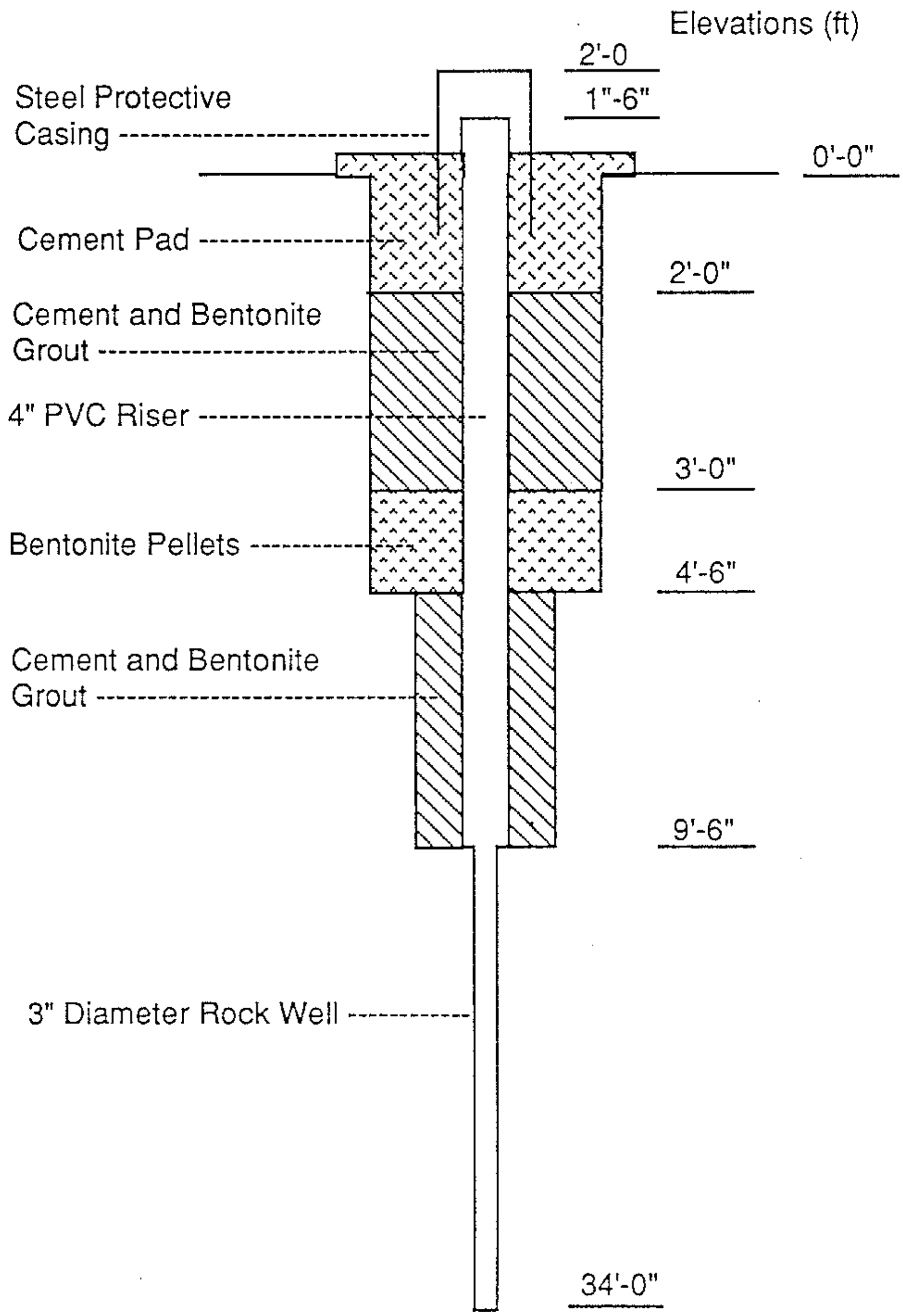
SOIL BORING LOGS AND WELL CONSTRUCTION DETAILS

EXISTING BORING LOGS AND MONITORING WELL CONSTRUCTION DETAILS

OVERBURDEN/BEDROCK WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-1
Date Installed 2/24/89

Water Level from
Top of Casing 21'-6 1/2"
Date 3/22/89 Time 10:30 AM



Gibbs & Hill, Inc.

6001243

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC		PROJECT NO. 5583	BORING NO. MW-1
Location: HERCULES	Coord:		Ground Elev:
Contractor: EMPIRE	Date Started: 2/15/89	G.W.L.	Hour: Date:
Inspector: J. SANGHVI	Date Completed:	G.W.L.	Hour: Date:
Notes:			

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	RQD %	HNu	Graphic Symbol	Description and Remarks
0		SS-1			4 / 52	4 / 100	14"		0	CL	Brown-gray, silt clay Shale fragments
5											
10											
15											BEDROCK
20											
25											
30											
35											
40											

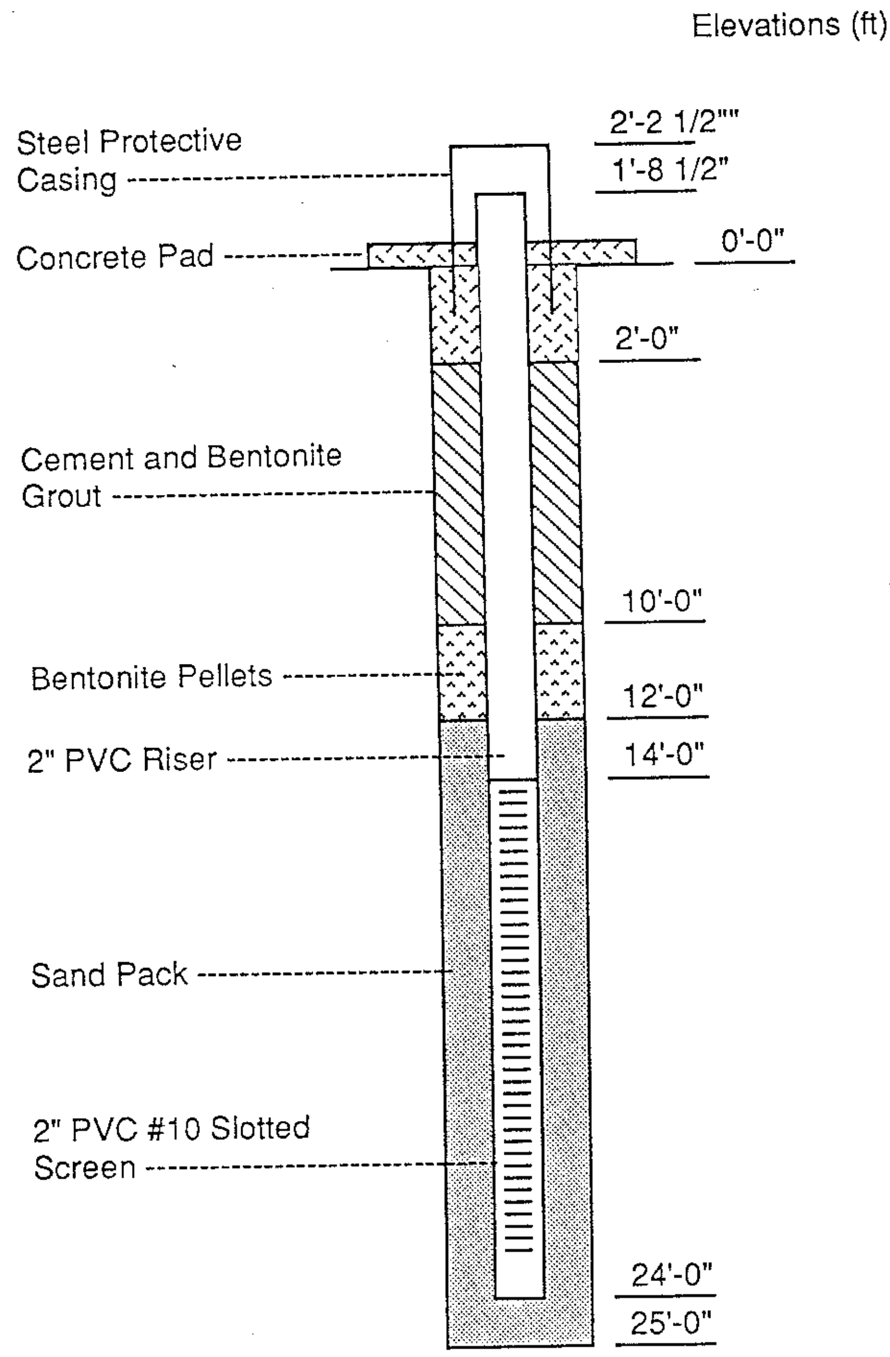
I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	6001255
Sample & Test Notations		

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-2A
Date Installed 2/21/89

Water Level from
Top of Casing 10'-9 1/2"
Date 3/22/89 Time 11:15 AM



Gibbs & Hill, Inc.

6001244

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC Phase II — PROJECT NO. 5583 — BORING NO. MW-2A

Location: Hercules, Inc — Coord: — Ground Elev:

Contractor: Empire — Date Started: 02/21/89 — G.W.L. — Hour: — Date:

Inspector: Jayesh Sanghvi — Date Completed: 02/21/89 — G.W.L. — Hour: — Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows: Casing Per Ft.	Blows: Sampler 6"	Blows: Sampler 6"	Recovery	[redacted] HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0											
2											
5											
		SS-1			9	15	14"	0		OL	Brown tanish orange clay some silt.
7					16	20					
10											
		SS-2			7	9	14"	.2		OL	Brown orange tanish clay Organics, grey wet Clay
12					10	12					
15											
		SS-3			2	3	11"	.1		OL	Mixture of brown and gray clay wet. Mostly gray. Low plasticity.
17					3	4					
20											
		SS-4			0	2	12"	0		CL	Gray clay low to medium plasticity Sandy and silty clay.
22					3	3					
25											
		SS-5			1	3	10"	.2		SM	Silty sand, Sand silt mixtures.
27					6	12					
0											
5											
0											

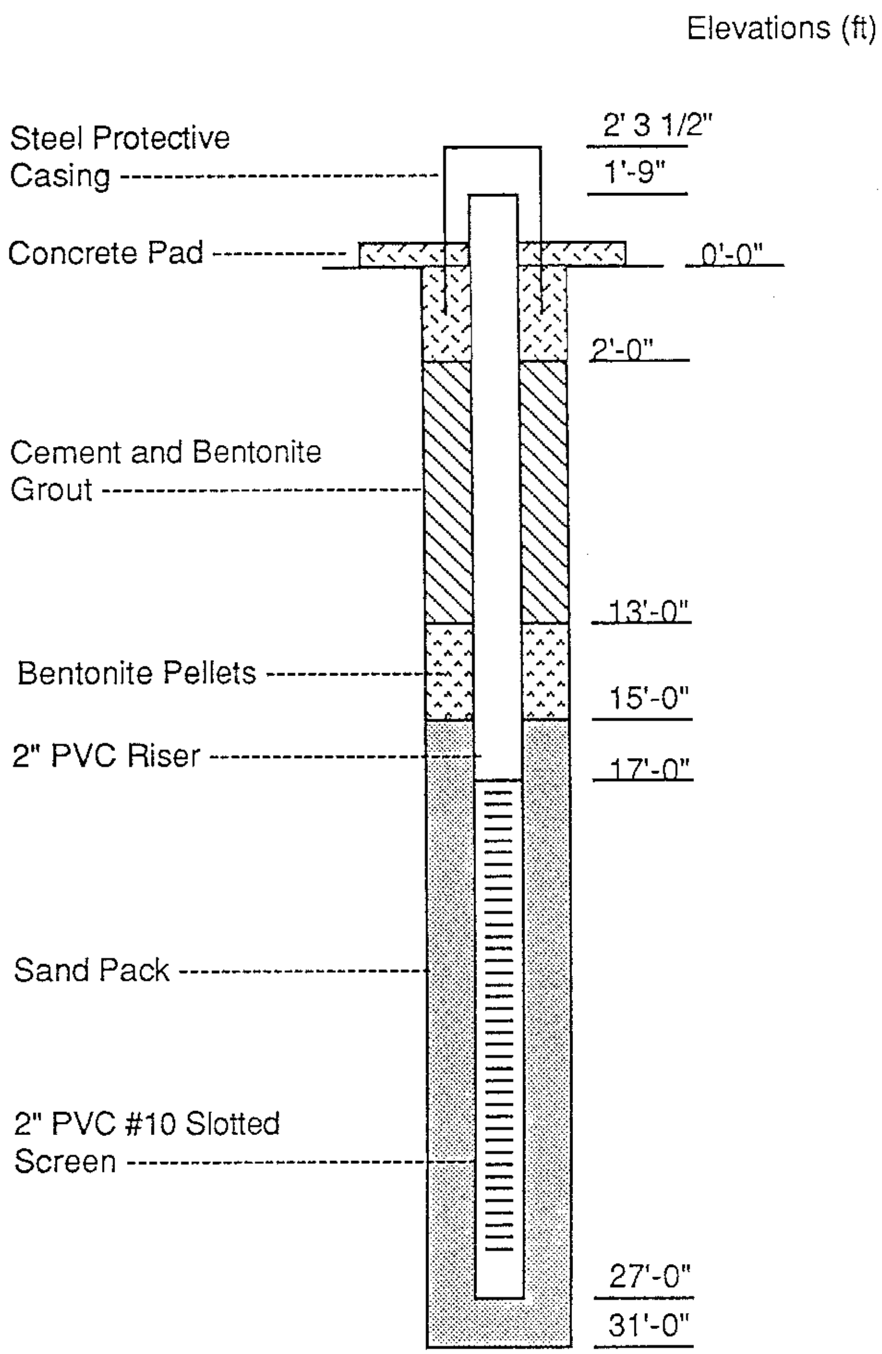
I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	6001256
Sample & Test Notations		

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-2B
Date Installed 2/20/89

Water Level from
Top of Casing 12'-7 1/2"
Date 3/22/89 Time 12:10 PM



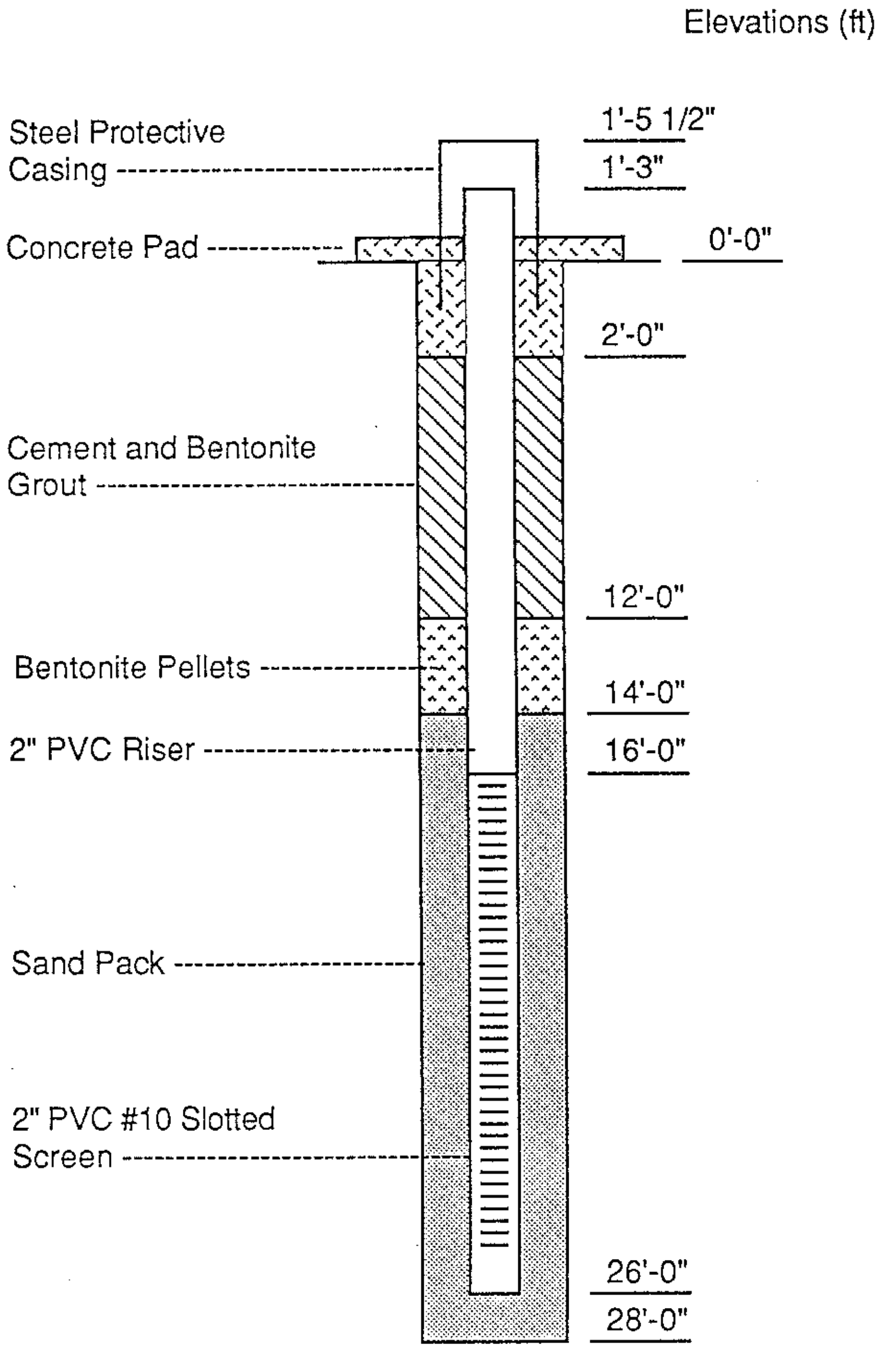
Gibbs & Hill, Inc.

60012-5

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-3
Date Installed 3/1/89

Water Level from Top of Casing 7'- 1 3/4"
Date 3/22/89 Time 1:30 PM



Gibbs & Hill, Inc.

6001246

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC Phase II | PROJECT NO. | BORING NO. MW-2B

Location: Hercules, Inc | Coord: | Ground Elev:

Contractor: Empire | Date Started: 02/17/89 | G.W.L. | Hour: | Date:

Inspector: Jayesh Sanghvi/R. Capone | Date Completed: 02/20/89 | G.W.L. | Hour: | Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery	[redacted] HNu	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0–2		SS-1	SS-1		6	4	6"	0		OL	Brown silty clay
					4	2					
5–7		SS-2			4	9	14"	0		OL	Brown tanish orange clay some silt
					13	15					
10–12		SS-3			4	10	14"	0		OL	Brown-orange tanish clay organics, gray wet clay
					11	10					
15–17		SS-4			2	3	10"	0		OL	Grayish clay, graded into tanish brown wet silty clay
					3	4					
20–22		SS-5			2	5	10"	0		SM	Brown silty sand some silt wet.
					4	5					
25–27		SS-6			1	1	14"	0		GM	Brown tanish organics, some silt and sand wet.
					3	4					
30–32		SS-7			19	47	10"	0		Bed-rock	Brown tanish gravel, some silt shale, Gray, grayish white shale
					57	90					
5											
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

6001 157

Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC Phase II	PROJECT NO. 5583	BORING NO. MW-3	
Location: Hercules Inc	Coord:	Ground Elev:	
Contractor: Empire	Date Started: 03/01/89 G.W.L.	Hour:	Date:
Inspector: Jayesh Sanghvi	Date Completed: 03/01/89 G.W.L.	Hour:	Date:
Notes:			

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	[redacted] HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0–2			SS-1		14 12	16 14	19"	0		OL	Brown silt and clay (Very Hard) frozen.
5–7			SS-2		4 11	8 12	23"	0		OL	Brown orange tanish clay with low plasticity.
10–12			SS-3		4 8	6 11	23"	0		OL	Brown clay little wet. some silt.
15–17			SS-4		2 3	3 4	22"	0		CL	Gray clay with low to medium plasticity also brown clay
20–22			SS-5		0 2	1 2	23"	0		CL	Mostly Gray clay with medium plasticity with mixture of brown silt and clay.
5											
0											
5											
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

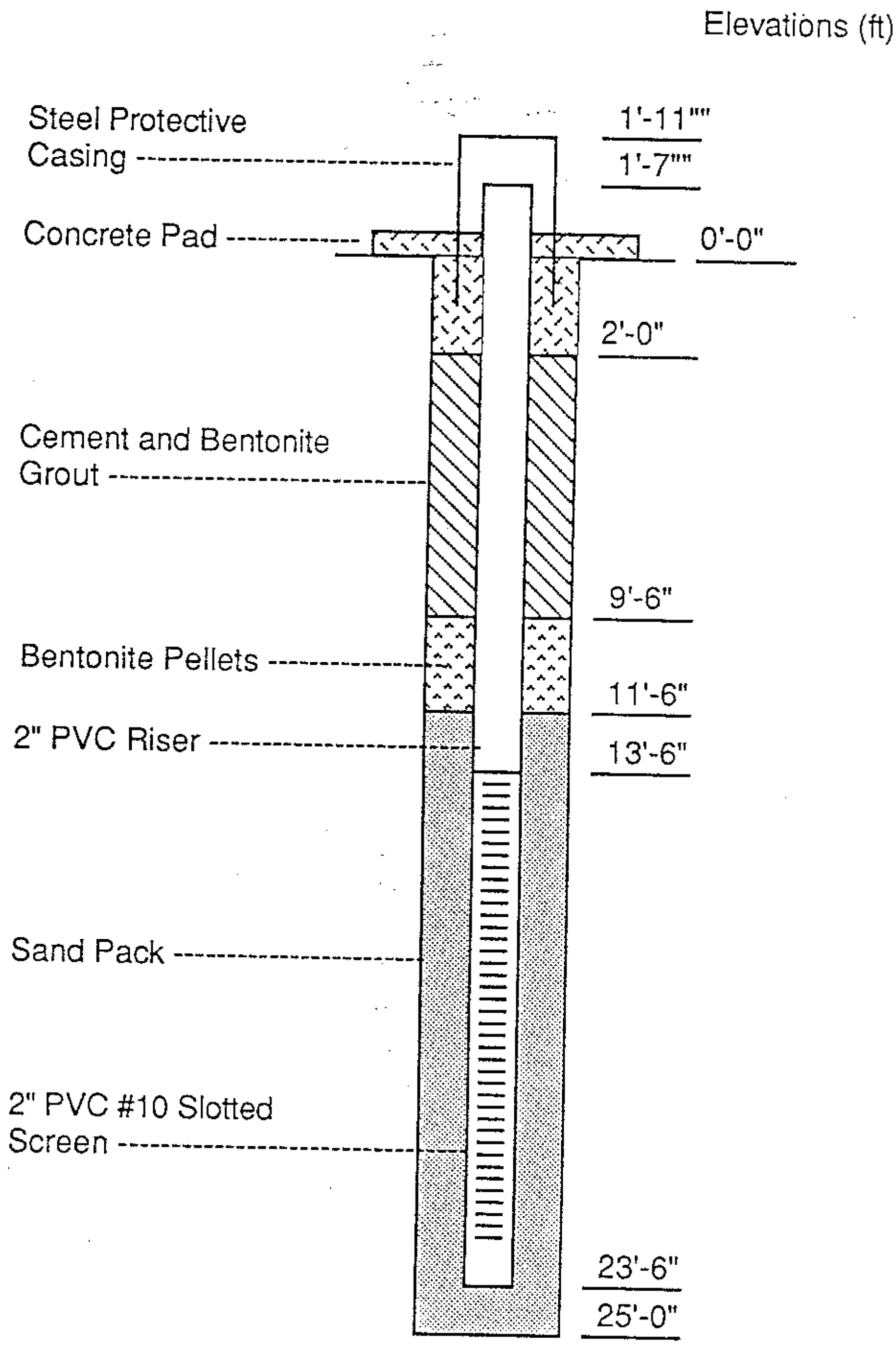
6001258

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-4A
Date Installed 2/27/89

Water Level from
Top of Casing 5'- 6 1/2"
Date 3/22/89 Time 2:00 PM



Gibbs & Hill, Inc.

6001247

BORING LOG

PROJECT: NYSDEC Phase II	PROJECT NO.	Sheet 1 of 1	BORING NO. MW-4A
Location: Hercules, Inc	Coord:		Ground Elev:
Contractor: Empire	Date Started: 02/27/89	G.W.L.	Hour: Date:
Inspector: J. Sanghvi	Date Completed: 02/27/89	G.W.L.	Hour: Date:
Notes:			

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery	[redacted] HNu	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0			SS-1		5	2	14"	0		OL	Mixture of silt and clay Mostly brown silty clay!
2					2	4					
5			SS-2		3	6	20"	0		OL	Mixture of silt and clay Mostly brown clay with low plasticity.
7					8	10					
10			SS-3		2	4	24"	0		OL	Silt and Clay Mostly brown Clay (little wet).
12					5	6					
15			SS-4		0	1	12"	0		CL	wet silt and clay Mostly clay with some very fine sand. Low to medium plasticity.
17					2	3					
0											
5											
0											
5											
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

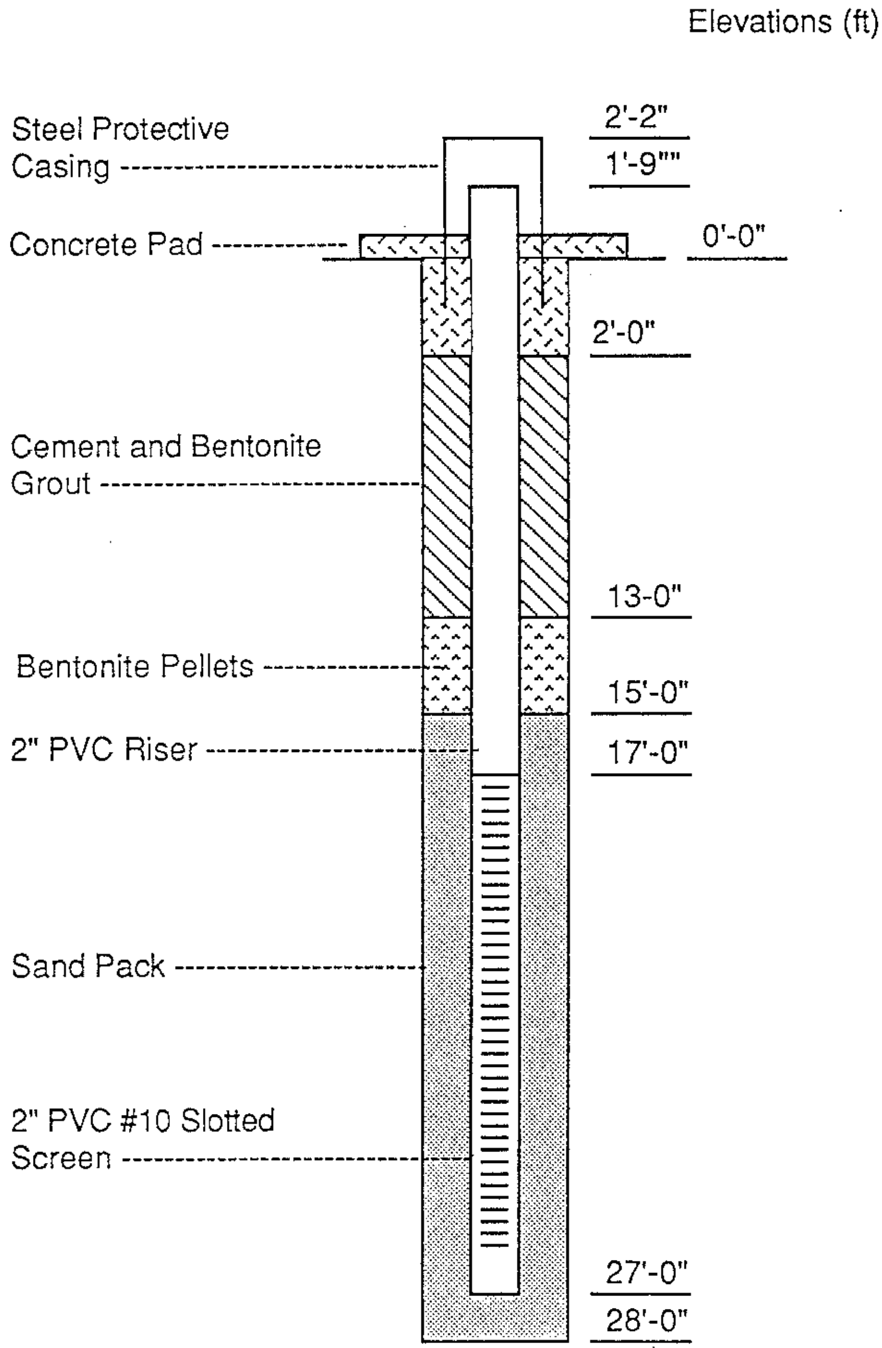
Gibbs & Hill, Inc.

6001259

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-4B
Date Installed 2/28/89

Water Level from
Top of Casing 6'-5"
Date 3/22/89 Time 2:45 PM



Gibbs & Hill, Inc.

6001248

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC Phase II | PROJECT NO. 5583 | BORING NO. MW-4B

Location: Hercules, Inc | Coord: | Ground Elev:

Contractor: Empire | Date Started: 02/28/89 G.W.L. | Hour: | Date:

Inspector: J. Sanghvi | Date Completed: 02/28/89 G.W.L. | Hour: | Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	RQD %	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0											
2		SS-1			8 / 3	4 / 3	14"			OL	Mixture of silt and clay. Mostly brown clay
5											
7		SS-2			7 / 10	8 / 14	18"			OL	Mostly brown clay with low plasticity and mixture of clay
10											
12		SS-3			5 / 5	4 / 6	24"			OL	Mostly brown silty clay very little wet.
15											
17		SS-4			1 / 2	2 / 1	23"			CL	Brown wet clay with low to medium plasticity.
20											
22		SS-5			0 / 1	0 / 2	18"			CL	Mixture of brown and gray clay wet. low to medium plasticity.
5											
0											
5											
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	6001260
Sample & Test Notations		

Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 1

PROJECT: Hercules | PROJECT NO. | BORING NO. MW-5
Location: Port Ewen, NY | Coord: | Ground Elev:
Contractor: Empire Drilling | Date Started: 3/14/89 | G.W.L. | Hour: | Date:
Inspector: Mik. Valentino | Date Completed: 3/14/89 | G.W.L. | Hour: | Date:
Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	~~RQD %~~ HNu	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0		S1			8 4	6 3	18"	0		SM	Brown dry silty medium sand
5		S2			4 11	7 12	20"	0		ML	Brown dry clayey silt - two moist 1" clay seams present
10		S3			5 6	5 5	18"	0		ML	Brown moist clayey silt some gray silt in nose piece
15		S4			2 3	3 5	15"	0		CL	gray very moist silty clay becoming more silty toward bottom - some gravel is present at bottom
20		S5			2 4	2 4	12"	0		ML	gray wet clayey silt turning more clayey with some medium sand at bottom.
25		S6			3 3	3 3				CL	gray wet silty clay some pebbles at bottom
30					7 7	6 7				ML	gray wet clayey silt some very fine sand present
35					100/.2						refusal
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample		
Test Notations		

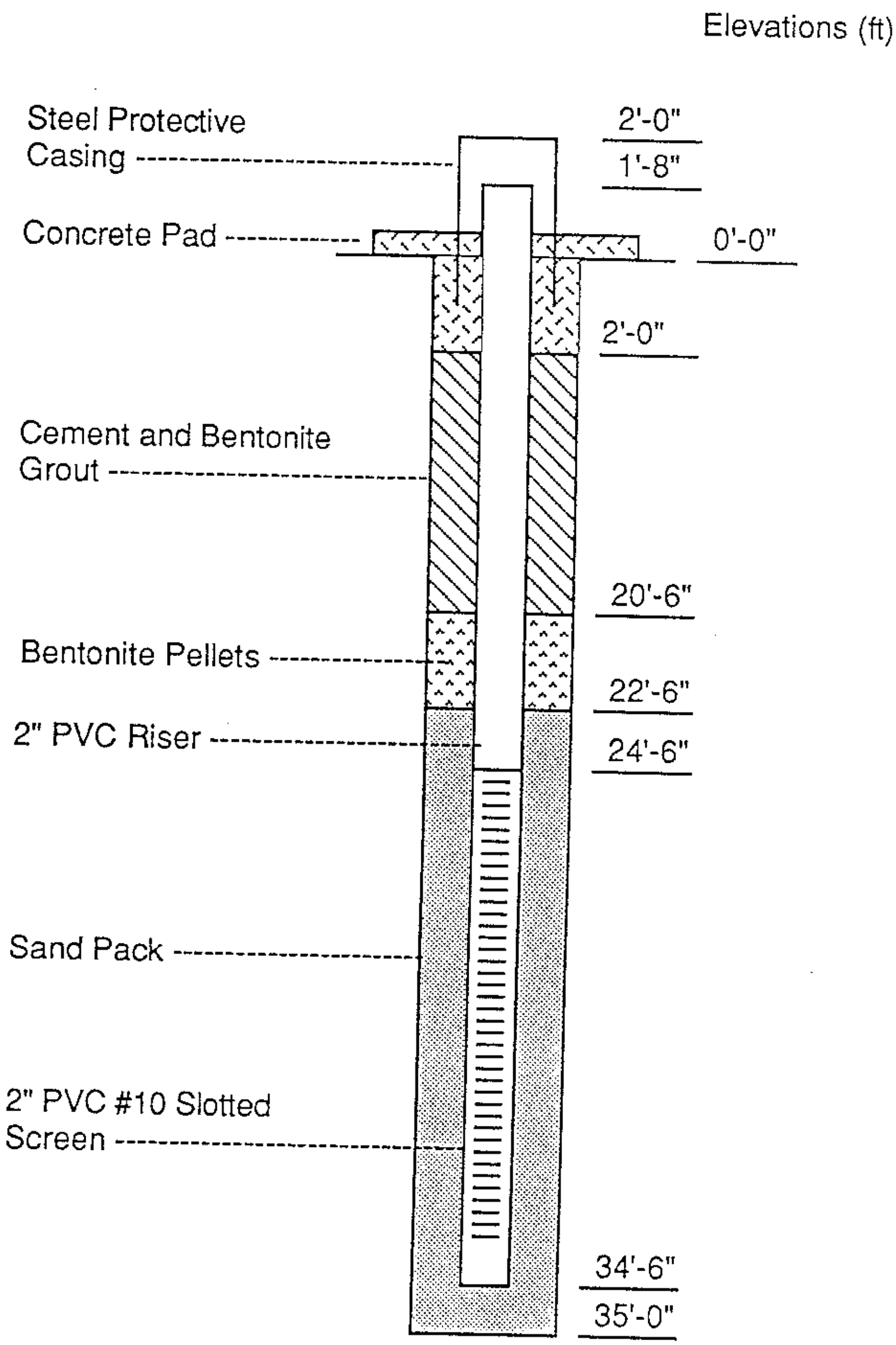
6001261

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-5
Date Installed 3/15/89

Water Level from
Top of Casing 19'- 9 1/2"
Date 3/23/89 Time 10:00 AM



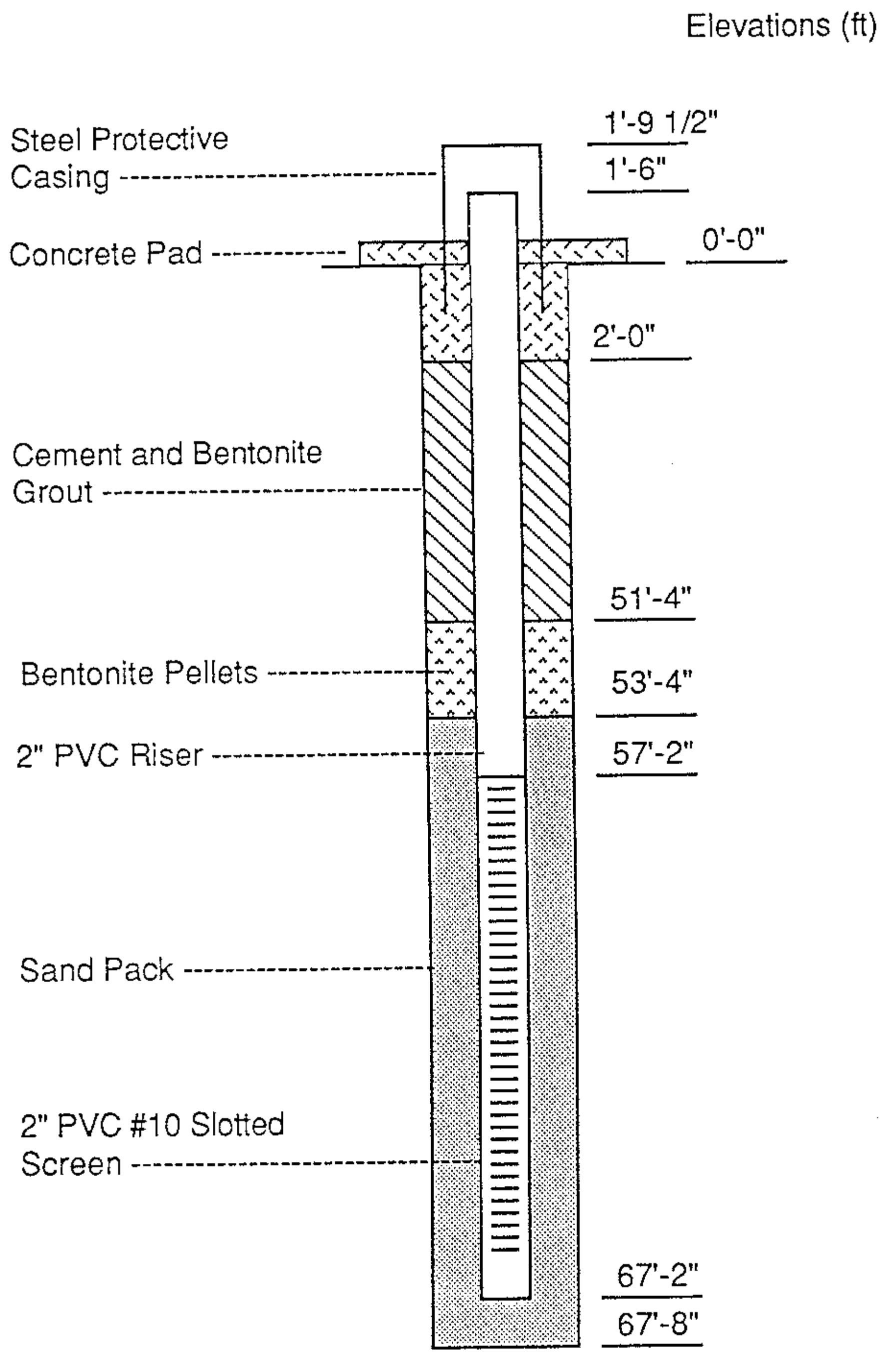
Gibbs & Hill, Inc.

6001249

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-6
Date Installed 3/10/89

Water Level from Top of Casing 14'-5"
Date 3/23/89 Time 11:00 A M



Gibbs & Hill, Inc.

6001250

BORING LOG

Sheet 1 of 2

PROJECT: Hercules		PROJECT NO. 5583-09		BORING NO. MW-6	
Location: Port Ewen, NY		Coord:		Ground Elev:	
Contractor: Empire Drilling		Date Started: 3/8/89	G.W.L.	Hour:	Date:
Inspector: Mike Valentino		Date Completed: 3/13/89	G.W.L.	Hour:	Date:
Notes:		HNU			

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	RQD %	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0		S1			16 / 5	7 / 6	18"	0		OL	Brown Sandy Clayey silt with organics
5		S2			7 / 19	17 / 20	16"	0		ML	Brown clayey dry silt
10		S3			7 / 18	15 / 22	18"	0		ML	Brown clayey dry silt
15		S4			4 / 13	7 / 9	18"	0		ML	Brown clayey moist silt
20		S5			1 / 2	2 / 2	20"	0		CL	Gray cohesive wet silty clay
25		S6			WOH / 1	WOH / 2	20"	0		CL	Gray cohesive wet silty clay
30		S7			WOR / WOR	WOR / WOH	24"	0		CL	Gray cohesive wet silty clay
35		S8			WOR / WOR	WOR / WOH	24"	0		CL	Gray cohesive wet silty clay
40											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	6001262
Sample & Test Notations		

Gibbs & Hill, Inc

BORING LOG

Sheet 2 of 2

PROJECT: Hercules — PROJECT NO. 5583-09 — BORING NO. MW-6

Location: Port Ewen, NY — Coord: — Ground Elev:

Contractor: Empire Drilling — Date Started: 3/9/89 — G.W.L. — Hour: — Date:

Inspector: Mike Valentino — Date Completed: 3/13 — G.W.L. — Hour: — Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	~~ROD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
40		S9			WOR	WOR	24"	0		CL	Gray cohesive wet silty clay
					WOR	WOH					
45		S10			WOR	WOR	24"	0		CL	Gray cohesive wet silty clay
					WOR	WOH					
50		S11			WOR	WOR	24"	0		ML	Gray wet clayey silt some fine sands at bottom
					WOH	4					
55		S12			WOR	WOR	24"	0		ML	Gray sandy clayey silt with some fine sand seams
					WOH	WOH					
60		S13			9	11	20"	0		SM	Gray clayey silty medium sands with gravel size fractured shale at bottom.
					27	28					
65											BOH
0											
5											
0											

I.D. Casing — Wgt. Hammer on Casing — Material Notations

I.D. Spoon — Wgt. Hammer on Spoon

Type Core Drill — Drop Hammer on Casing

Core Dia. — Drop Hammer on Spoon

Sample & Test Notations

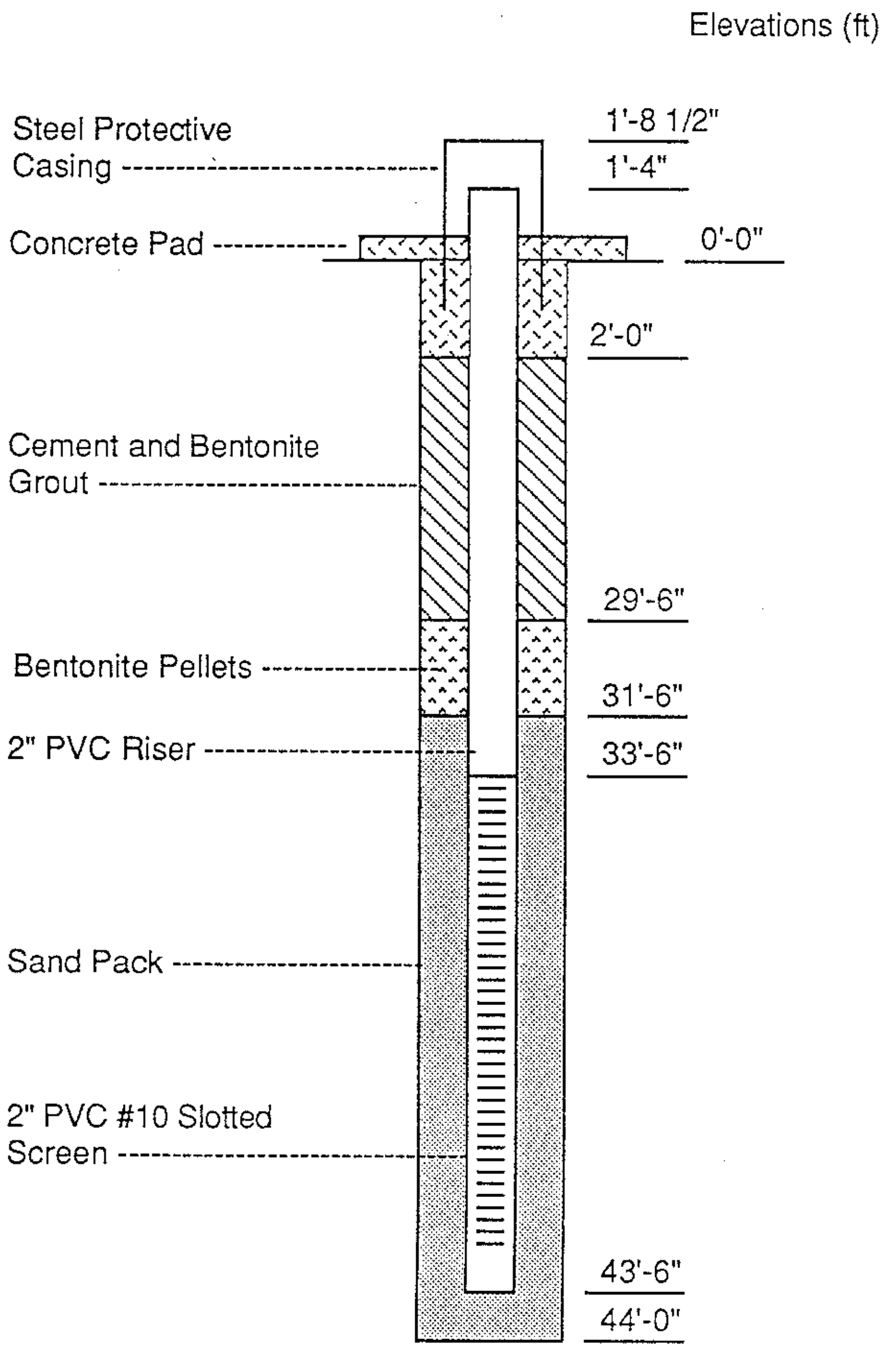
6001263

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-7
Date Installed 3/17/89

Water Level from
Top of Casing 9'-7 1/4"
Date 3/23/89 Time 11:30 AM



Gibbs & Hill, Inc.

6001251

BORING LOG

PROJECT: Hercules | PROJECT NO. 5583-09 | BORING NO. MW-7

Location: Port Ewen, NY | Coord: | Ground Elev:

Contractor: Empire Drilling | Date Started: 3/16/89 | G.W.L. | Hour: | Date:

Inspector: Mike Valentino | Date Completed: 3/17/89 | G.W.L. | Hour: | Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0	SM	S1			2 6	9 5	18"	0		SM	Dry brown silty gravelly fine sand
5		S2			3 7	5 7	18"	0		ML	Dry brown clayey silt
10		S3			3 4	4 5	22"	0		ML	Moist brown clayey silt becoming grayer toward bottom
15		S4			WOH 1	WOH 2	22"	0		CL	wet gray silty clay
20		S5			WOR WOH	WOH WOH	24"	0		CL	wet gray silty clay
25		S6			WOH 2	WOH 2	16"	0		CL	wet gray silty clay
30		S7			WOH 2	WOH 3	24"	0		CL	Wet gray silty clay
35		S8			WOR WOH	WOH 1	24"	0		CL	Wet gray silty clay some gravel at bottom
40											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

6001264

Gibbs & Hill, In

BORING LOG

Sheet 2 of 2

PROJECT: Hercules — PROJECT NO. 5583-09 — BORING NO. GW-7

Location: Port Ewen, NY — Coord: — Ground Elev:

Contractor: Empire Drilling — Date Started: 3/16/89 — G.W.L. — Hour: — Date:

Inspector: MIK Valentine — Date Completed: 3/17/89 — G.W.L. — Hour: — Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	RQD %	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
40		S9			WOR	5	12"	0		GM	wet dark shale fragments in a gray clayey silty matrix
					7	5					
5					100/.3						BOH — Refusal at 45'
0											
5											
0											
5											
0											
5											
0											

I.D. Casing — Wgt. Hammer on Casing — Material Notations

I.D. Spoon — Wgt. Hammer on Spoon

Type Core Drill — Drop Hammer on Casing

Core Dia. — Drop Hammer on Spoon

Sample & Test Notations

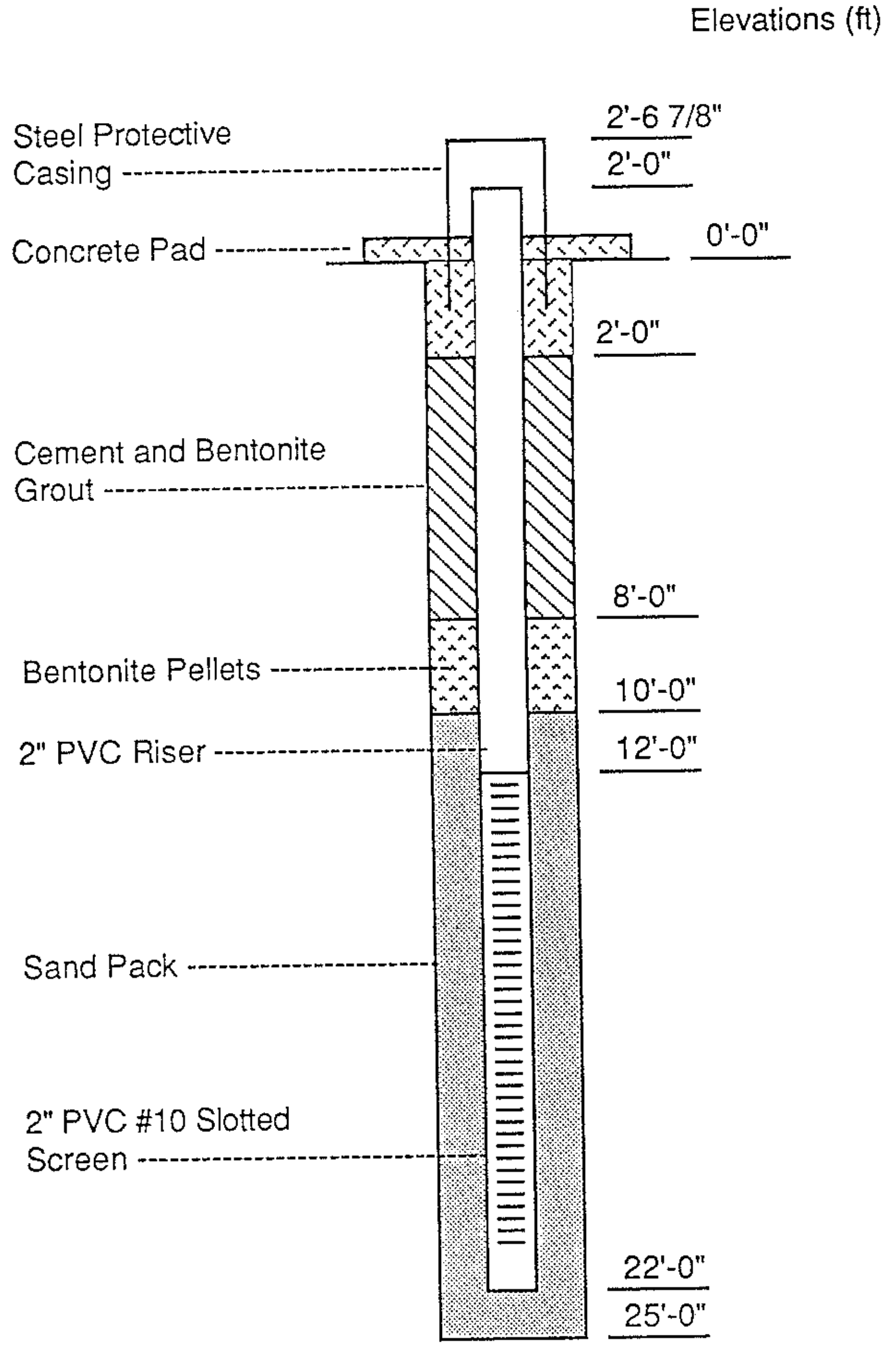
6001265

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-8
Date Installed 3/8/89

Water Level from
Top of Casing 8'-5 1/4"
Date 3/23/89 Time 1:00 PM



Gibbs & Hill, Inc.

6001252

BORING LOG

PROJECT: Hercules | PROJECT NO. 5583-09 | BORING NO. MW-8

Location: Port Ewen, N.Y. | Coord: | Ground Elev:

Contractor: Empire Drilling | Date Started: 3/8/89 | G.W.L. | Hour: | Date:

Inspector: Mike Valentino | Date Completed: 3/8/89 | G.W.L. | Hour: | Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0											No Sample
5					4 / 6	5 / 8	12"	0		ML	yellowish brown moist clayey-silt.
10					6 / 7	6 / 8	12"	0		ML	yellowish brown more moist clayey silt
15					2 / 1	2 / 2	10"	0		ML	Gray wet clayey silt
20					0 / 0	0 / 1	20"	0		ML	Gray saturated clayey silt
25											BOH - 25 ft
30											
35											
40											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

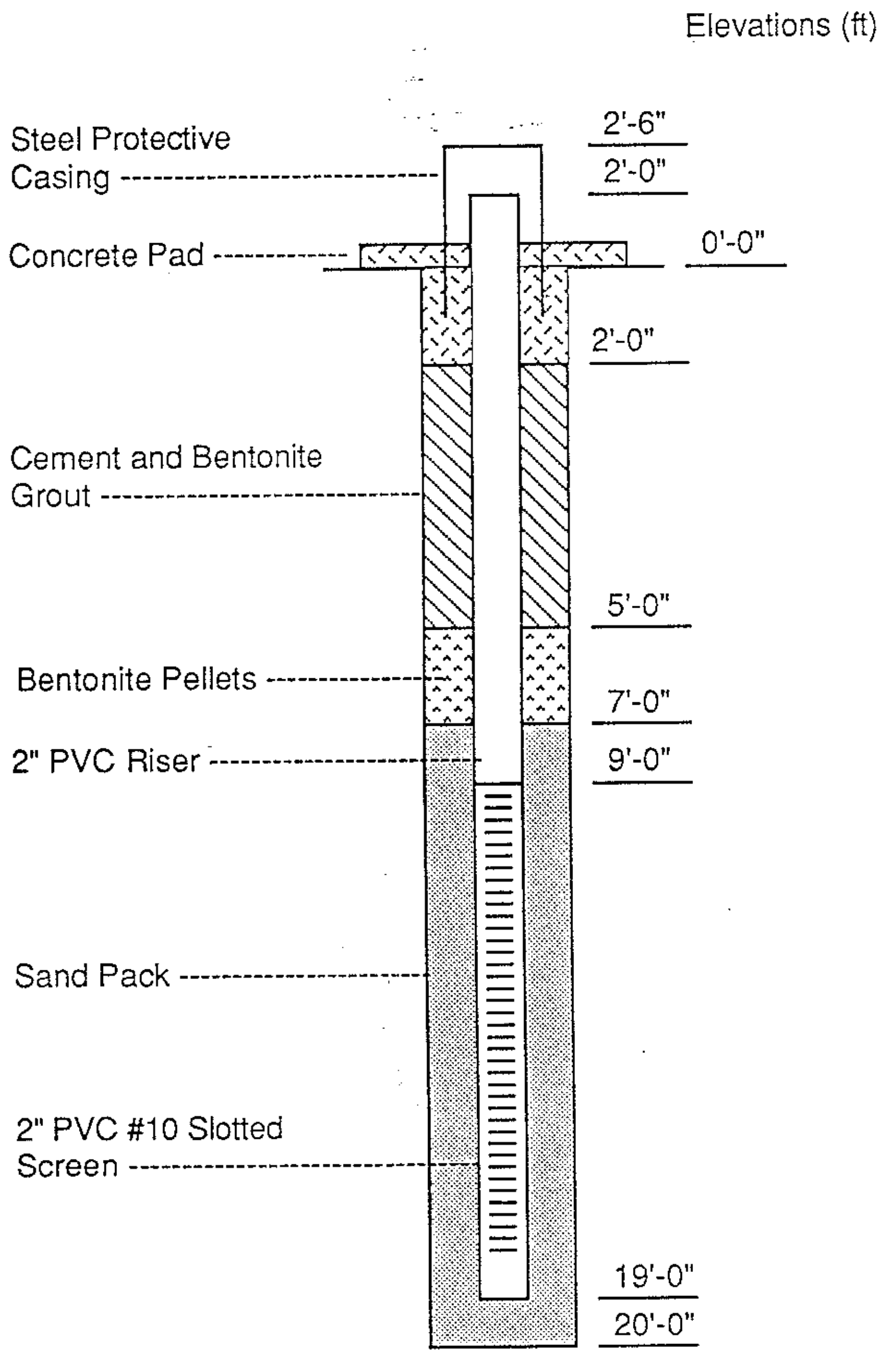
6001266

Gibbs & Hill, Inc

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-9
Date Installed 3/7/89

Water Level from
Top of Casing 2'- 7 1/2"
Date 3/23/89 Time 2:00 PM



Gibbs & Hill, Inc.

60 1253

BORING LOG

B Sheet 1 of 1

PROJECT: Hercules PROJECT NO. 5583-09 BORING NO. MW-9

Location: Port Ewen, NY Coord: Ground Elev:

Contractor: Empire Drilling Date Started: 3/7/89 G.W.L. 3' 6.5. Hour: 2:30P Date: 3/7

Inspector: Mike Valentino Date Completed: 3/7/89 G.W.L. 4'5" TOC Hour: 9:10A Date: 3/9

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Sampler 6"	Sampler 6"	Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0					20	13	12"	0		ML	Dry brown clayey silt - 1st 3" frozen
					10	10					
5					3	7	18"	0		ML	Dry brown clayey silt becoming moist toward bottom of core
					4	7					
0					2	3	20"	0		ML	Moist brown clayey silt changing to gray clayey silt at 11'8"
					3	4					
5					0	0	12"	0		ML	Wet gray clayey silt
					2	2					
0					17	18	12"	0		GM	Weathered black shale in a silty matrix
					29	47					
5											
0											
5											
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

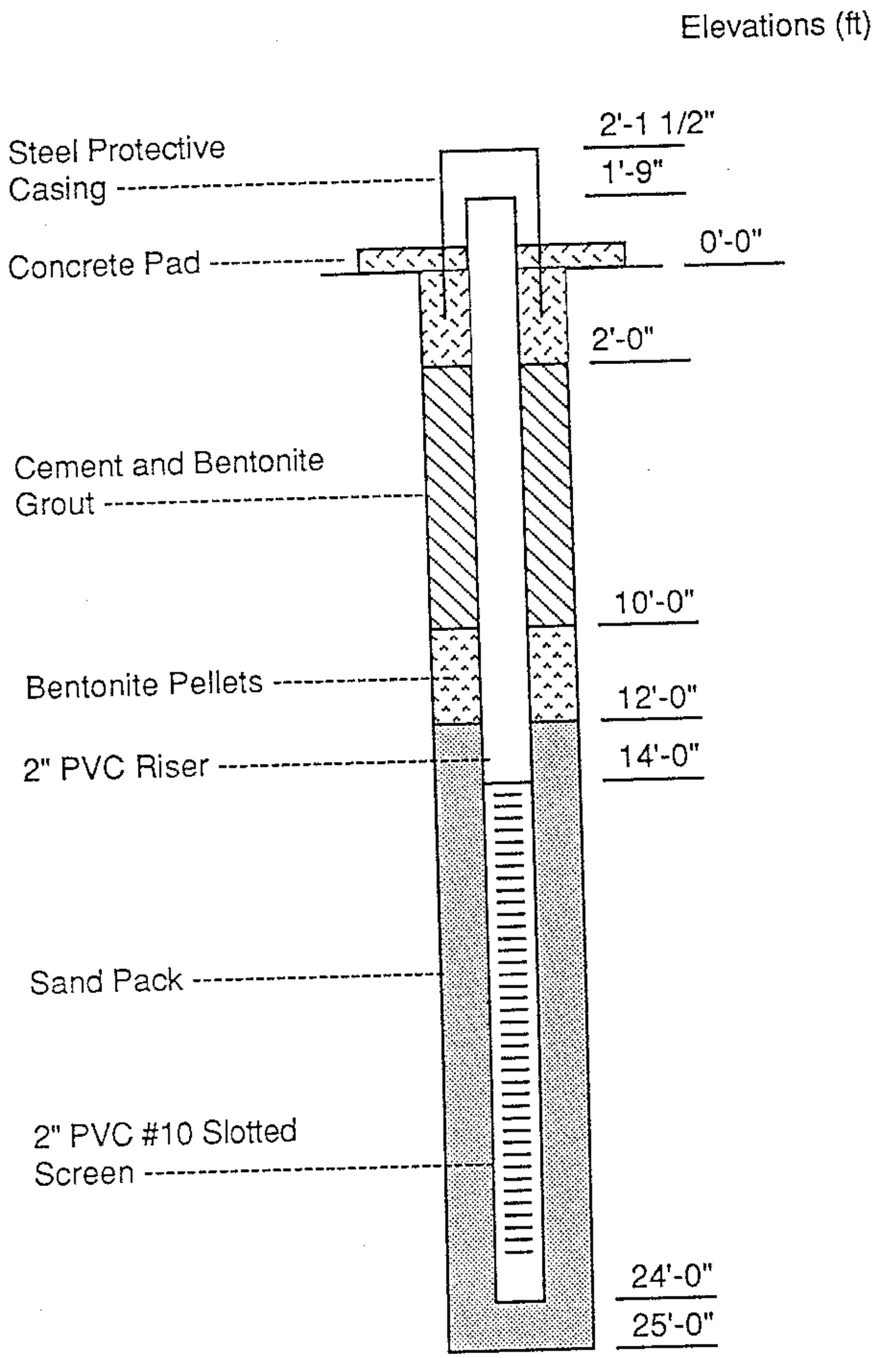
6001267

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-10
Date Installed 3/6/89

Water Level from
Top of Casing 3'- 9"
Date 3/23/89 Time 2:45 PM



Gibbs & Hill, Inc.

6001254

BORING LOG

PROJECT: Hercules — PROJECT NO. 5583-09 — BORING NO. MW-10

Location: Port Ewen, N.Y. — Coord: — Ground Elev:

Contractor: Empire Drilling — Date Started: 3/6/89 — G.W.L. 5' (TOC) — Hour: 1:20P — Date: 3/7/89

Inspector: Mike Valentino — Date Completed: 3/7/89 — G.W.L. — Hour: — Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0					3 6	3 7	20"	0		ML	Brown. dry-moist clayey silt – top 3" frozen
5					5 8	6 9	23"	0		ML	Clayey brown moist silt.
0					1 2	2 3	24"	0		ML	Clayey brown moist silt changing to gray wet clayey silt at 11½'
5					2 2	4 2	18"	0		ML	wetter gray clayey silt
0					0 2	1 3	18"	0		ML	Saturated gray clayey silt.
5											BOH ↑
0											
5											
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample		

6001268

Gibbs & Hill, Inc.

HYDROPUNCH® BORING LOGS

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-1

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/22/95*
Finish Date: *06/23/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

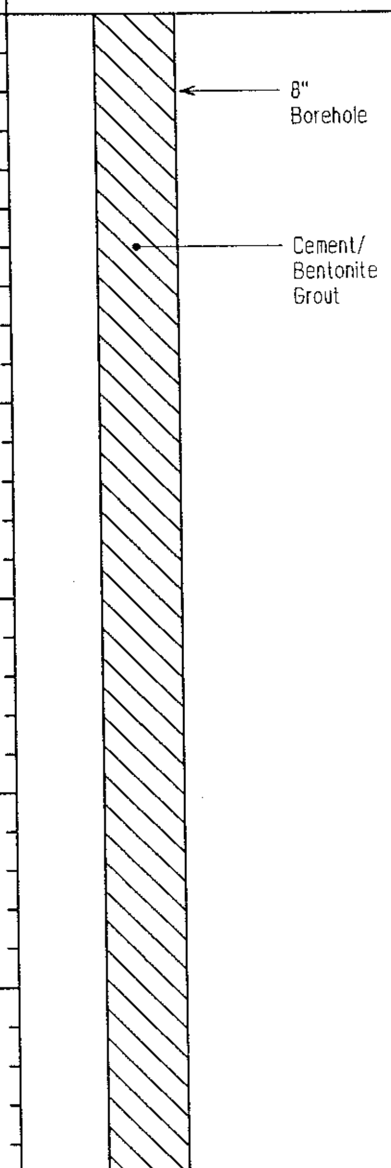
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *163.4*
TWC: *NA*
TPC: *NA*
North: *685,400.08*
East: *594,246.34*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	6-8-8-8	1.4'	SM / CH	0	LACUSTRINE DEPOSITS Light brown mf SAND, some Clayey Silt, with root hairs, dry @ 0.2' grading to brown Silty CLAY, trace f Sand, moist to wet	Borehole backfilled with cement/bentonite grout.
5	S-2	6-7-7-9	1.5'	CH	0		
10	S-3	6-5-5-8	1.8'	CH	34		
15	S-4	6-3-3-4	2.0'	CH	144	@ 15.0' brown CLAY, trace f Sand, saturated @ 16.9' changing to gray CLAY, trace f SAND	
20	S-5	3-1-2-2	2.0'	CH	0.4		
25							
30							Hydropunch sample collected @ 28-29'

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-1

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

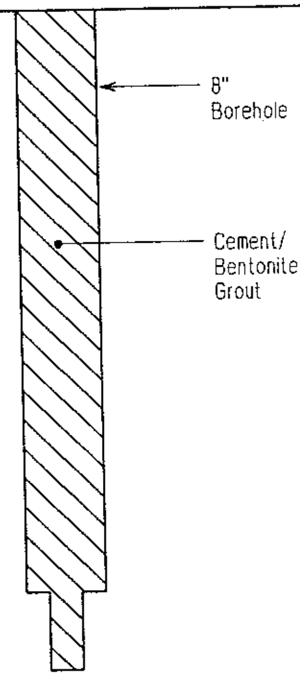
Project No.: *9596.03*

Start Date: *06/22/95*

Finish Date: *06/23/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-6	2-1-2-1	0.9'	CH	0		
35	S-7	2-2-1-1	2.0'	CH	0		
40							Hydropunch sample collected @ 42-43'
45	S-8	3-4-31-55	0.1'	GC	0	@ 45.0' gray mf GRAVEL and f SAND, some Silty Clay	
47						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/07/95*
Finish Date: *06/09/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *164.7*
TWC: *NA*
TPC: *NA*
North: *685,422.24*
East: *594,300.63*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION: 8" Borehole; Cement/Bentonite Grout

SAMPLE DATA

Depth (feet)	Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	5-6-7-7	1.3'	CH	0	LACUSTRINE DEPOSITS Brown CLAY & SILT, trace f Sand, with root hairs, dry to moist	Borehole backfilled with cement/bentonite grout.
5	S-2	4-6-7-9	1.4'	CH	0.2		
10	S-3	6-5-6-7	1.4'	CH	30		
15	S-4	2-1-2-2	1.8'	CH	1	@ 15.0' gray Silty CLAY, trace f Sand, saturated	
20	S-5	WOR-1-3-2	2.0'	CH	0		
25	S-6	WOR/12"-1/12"	NR	CH	NA		Hydropunch sample collected @ 26-29'
30							

(Run No. / Hydraul. Cond. cm/sec / Rec. (ft.) / RQD columns: no entries)

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-2

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

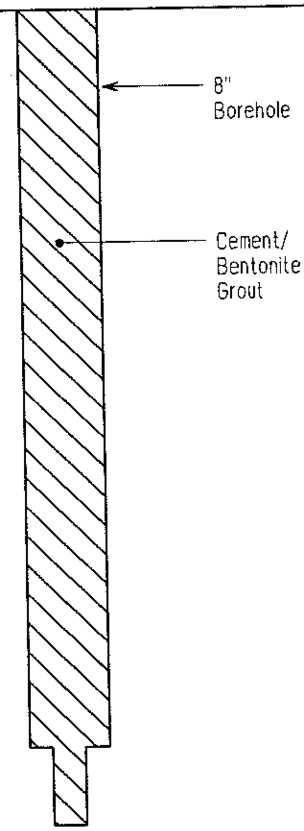
Project No.: *9596.03*

Start Date: *06/07/95*

Finish Date: *06/09/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	1-1-1-2	2.0'	CH	0	@ 30.0' gray CLAY, trace f Sand	
35	S-8	WOR/24"	2.0'	CH	0	@ 35.0' gray Silty CLAY, little f Sand	
45	S-9	WOR/24"	NR	NA	NA		Hydropunch sample collected @ 46-49'
49–50	S-10	6-4-24-17	0.7'	GC	0	@ 49.0' gray Silty CLAY, some angular fm Gravel, little cmf Sand	
51						End of Boring at 51.0 feet.	

Depth scale (feet): 30, 35, 40, 45, 50, 55, 60, 65, 70

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-3

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/22/95*
Finish Date: *07/07/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850/Acker Soil Max*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *164.4*
TWC: *NA*
TPC: *NA*
North: *685,424.48*
East: *594,343.99*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION / SAMPLE DATA

Well construction (0–30 ft): 8" Borehole; Cement/Bentonite Grout.

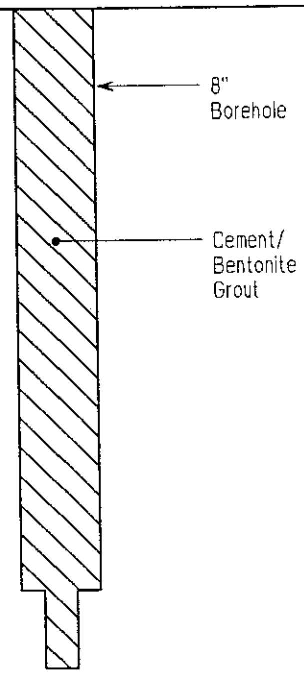
Depth (feet)	Samp. No.	Blows/6 in.	Rec. (ft.)	USCS	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	7-8-7-6	1.2'	SP / CH	24	FILL (0.8): Light brown to black fmc SAND, little Clayey Silt, little f Gravel, with roots & cinders, dry to moist. LACUSTRINE DEPOSITS	Borehole backfilled with cement/bentonite grout.
5	S-2	5-6-8-6	1.1'	CH	4.8	Gray-black Silty CLAY, trace f Sand, damp. @ 5.0 brown & gray Silty CLAY, trace f Sand, moist to wet	
10	S-3	7-7-8-11	2.0'	CH	60		
15	S-4	3-4-3-5	2.0'	CH	12	@ 15.0' brown CLAY, trace (-) f Sand, saturated	
20	S-5	4-2-2-3	2.0	CH	0.2	@ 20.0' gray CLAY, trace (-) f Sand	Hydropunch sample collected @ 23-24'
25	S-6	4-3-4-5	1.2'	CH	1.2		
30							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-3

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/22/95*
Finish Date: *07/07/95*

(CONTINUATION)

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	3-4-4-4	1.2'	CH	0		
35						@ 35.0' gray CLAY, little f Sand	
	S-8	WOH/24"	2.0'	CH	0		
40							
							Hydropunch sample collected @ 43-44'
45	S-9	5-5-4-3	2.0'	CH	0		
47						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-4

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/21/95*
Finish Date: *06/21/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: 164.6
TWC: NA
TPC: NA
North: 685,380.71
East: 594,335.46

Geophysical Log: ☐ yes ☒ no
Comments:

Well construction: 8" Borehole; Cement/Bentonite Grout (0–30 ft)

Depth (feet)	Samp. No.	Blows/6 in.	Rec. (ft.)	USCS	PID (ppm)	Visual Classification	Remarks
0	S-1	9-11-5-5	0.9'	GM	1.6	LACUSTRINE DEPOSITS Gray mf GRAVEL, some fmc Sand, little Clay & Silt, dry to moist @ 0.7'	Borehole backfilled with cement/bentonite grout.
5	S-2	4-6-9-12	1.7'	CH	0.8	@ 5.0' brown Silty CLAY, trace f Sand, moist to wet	
10	S-3	4-7-9-10	2.0'	CH	11.2		
15	S-4	2-4-4-5	2.0'	CH	40	@ 16.4' changing to red-brown Silty CLAY, trace f Sand, saturated	
20	S-5	WOH/18"-3	2.0'	CH	19.6	@ 20.0' gray CLAY, trace (-) f Sand	
25							
30							Hydropunch sample collected @ 27.5-28.5'

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-4

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

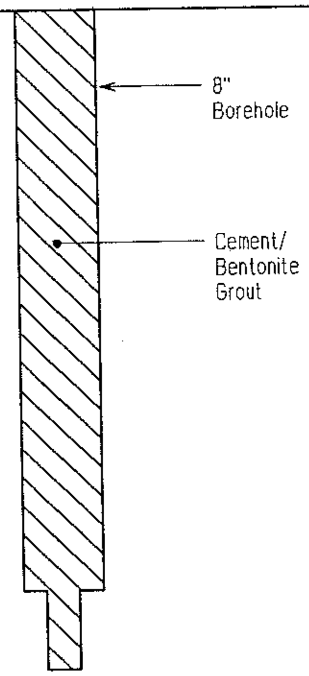
Project No.: *9596.03*

Start Date: *06/21/95*

Finish Date: *06/21/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	Visual Classification	Remarks
30	S-6	1-2-1-1	1.2'	CH	0		
35	S-7	1-1-1-1	NR	NA	NA		
40							Hydropunch sample collected @ 42-43'
45	S-8	1-1-4-5	NR	CH	NA		
47						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP−5

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/05/95*
Finish Date: *06/07/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

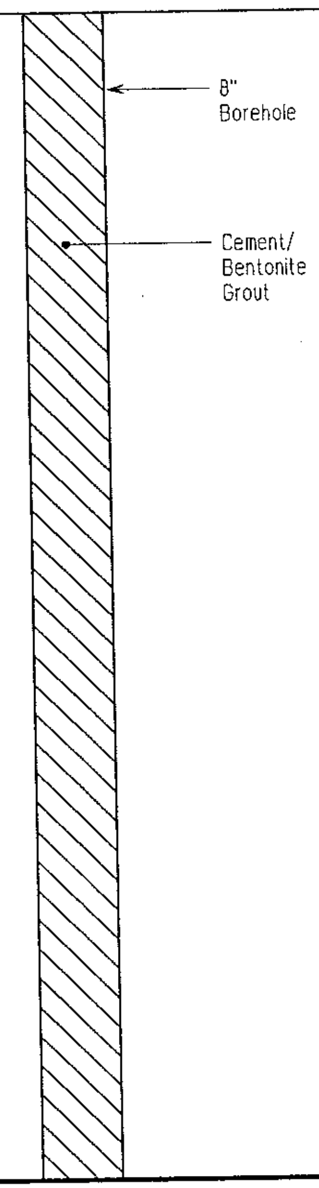
Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: 161.1
TWC: NA
TPC: NA
North: 685,435.55
East: 594,448.56

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	4-3-5-7	0.9'	CL	0	LACUSTRINE DEPOSITS Brown SILT & CLAY, trace f Sand, dry	Borehole backfilled with cement/bentonite grout.
5	S-2	6-8-7-9	1.2'	CH	0	@ 5.0' brown Silty CLAY, trace f Sand, moist	
10	S-3	4-7-8-12	1.7'	CH	2		
15	S-4	3-4-3-3	2.0'	CH	0.6	@ 16.7' changing to gray Silty CLAY, trace f Sand, wet	
20	S-5	WOH/12"-2-3	2.0'	CH	0	@ 20.0' gray Silty CLAY, trace (-) f Sand, saturated	
25	S-6	1/24"	NR	NA	NA		Hydropunch sample collected @ 26-28'
30							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-5

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *06/05/95*

Finish Date: *06/07/95*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	8" Borehole; Cement/ Bentonite Grout	S-7	1-1-1-1	2.0'	CH	0.1	@ 30.0' gray CLAY, trace (-) f SAND	
35		S-8	WOR/12"-1-3	2.0'	CH	0.1		
40		S-9	1-1-1-1	NR	NA	NA		Hydropunch sample collected @ 42-45'
45							End of Boring at 45.0 feet.	
50								
55								
60								
65								
70								

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-6 — Page 1 of 2
Project: *Groundwater Investigation* / Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	Project No.: *9596.03*	Start Date: *06/15/95* / Finish Date: *06/19/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *157.8*
TWC: *NA*
TPC: *NA*
North: *685,379.73*
East: *594,512.92*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION: 8" Borehole; Cement/ Bentonite Grout

Depth (feet)	Samp. No. (soil) / Run No. (rock)	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0						LACUSTRINE DEPOSITS	Borehole backfilled with cement/bentonite grout.
0–2	S-1	3-4-3-4	1.4'	CL	0	Brown SILT & CLAY, little mf Sand, with reeds & roots, damp	
5–7	S-2	4-6-7-8	2.0'	CH	0	@ 5.0' brown Silty CLAY, trace f Sand, moist to wet	
10–12	S-3	3-5-7-7	2.0'	CH	0.1		
15–17	S-4	3-2-3-3	1.0'	CH	0	@ 15.0' gray Silty CLAY, trace f Sand, saturated	
23–24							Hydropunch sample collected @ 23-24'
25–27	S-5	2-4-4-3	1.5'	CH	0	@ 25.0' gray CLAY, trace (-) f Sand	
30							

ECKENFELDER INC.

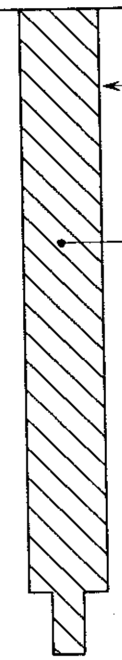
Subsurface Boring Log

Well Name/Location: HP-6

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/15/95*
Finish Date: *06/19/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	soil Samp. No. / rock Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-6	1-1-3-3	1.0'	CH	0	@ 30.0' gray CLAY, little f Sand	
35	S-7	2-1/12"-1	2.0'	CH	0		
40							Hydropunch sample collected @ 41-44'
45	S-8	32-34-65-100/0.1"	1.3'	GC	0	@ 45.0' gray mf GRAVEL, some Silty Clay, some fmc Sand Bedrock @ 46.6 feet.	
						End of Boring at 46.6 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-7

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/13/95*
Finish Date: *07/14/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: 157.8
TWC: NA
TPC: NA
North: 685,305.36
East: 594,648.93

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION — 8" Borehole; Cement/Bentonite Grout (0–30 ft)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	S-1	3-5-9-10	2.0'	CH	0.2	LACUSTRINE DEPOSITS Brown Silty CLAY, trace f Sand, with roots, dry to wet	Borehole backfilled with cement/bentonite grout.
5–7	S-2	5-5-5-8	2.0'	CH	0		
10–12	S-3	4-6-5-6	NR	NA	NA		
15–17	S-4	4-2-3-1	2.0'	CH	0	@ 15.7' grading to gray Silty CLAY, trace f Sand, saturated	
23–24							Hydropunch sample collected @ 23–24'
25–27	S-5	WOH/18"-2	1.2'	CH	0		

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-7

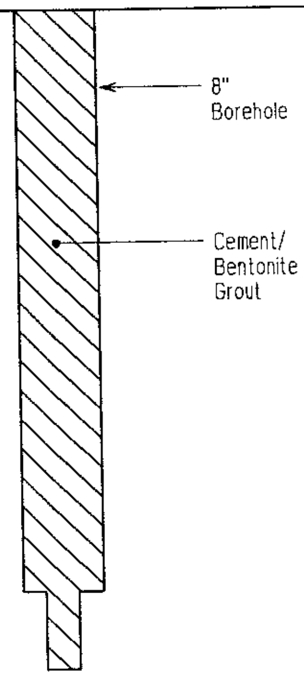
Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *07/13/95*
Finish Date: *07/14/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-6	1-1-1-2	1.8'	CH	0	@ 30.0' gray Silty CLAY, little (+) f Sand	
35	S-7	WOR/24"	1.8'	CH	0		
40							
42–44							Hydropunch sample collected @ 42–44'
45	S-8	16-14-42-38	1.1'	GP	0	@ 45.0' gray fmc GRAVEL, some cmf Sand, little Silt & Clay	
47						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **HP-8**

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/12/95*
Finish Date: *07/15/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

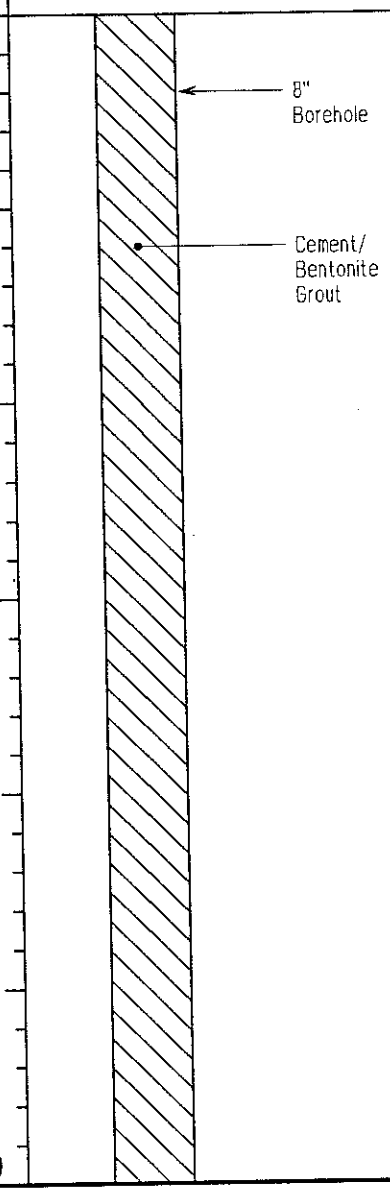
WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: 162.7
TWC: NA
TPC: NA
North: 685,218.76
East: 594,639.62

Geophysical Log: ☐ yes ☒ no
Comments:



Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	2-4-6-10	1.5'	CH	0	LACUSTRINE DEPOSITS Dark brown to gray-brown Silty CLAY, trace f Sand, dry to wet	Borehole backfilled with cement/bentonite grout.
5	S-2	6-8-11-11	2.0'	CH	0		
10	S-3	7-5-8-11	2.0'	CH	0		
15	S-4	6-5-4-5	1.3'	CH	0	@ 15.0' gray Silty CLAY, trace f Sand, saturated	
20							
							Hydropunch sample collected @ 23-24' plus DUP071395
25	S-5	2-2-2-4	1.5'	CH	0	@ 25.0' gray Silty CLAY, little f Sand	
30							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-8

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *07/12/95*
Finish Date: *07/15/95*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	8" Borehole; Cement/ Bentonite Grout	S-6	2-3-2-3	1.3'	CH	0	@ 30.0' gray Silty CLAY, some (-) f Sand	
35		S-7	1-2-1-1	1.5'	CH	0		
40								Hydropunch sample collected @ 42-43'
45		S-8	12-16-15-24	1.3'	SP	0	@ 45.0' gray cmf SAND, some fmc Gravel, little Silt & Clay	
							End of Boring at 47.0 feet.	
50								
55								
60								
65								
70								

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-9

Project: *Groundwater Investigation*	Project No.:	Start Date: *07/12/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	*9596.03*	Finish Date: *07/12/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

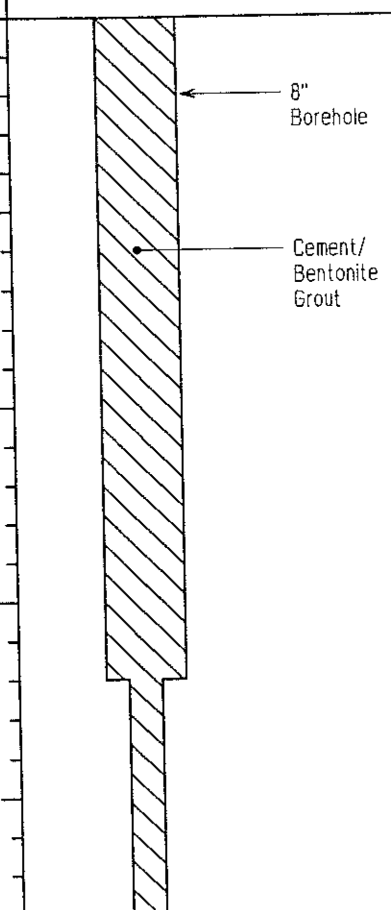
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *164.0*
TWC: *NA*
TPC: *NA*
North: *685,130.17*
East: *594,614.45*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	soil: Samp. No. / rock: Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	2-5-9-12	1.5'	OL / CH	0	LACUSTRINE DEPOSITS Dark brown SILT, some f Sand, with roots, needles & leaf litter, dry @ 0.4' grading to brown Silty CLAY, trace to little f Sand, dry to moist	Borehole backfilled with cement/bentonite grout.
5	S-2	8-7-8-10	1.7'	CH	0		
10	S-3	6-5-4-4	1.8'	CH	0.2	@ 10.4' changing to gray Silty CLAY, trace f Sand, wet to saturated	
15	S-4	7-7-6-6	0.9'	CH	0		
20							Hydropunch sample collected @ 22-23'
23						End of Boring at 23.0 feet.	
25							
30							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-10

Project: *Groundwater Investigation* — Project No.: *9596.03* — Start Date: *06/02/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.* — Finish Date: *06/08/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NGVD/NYS Plane

Grade: *156.8*
TWC: *NA*
TPC: *NA*
North: *685,220.05*
East: *594,500.02*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION: 8" Borehole; Cement/ Bentonite Grout (0–30 ft)

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	S-1	1-3-3-4	1.6'	CH	2.6	LACUSTRINE DEPOSITS Brown CLAY & SILT, trace to (-) f Sand, moist to saturated	Borehole backfilled with cement/bentonite grout.
5–7	S-2	2-3-5-7	1.8'	CH	200		
10–12	S-3	4-4-4-6	2.0'	CH	250		
15–17	S-4	1-2-2-2-	2.0'	CH	400	@ 15.3' changing to gray CLAY, trace (-) f Sand, saturated	
20–22	S-5	WOH/24"	NR	NA	NA		Hydropunch sample collected @ 21-24', plus DUP060895
25–27	S-6	1/12"-1/12"	0.7'	CH	1		

Depth scale: 0, 5, 10, 15, 20, 25, 30

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-10

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

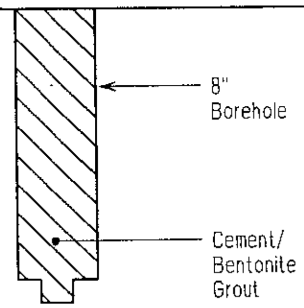
Project No.: *9596.03*

Start Date: *06/02/95*

Finish Date: *06/08/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	1-1-1-2	2.0'	CH	0.4		Hydropunch sample, HP-10A, collected @ 32-34'
35	S-8	WOR/18"-40	2.0'	CH	0.5	@ 36.6' grading to gray CLAY, some fm Sand	
37.5	S-9	100/2"	NR	CH	NA	Bedrock @ 37.5 feet.	Hydropunch sample collected @ 37-37.5'
						End of Boring at 37.5 feet.	

Depth scale: 30, 35, 40, 45, 50, 55, 60, 65, 70

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-11

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/09/95*
Finish Date: *06/12/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA DATUM: NGVD/NYS Plane

Grade: 161.8
TWC: NA
TPC: NA
North: 685,096.79
East: 594,493.05

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION — 8" Borehole; Cement/Bentonite Grout (0–30 ft)

SAMPLE DATA (soil / rock)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	2-8-9-9	1.2'	CH	0	<u>LACUSTRINE DEPOSITS</u> Brown Silty CLAY, trace f Sand, dry to moist	Borehole backfilled with cement/bentonite grout.
5	S-2	6-4-7-10	1.6'	CH	0		
10	S-3	6-4-5-5	1.8'	CH	0		
15	S-4	6-4-3-2	1.5'	CH	0	@ 15.0' gray Silty CLAY, trace (-) f Sand, wet to saturated	
20							Hydropunch sample collected @ 21-24'
25	S-5	5-3-1-2	1.4'	CH	0		
30							

ECKENFELDER INC.

Subsurface Boring Log

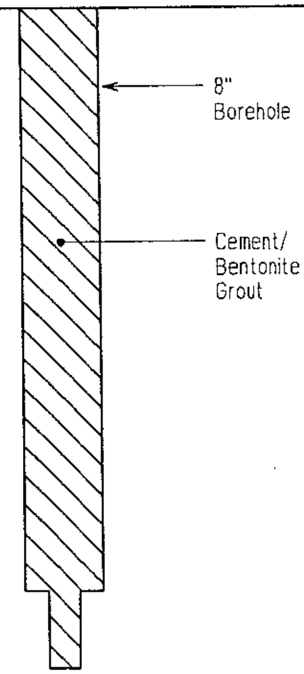
Well Name/Location: HP-11

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *06/09/95*
Finish Date: *06/12/95*

WELL CONSTRUCTION



(CONTINUATION)

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-6	4-3-2-1	NR	NA	NA		
35	S-7	3-2-1-1	1.7'	CH	0		
40							Hydropunch sample collected @ 41-43.5'
45	S-8	3-3-3-2	2.0'	CH	0		
47						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP–12

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/12/95*
Finish Date: *06/28/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

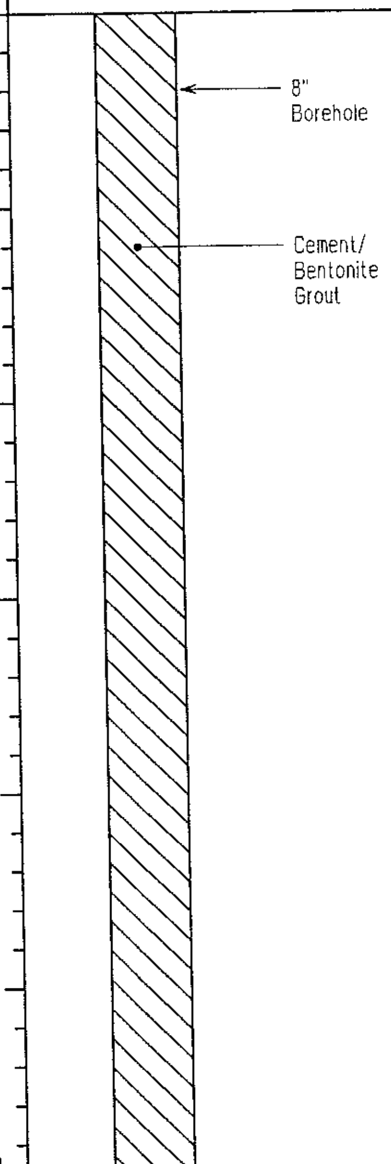
SURVEY DATA

DATUM: NGVD/NYS Plane

Grade: 158.9
TWC: NA
TPC: NA
North: 685,152.73
East: 594,414.82

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	2-4-4-5	1.7'	CH	0	LACUSTRINE DEPOSITS Brown Silty CLAY, trace f Sand, with roots & reeds, moist	Borehole backfilled with cement/bentonite grout.
5	S-2	3-6-7-8	1.9'	CH	0.8	@ 5.0' brown Silty CLAY, little f Sand, damp	
10	S-3	2-3-2-2	2.0'	CH	120	@ 11.2' grading to gray Silty CLAY, trace f Sand, moist to saturated	
15	S-4	1-1/12"-1	2.0'	CH	0.2	@ 15.0' gray CLAY, trace (–) f Sand	
20							Hydropunch sample collected @ 23–24'
25	S-5	2-1-1-2	2.0'	CH	0		
30							

ECKENFELDER INC.

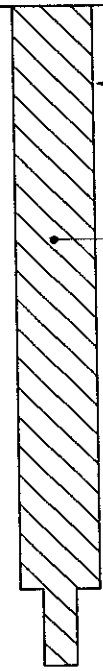
Subsurface Boring Log

Well Name/Location: HP-12

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/12/95*
Finish Date: *06/28/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-6	WOR/6"-WOH/18"	0.8'	CH	0		
35	S-7	3-1-1-3	1.9'	CH	0	@ 36.0' gray CLAY, little to some f Sand	
40							Hydropunch sample collected @ 42-43'
45	S-8	WOR/12"-1-2	2.0'	CH	0		
47						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-13 Page 1 of 2
Project: *Groundwater Investigation*	Project No.: *9596.03*	Start Date: *06/14/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*		Finish Date: *06/16/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NGVD/NYS Plane

Grade: *163.0*
TWC: *NA*
TPC: *NA*
North: *685,252.57*
East: *594,332.84*

Geophysical Log: ☐ yes ☒ no
Comments:

Well construction: 8" Borehole; Cement/Bentonite Grout (0–30 ft)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	2-5-5-13	0.5'	CH	1.5	FILL Brown Silty CLAY, some mf Sand, with black cinders, saturated	Borehole backfilled with cement/bentonite grout.
5	S-2	7-5-7-10	1.3'	CH	270	LACUSTRINE DEPOSITS Brown Silty CLAY, trace f Sand, moist	
10	S-3	7-8-8-13	0.3'	CH	220		
15	S-4	3-2-2-4	2.0'	CH	220	@ 15.4' grading to gray Silty CLAY, trace f Sand, wet to saturated	
20	S-5	2-2-1-2	2.0'	CH	2	@ 20.0' gray CLAY, trace (-) f Sand	Hydropunch sample collected @ 22-22.5'
25	S-6	2-1-2-3	0.7'	CH	0.3		
30							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **HP-13**

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

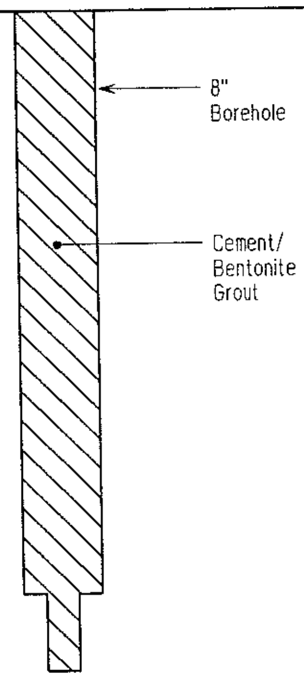
Project No.: *9596.03*

Start Date: *06/14/95*

Finish Date: *06/16/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	3-3-1-2	1.6'	CH	0.2		
35	S-8	WOH/18"-1	2.0'	CH	0		
40							
43–44							Hydropunch sample collected @ 43-44'
45	S-9	1/12"-1/12"	NR	NA	NA		
47						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-14

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/01/95*
Finish Date: *06/06/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850/CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

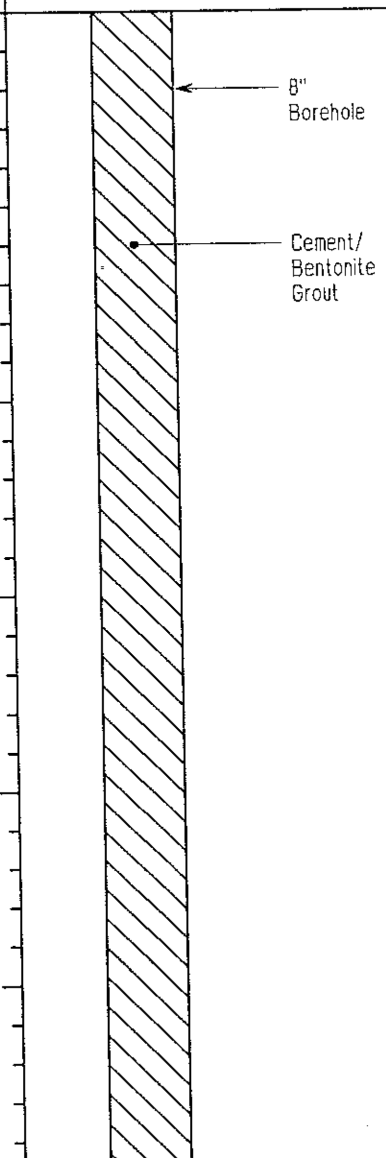
Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: 163.4
TWC: NA
TPC: NA
North: 685,571.49
East: 594,367.79

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	2-2-3-6	1.3'	CH	0	LACUSTRINE DEPOSITS Brown CLAY & SILT, trace f Sand, with root hairs, moist to wet	Borehole backfilled with cement/bentonite grout.
5	S-2	2-3-6-7	2.0'	CH	0.1		
10	S-3	3-4-5-8	2.0'	CH	1.1		
15	S-4	2-2-2-3	2.0'	CH	0	@ 15.5' grading to gray Silty CLAY, trace to no f Sand, moist to saturated	
20	S-5	WOH-1-1-2	1.6'	CH	0		
25	S-6	WOH/18"-2	0.2'	CH	0		Hydropunch sample collected @ 25'
30							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-14

Project: *Groundwater Investigation*

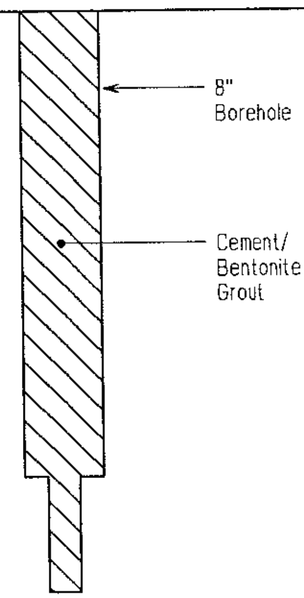
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *06/01/95*

Finish Date: *06/06/95*

(CONTINUATION)



Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	WOH/18"-3	2.0'	CH	0		
35	S-8	WOR/24"	2.0'	CH	0		
40	S-9	WOR/24"	2.0'	CH	0		Hydropunch sample collected @ 42-45'
45						End of Boring at 45.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-15

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/28/95*
Finish Date: *06/29/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: 163.2
TWC: NA
TPC: NA
North: 685,582.15
East: 594,431.75

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	Visual Classification	Remarks
0	8" Borehole; Cement/ Bentonite Grout (0–30')	S-1	15-21-12-14	1.5'	GW / CH	0	FILL: Gray GRAVEL and black cinders, dry (0.4); LACUSTRINE DEPOSITS: Brown Silty CLAY, trace f Sand, dry to wet	Borehole backfilled with cement/bentonite grout.
5		S-2	7-6-7-9	1.4'	CH	0		
10		S-3	6-5-7-8	1.5'	CH	0.4	@ 10.0' brown Silty CLAY, little f Sand wet	
15		S-4	4-3-2-3	1.5'	CH	NM	@ 15.5' grading to gray CLAY, trace f Sand, wet to saturated	
20		S-5	2-1-2-3	1.7'	CH	NM		
25								
30								Hydropunch sample collected @ 28-29'

Run No. / Hydraul. Cond. cm/sec / Rec. (ft.) / RQD

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-15

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *06/28/95*
Finish Date: *06/29/95*

(CONTINUATION)

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	Visual Classification	Remarks
30	8" Borehole; Cement/Bentonite Grout	S-6	2-2-1-1	1.5'	CH	0		
35		S-7	WOH/12"-1-2	NR	NA	NA		
40								Hydropunch sample collected @ 43-44'
45		S-8	WOH-2-1-4	1.6'	CH	0	@ 45.0' gray Silty CLAY and fmc SAND, trace f Gravel	
47							End of Boring at 47.0 feet.	
50								
55								
60								
65								
70								

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-16

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/27/95*
Finish Date: *06/28/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

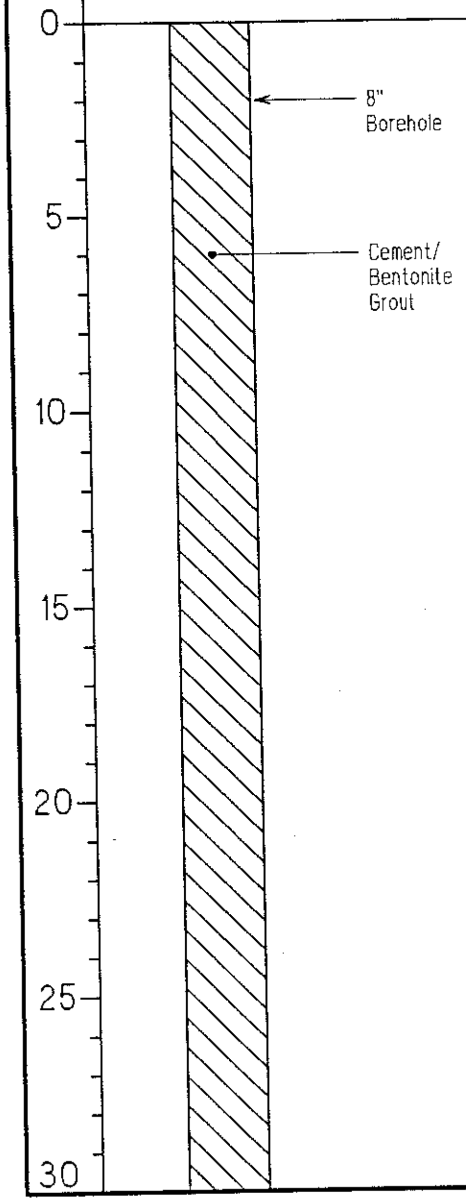
Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: 163.0
TWC: NA
TPC: NA
North: 685,205.71
East: 594,314.34

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (ft)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	4-3-2-2	0.2'	SP	0	LACUSTRINE DEPOSITS Brown & black cmf SAND, some fm Gravel, little Clay & Silt, with roots, dry	Borehole backfilled with cement/bentonite grout.
5	S-2	3-7-10-13	1.2'	CH	0	@ 5.0' brown Silty CLAY, trace f Sand, moist	
10	S-3	4-5-5-9	1.3'	CH	0		
15	S-4	4-3-2-2	1.5'	CH	0	@ 15.4' grading to gray CLAY, trace f Sand, saturated	
20–25							Hydropunch sample collected @ 23-24'
25	S-5	2-1-1-1	2.0'	CH	0		

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-16

Project: *Groundwater Investigation*
Project No.: *9596.03*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Start Date: *06/27/95*
Finish Date: *06/28/95*

(CONTINUATION)

Well construction: 8" Borehole; Cement/Bentonite Grout

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	Visual Classification	Remarks
30–32	S-6	2/12"-1-1	0.8'	CH	0		
35–37	S-7	WOR/12"-WOH-2	2.0'	CH	0		
43–44							Hydropunch sample collected @ 43-44'
45–47	S-8	WOH/24"	2.0'	CH	0	@ 45.0' gray CLAY, little f SAND	
47						End of Boring at 47.0 feet.	

NEWLY INSTALLED MONITORING WELLS

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-11S

Project: *Groundwater Investigation*	Project No.:	Start Date: *07/31/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	*9596.03*	Finish Date: *07/31/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

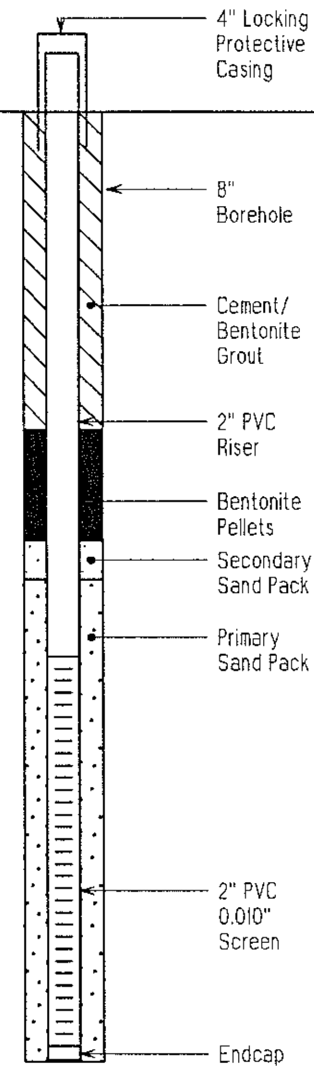
Method: *Surge Block/Bailer*
Duration: *0.5 hours*
Gals. Purged: *14 gallons*
Slug Test: *3.6 x 10^{-6}* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *162.1*
TWC: *164.4*
TPC: *164.6*
North: *683,792.33*
East: *593,680.59*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil/rock Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0							*See MW-11D for sample description.*	
25							End of Boring @ 24.4 feet.	
30								



ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-11D

Project: *Groundwater Investigation* Project No.: *9596.03*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Start Date: *07/26/95*
Finish Date: *07/28/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

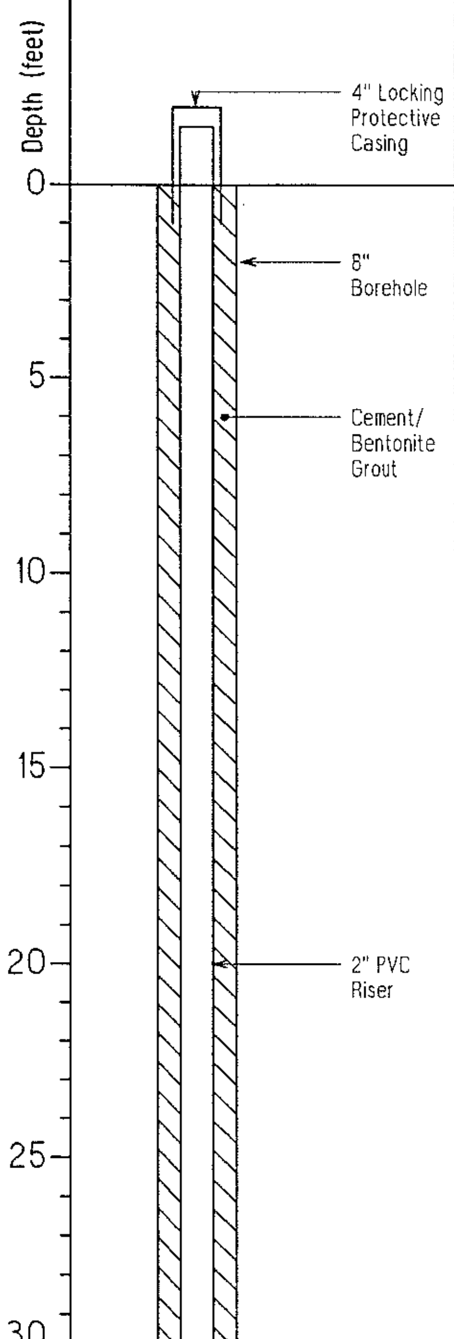
WELL DEVELOPMENT

Method: *Surge Block/Dual Line Air*
Duration: *4.4 hours*
Gals. Purged: *125 gallons*
Slug Test: *8.8×10^{-3}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *161.4*
TWC: *163.9*
TPC: *164.0*
North: *683,789.62*
East: *593,686.64*

Geophysical Log: ☐ yes ☒ no
Comments:



Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	2-5-8-11	1.6'	CL	0	LACUSTRINE DEPOSITS Brown CLAY & SILT, trace f Sand, with roots in top 0.2', damp to dry	
5	S-2	2-7-8-15	1.8'	CH	0	@ 5.0' brown Silty CLAY, little f Sand, damp to wet	
10	S-3	5-6-6-9	2.0'	CH	0		
15	S-4	2-2-2-2	2.0'	CH	0	@ 15.0' gray Silty CLAY, trace f Sand, saturated	
20	S-5	2-1-1-2	1.9'	CH	0		
25	S-6	WOH/24"	1.8'	CH	0		
30							

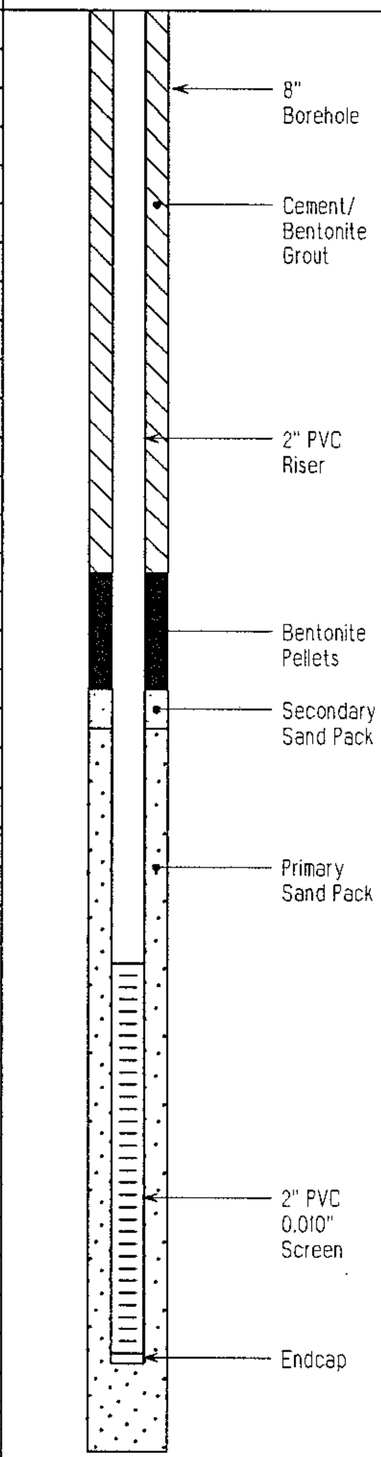
ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-11D

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/26/95*
Finish Date: *07/28/95*

WELL CONSTRUCTION



(CONTINUATION)

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	WOR/12"– WOH/12"	1.6'	CH	0		
35	S-8	WOH/24"	1.7'	CH	0	@ 35.0' gray Silty CLAY, little to trace f Sand	
40	S-9	WOR/18"– WOH/6"	1.6'	CH	0		
45	S-10	WOR-5- 10-7	0.4'	SC	0	@ 45.0' gray cmf SAND, some Clay & Silt, little fm Gravel	
50	S-11	12-12- 8-12	0.6'	GM	0	@ 50.0' gray GRAVEL and cmf SAND, little Clay & Silt	
55	S-12	9-12- 11-13	1.3'	GM	0	@ 55.0' gray mf GRAVEL, some fmc Sand, trace (–) Clayey Silt	
60	S-13	36-51- 35-30	2.0'	GP	0	@ 60.0' gray cmf SAND and fmc GRAVEL, trace Clayey Silt	
65	S-14	13-83- 104-74	1.6'	GP	0		
67						End of Boring at 67.0 feet.	
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-12S

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/18/95*
Finish Date: *05/18/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	PVC, Sch. 40	PVC, 0.010" Screen
Diameter (ID):	2 inch	2 inch
Coupling:	Flush-Threaded	Flush-Threaded

WELL DEVELOPMENT

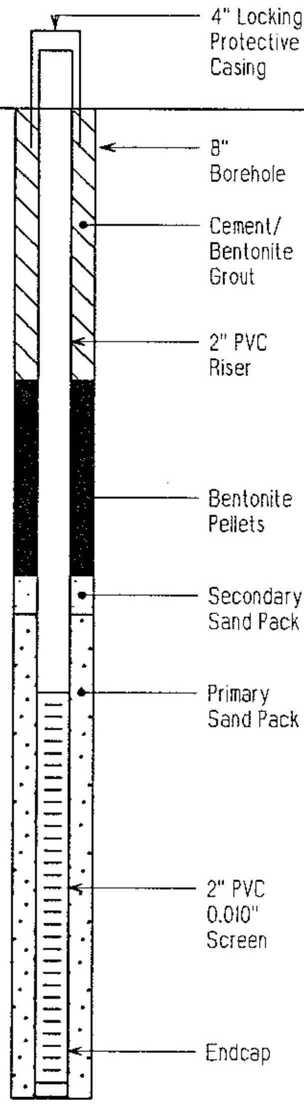
Method: *Surge Block/Bailer*
Duration: *0.5 hours*
Gals. Purged: *27 gallons*
Slug Test: 7.4×10^{-6} (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *166.5*
TWC: *168.9*
TPC: *169.0*
North: *685,004.95*
East: *593,902.75*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	S-1	12-12-15-14	1.1'	SM / CH	0	LACUSTRINE DEPOSITS Brown fm SAND, some Clayey Silt, little (-) f Gravel, dry @ 0.5' brown Silty CLAY, trace f Sand, dense, dry to wet	
5–7	S-2	6-8-10-13	1.6'	CH	0		
10–12	S-3	2-4-5-6	1.9'	CH	0		
12–14	S-4	7-5-7-7	1.4'	CH	0	@ 12.9' grading to gray Silty CLAY, trace f Sand, saturated	
14–16	S-5	2-1-2-3	1.9'	CH	0	@ 14.0' gray CLAY	
16–18	S-6	3-2-3-3	1.7'	CH	0		
18–20	S-7	WOH-1-2-3	1.5'	CH	0		
25						End of Boring at 25.0 feet.	

Depth (feet): 0, 5, 10, 15, 20, 25, 30

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW–12D

Project: *Groundwater Investigation*	Project No.: *9596.03*	Start Date: *05/15/95*	
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*		Finish Date: *05/17/95*	

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush–Threaded*	*Flush–Threaded*

WELL DEVELOPMENT

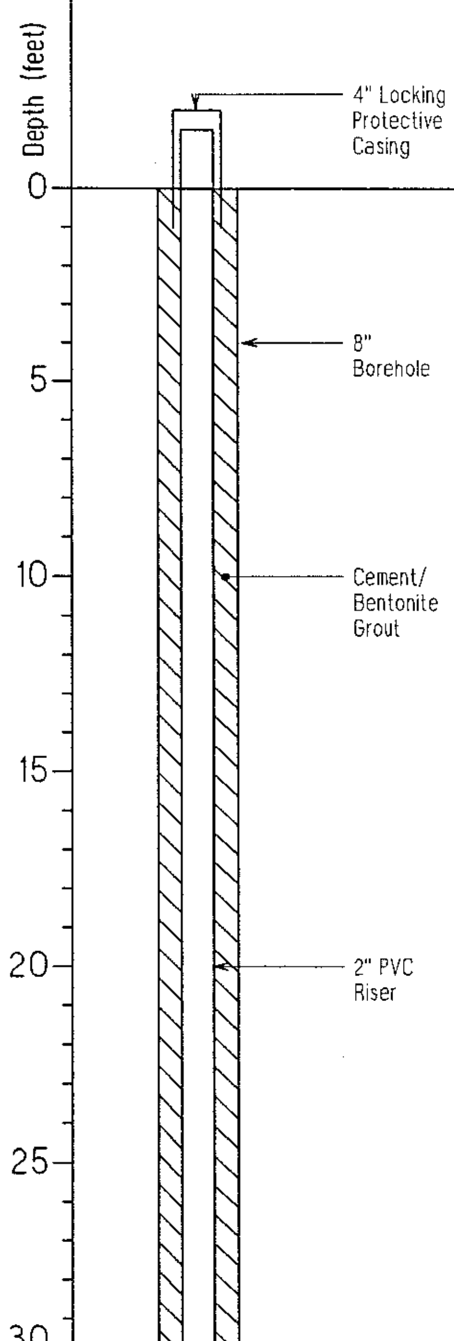
Method: *Surge Block/Bailer/Dual Line Air*
Duration: *4 hours*
Gals. Purged: *285 gallons*
Slug Test: *9.9×10^{-4}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *166.0*
TWC: *168.4*
TPC: *168.6*
North: *685,000.73*
East: *593,908.21*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	12-9-10-8	1.2'	GC / CH	0	FILL (0.5) Gray fm GRAVEL and medium-brown Silty CLAY, dry	
						LACUSTRINE DEPOSITS Medium-brown Silty CLAY, trace f Sand, dry to wet	
5	S-2	4-7-8-8	1.0'	CH	0		
10	S-3	4-5-4-7	0.8'	CH	0	@ 10.0' brown Silty CLAY, little fm Sand, trace f angular Gravel, wet	
15	S-4	3-2-2-2	0.2'	CH	0	@ 15.0' gray Silty CLAY, trace f Sand, wet	
20	S-5	WOR-1-2-1	1.6'	CH	0	@ 20.0' gray CLAY, saturated	
25	S-6	1-1-1-1	2.0'	CH	0		
30							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-12D

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/15/95*
Finish Date: *05/17/95*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30		S-7	1-1-1-1	2.0'	CH	0		
35		S-8	WOR/18"-2	2.0'	CH	0		
	8" Borehole							
40	Cement/Bentonite Grout	S-9	WOH/24"	1.4'	CH	0		
	2" PVC Riser							
45		S-10	WOR/18"-4	2.0'	CH	0	@ 46.5' gray CLAY, trace (-) f Sand	
50		S-11	WOR/12"-WOH-1	1.8'	CH	0		
55		S-12	WOR/12"-2-3	2.0'	CH	0	@ 55.0' gray CLAY	
60		S-13	WOR/18"-3	2.0'	CH	0		
65		S-14	WOR/12"-3-2	2.0'	CH	0	@ 66.8' gray CLAY, trace (-) fm angular Gravel, trace (-) f Sand	
	Bentonite Slurry							
70								

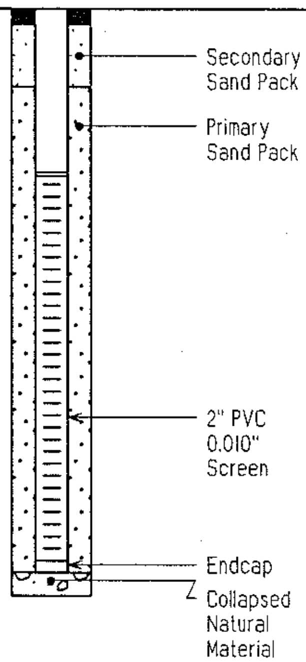
ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-12D**

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/15/95*
Finish Date: *05/17/95*

WELL CONSTRUCTION



(CONTINUATION)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
70	S-15	2-3-3-8	1.3'	GC	0	@ 70.0' gray Silty CLAY, little fm grading to some fmc angular Gravel, trace f Sand	
75	S-16	5-3-4-6	0.5'	GC	0		
80	S-17	18-15-8-12	1.4'	SM / GC	0	@ 80.0' gray cmf SAND, trace Clayey Silt @ 81.0' gray Silty CLAY and mf GRAVEL, some cf Sand	
85	S-18	100/1"	0.1'	GC	0	Bedrock @ 85.1 feet. End of Boring at 85.1 feet.	
90							
95							
100							
105							
110							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-13S

Project: *Groundwater Investigation*	Project No.:	Start Date: *05/31/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	*9596.03*	Finish Date: *05/31/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

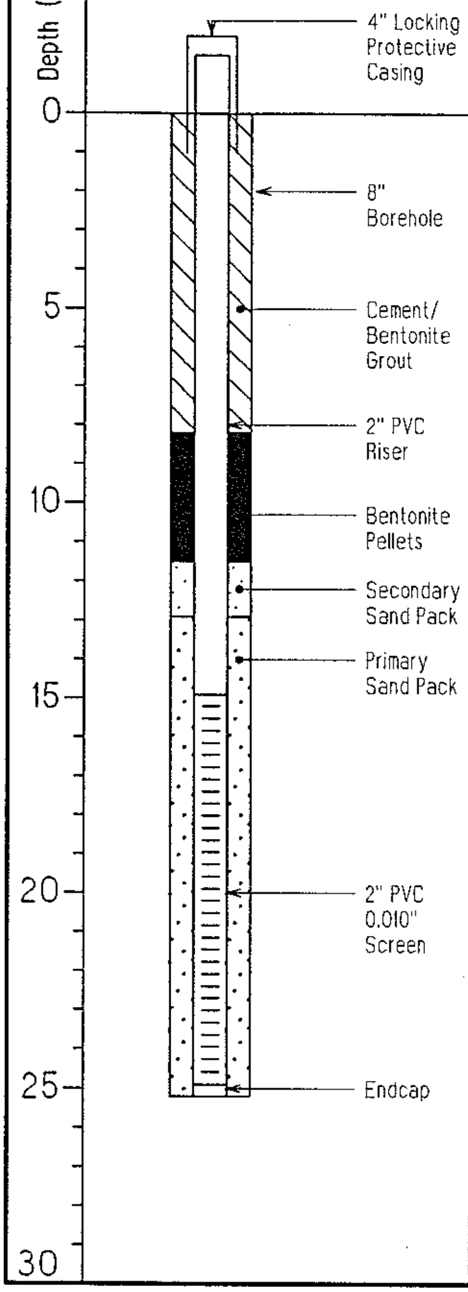
Method: *Surge Block/Bailer*
Duration: *0.75 hours*
Gals. Purged: *33 gallons*
Slug Test: 4.3×10^{-7} (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *160.1*
TWC: *162.5*
TPC: *162.6*
North: *686,130.09*
East: *594,562.13*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0–25.2							*See MW-13D for sample description.*	
25.2							End of Boring @ 25.2 feet.	



ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-13D**

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/26/95*
Finish Date: *05/31/95*

DRILLING DATA

Inspector: *L. Scheuing/D. Gawronski*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	PVC, Sch. 40	PVC, 0.010" Screen
Diameter (ID):	2 inch	2 inch
Coupling:	Flush-Threaded	Flush-Threaded

WELL DEVELOPMENT

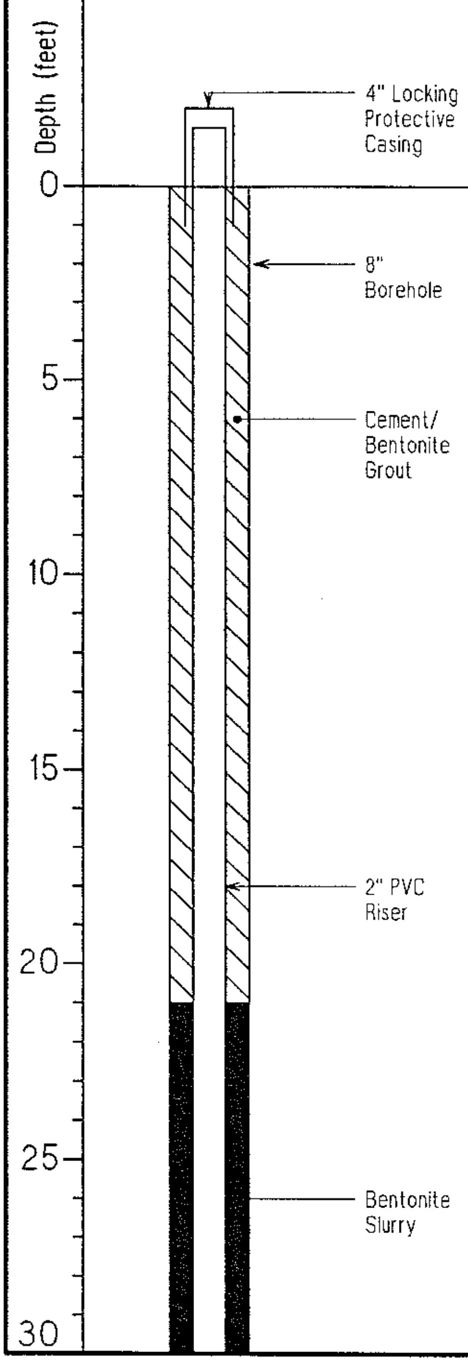
Method: *Surge Block/Dual Line Air*
Duration: *2.6 hours*
Gals. Purged: *205 gallons*
Slug Test: 1.9×10^{-2} (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *160.2*
TWC: *162.4*
TPC: *162.6*
North: *686,123.89*
East: *594,562.05*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



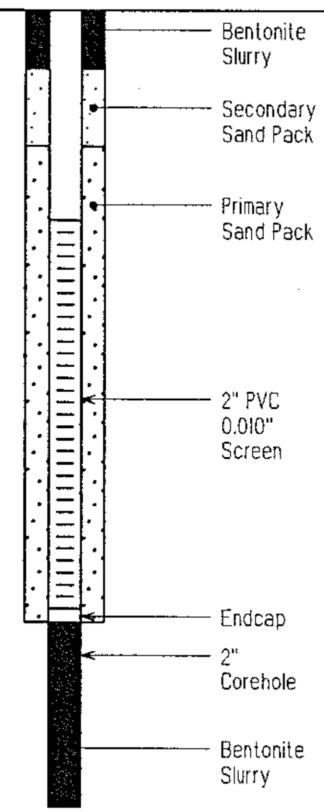
SAMPLE DATA

Depth (ft)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	15-8-6-8	1.1'	SW / CH	0.1	FILL (0.9) Dark gray mf SAND, with cinders, wet. LACUSTRINE DEPOSITS Brown Silty CLAY, trace f Sand, wet to moist	
5	S-2	3-4-5-6	1.6'	CH	0		
10	S-3	3-4-5-6	2.0'	CH	0	@ 10.0' brown Silty CLAY, little f Sand, trace to no f Gravel, moist	
15	S-4	1-2-2-2	1.9'	CH	0	@ 15.3' grading to gray Silty CLAY, trace to little f Sand, saturated	
20	S-5	WOR-1-1-2	2.0'	CH	0		
25	S-6	WOH/18"-2	2.0'	CH	0		

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-13D
Project: *Groundwater Investigation*	Project No.: *9596.03*	Start Date: *05/26/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*		Finish Date: *05/31/95*

(CONTINUATION)

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	WOR/12"-2-1	2.0'	CH	0		
35	S-8	WOH/18"-1	2.0'	CH	0	@ 35.0' gray CLAY, with few f Sand partings	
40	S-9	WOH-4-4-10	0.4'	CH	0	@ 40.0' gray Silty CLAY, little f Sand	
43.5	S-10	100/1"	0.1'	SM	0	@ 43.5' gray f SAND and Clayey SILT, some f Gravel	
43.6						BEDROCK	
45	R-1	NM	0.5'	40%	NM	Gray & black interbedded SHALE, with quartz & calcite mineralization	
	R-2	NM	1.2'	60%	NM		
50	R-3	NM	2.8'	70%	NM		
50.5						End of Boring at 50.5 feet.	

Depth (feet): 30, 35, 40, 45, 50, 55, 60, 65, 70

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-14S**

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/18/95*
Finish Date: *05/25/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	PVC, Sch. 40	PVC, 0.010" Screen
Diameter (ID):	2 inch	2 inch
Coupling:	Flush-Threaded	Flush-Threaded

WELL DEVELOPMENT

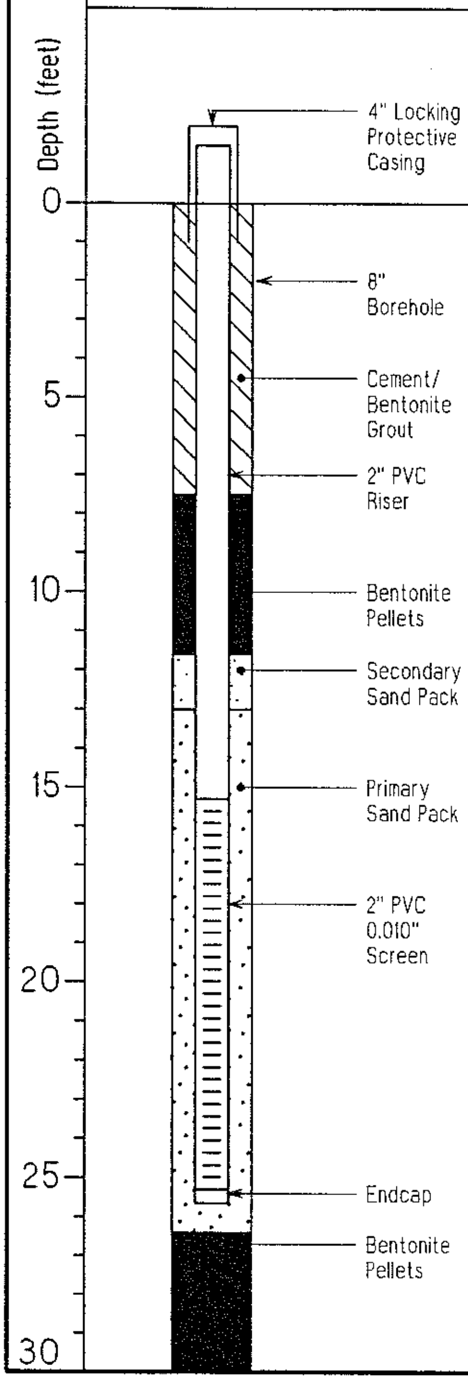
Method: *Surge Block/Bailer*
Duration: *0.75 hours*
Gals. Purged: *27 gallons*
Slug Test: 1.8×10^{-5} (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *173.1*
TWC: *175.6*
TPC: *175.8*
North: *686,268.37*
East: *593,685.26*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
S-1	4-7-8-15	1.3'	CH	0	LACUSTRINE DEPOSITS Brown Silty CLAY, little to no f Gravel, trace (–) mf to f Sand, with roots, dry to moist	
S-2	35-15-10-16	0.9'	CH	0		
S-3	14-7-7-8	1.4'	CH	0		
S-4	5-2-2-2	1.5'	CH	0	@ 15.0' gray Silty CLAY, trace f Sand, saturated	
S-5	1-1-2-3	1.4'	CH	0		
S-6	2-1-0-2	2.0'	CH	0		

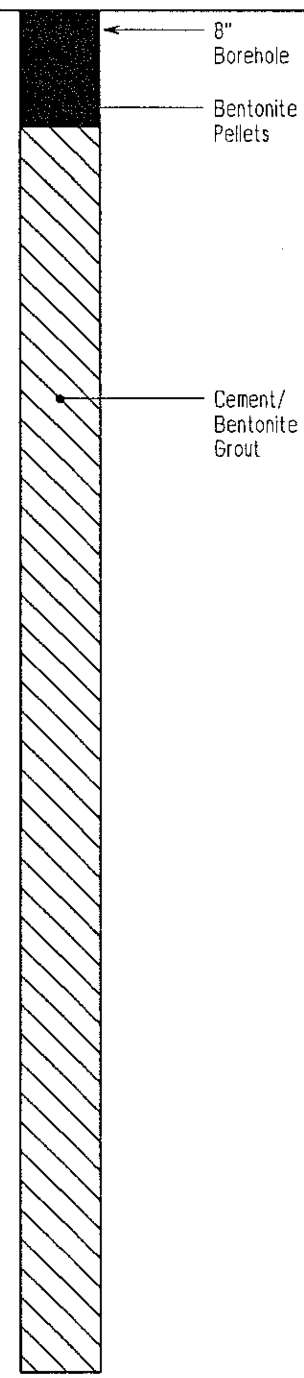
ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-14S**

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/18/95*
Finish Date: *05/25/95*

WELL CONSTRUCTION



(CONTINUATION)

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	WOR-2-1-2	1.5'	CH	0		
35	S-8	3-1-2-2	1.5'	CH	0	@ 35.0' gray Silty CLAY, trace f Gravel @ 36.0' gray CLAY	
40	S-9	WOR/18"-2	2.0'	CH	0	@ 40.6' gray CLAY, trace f Sand	
45	S-10	WOR/24"	1.6'	CH	0		
50	S-11	WOR/18"-1	1.5'	CH	0		
55	S-12	WOR-1-3-4	1.8'	CH	0	@ 55.0' gray CLAY, trace f Sand, trace (-) to no f Gravel	
60	S-13	WOR/18"-3	2.0'	CH	0		
65	S-14	100/0"	NR	NA	NA	Bedrock @ 65.0 feet. End of Boring at 65.0 feet.	
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-14D**

Project: *Groundwater Investigation*	Project No.:	Start Date: *05/18/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	*9596.03*	Finish Date: *05/25/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

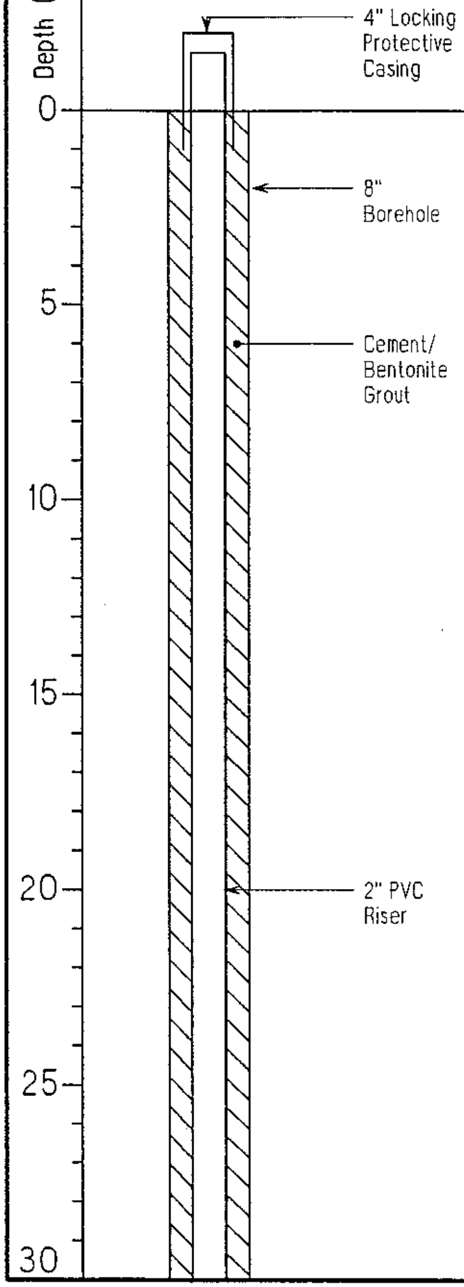
WELL DEVELOPMENT

Method: *Surge Block/Dual Line Air*
Duration: *4 hours*
Gals. Purged: *170 gallons*
Slug Test: *1.4×10^{-3}* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *173.7*
TWC: *176.1*
TPC: *176.4*
North: *686,262.84*
East: *593,680.99*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0–30							*See MW-14S for sample descriptions.*	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-14D**

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

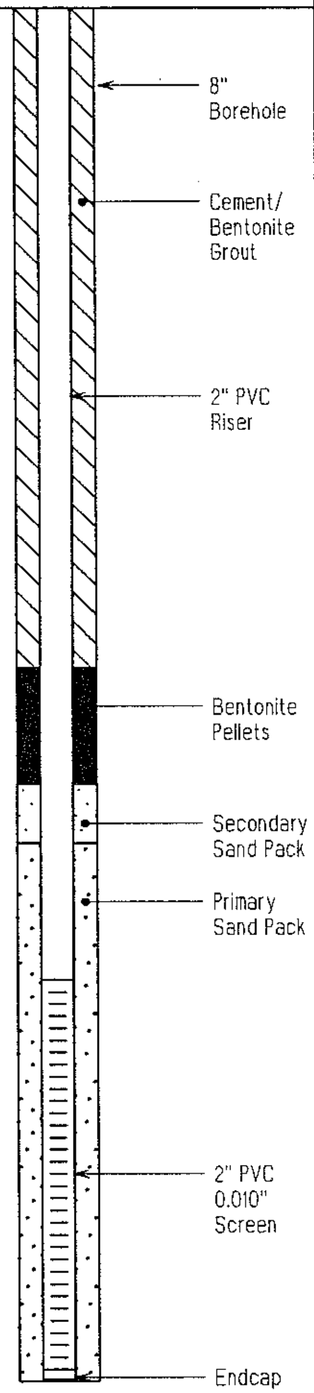
Project No.: *9596.03*

Start Date: *05/18/95*

Finish Date: *05/25/95*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30								
35								
40								
45								
50								
55								
60								
65							End of Boring @ 65.3 feet.	
70								



ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-15S

Project: *Groundwater Investigation*	Project No.:	Start Date: *07/25/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	*9596.03*	Finish Date: *07/25/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

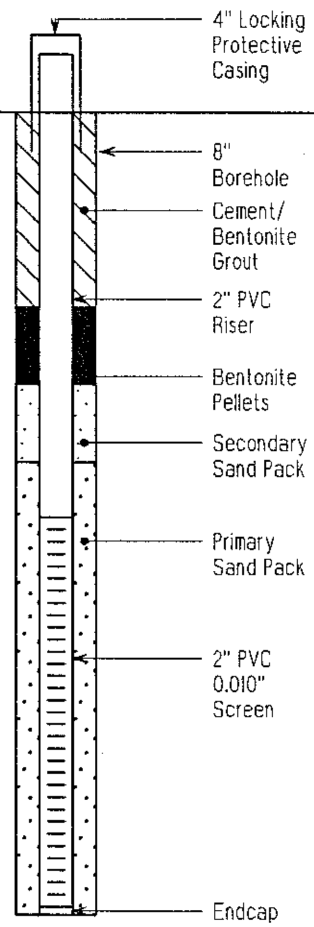
Method: *Surge Block/Bailer*
Duration: *0.5 hours*
Gals. Purged: *20 gallons*
Slug Test: *6.9 x 10^4* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *159.6*
TWC: *162.0*
TPC: *162.2*
North: *687,490.56*
East: *594,477.68*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil / rock	SAMPLE DATA: Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0								*See MW-15D for sample description.*	
20.6								End of Boring @ 20.6 feet.	



Depth (feet): 0, 5, 10, 15, 20, 25, 30

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-15D

Project: *Groundwater Investigation* | Project No.: *9596.03* | Start Date: *07/19/95*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.* | Finish Date: *07/24/95*

DRILLING DATA

Inspector: *Laurie Scheuing*

Contractor: *B. Bosworth/Empire Soils Investigation Inc.*

Equipment: *CME 850*

Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

Method: *Surge Block/Dual Line Air*

Duration: *1.5 hours*

Gals. Purged: *45 gallons*

Slug Test: *1.4 x 10^{-2}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane

Grade: *159.2*

TWC: *162.0*

TPC: *161.6*

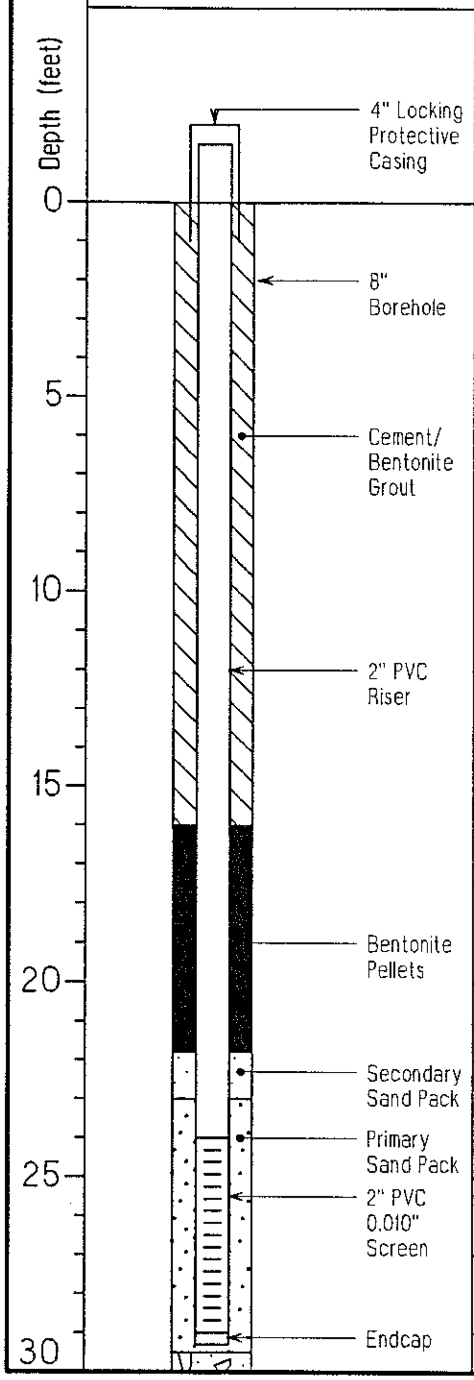
North: *687,485.21*

East: *594,477.51*

Geophysical Log: ☐ yes ☒ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
					LACUSTRINE DEPOSITS	
S-1	2-2-4-4	1.5'	CH	0	Brown Silty CLAY, trace to little f Sand, with roots, dry to wet	
S-2	4-5-6-8	1.6'	CH	0		
S-3	3-3-3-5	1.2'	CH	0		
S-4	1-1-2-1	1.1'	CH	0	@ 15.5' gray Silty CLAY, little f Sand, saturated	
S-5	4-5-7-14	0.2'	GP	0	@ 20.0' gray angular mf GRAVEL, some fmc Sand, no to little Clay & Silt	
S-6	23-29-18-15	0.2'	GP	0		
S-7	84-100/1"	0.1'	GP	0	@ 29.0' gray angular GRAVEL and cmf SAND	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW–15D

Project: *Groundwater Investigation* | Project No.: *9596.03* | Start Date: *07/19/95*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.* | Finish Date: *07/24/95*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	Collapsed Natural Material	S-7	84-100/1"	0.1'	GP	0	Bedrock @ 31.0 feet. End of Boring at 31.0 feet.	
35								
40								
45								
50								
55								
60								
65								
70								

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-16S

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/10/95*
Finish Date: *07/11/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

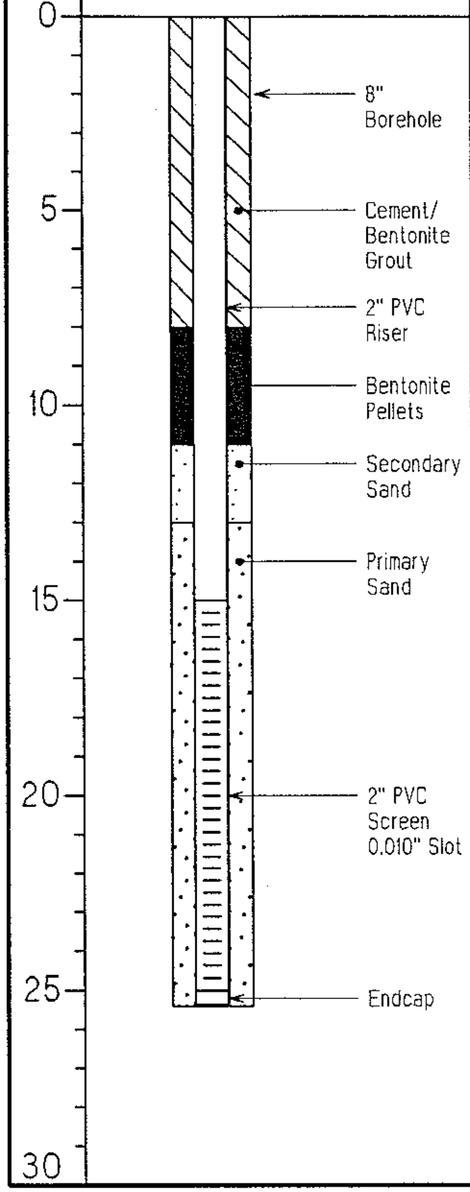
WELL DEVELOPMENT

Method: *Surge Block/Bailer*
Duration: *0.5 hours*
Gals. Purged: *10.5 gallons*
Slug Test: *5.0×10^{-6}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *157.3*
TWC: *159.3*
TPC: *159.5*
North: *686,949.23*
East: *595,108.94*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0							*See MW-16D for sample description.*	
25.4							End of Boring @ 25.4 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW−16D

Project: *Groundwater Investigation*
Project No.: *9596.03*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Start Date: *07/06/95*
Finish Date: *07/11/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush−Threaded*	*Flush−Threaded*

WELL DEVELOPMENT

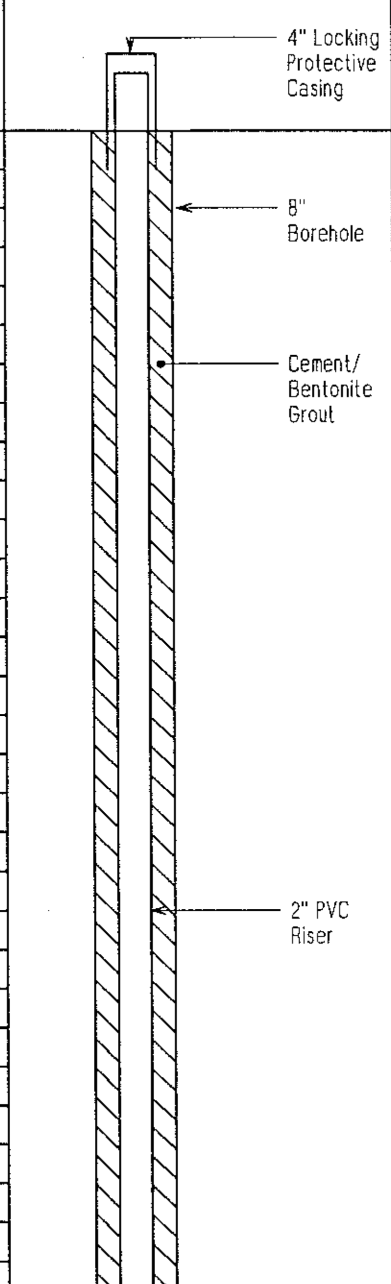
Method: *Surge Block/Dual Line Air/Bailer*
Duration: *2 hours*
Gals. Purged: *48 gallons*
Slug Test: *9.2×10^{-3}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *157.4*
TWC: *159.9*
TPC: *160.1*
North: *686,942.93*
East: *595,107.68*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	3-6-7-9	1.0'	SW / CH	0.2	LACUSTRINE DEPOSITS Black f SAND, with roots, dry @ 0.2' brown, Silty CLAY, trace f Sand, dry to moist	
5	S-2	3-7-5-9	1.6'	CH	0		
10	S-3	7-8-7-7	NR	CH	0		
15	S-4	3-4-4-3	1.1'	CH	0	@ 15.0' gray Silty CLAY, little to trace f Sand, saturated	
20	S-5	2-3-3-3	0.8'	CH	0		
25	S-6	1-3-1-2	2.0'	CH	0		
30							

ECKENFELDER INC.

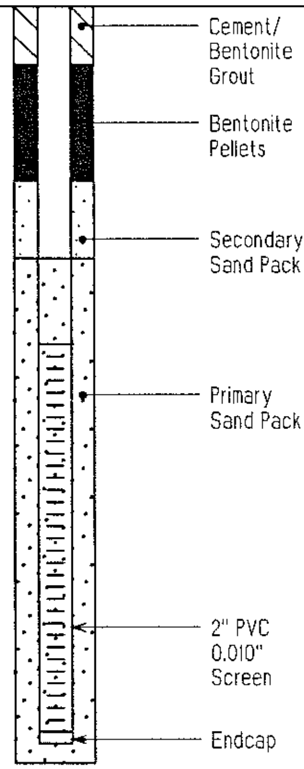
Subsurface Boring Log

Well Name/Location: MW–16D

Project: *Groundwater Investigation*
Project No.: *9596.03*
Start Date: *07/06/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Finish Date: *07/11/95*

(CONTINUATION)

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	1-2-2-2	1.6'	CH	0		
35	S-8	WOR/6"-WOH/18"	2.0'	CH	0		
40	S-9	WOH/24"	2.0'	CH	0	@ 40.0' gray CLAY	
45	S-10	WOR-3-5-8	0.1'	CH	0		
49	S-11	40-100/1"	0.5'	SC	0	@ 49.0' gray fm SAND, some Silty CLAY, with gray Limestone or Shale fragments Bedrock @ 49.5 feet. End of Boring at 49.5 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-17S

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *10/03/95*
Finish Date: *10/03/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *R. Heffernen/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

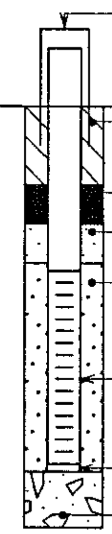
Method: *Surge Block/Bailer*
Duration: *0.75 hours*
Gals. Purged: *20 gallons*
Slug Test: *7.8×10^{-3}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *140.8*
TWC: *143.9*
TPC: *144.0*
North: *686,934.03*
East: *595,603.13*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	S-1	2-3-1-3	1.1'	CL	NM	LACUSTRINE DEPOSITS Brown Clayey SILT, trace f Gravel, with reed fragments, moist @ 0.5' grading to gray CLAY & SILT, moist	
5–7	S-2	19-20-18-18	1.5'	SM	NM	@ 5.0' brown fmc SAND and Clayey SILT, some fm Gravel, wet	
10–10.8	S-3	38-100/3"	0.8'	GP	NM	@ 10.0' gray fmc GRAVEL, little f Sand, saturated Bedrock @ 10.8 feet.	
						End of Boring at 10.8 feet.	

Depth scale (feet): 0, 5, 10, 15, 20, 25, 30

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-18S**

Page 1 of 1

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/18/95*
Finish Date: *07/19/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	PVC, Sch. 40	PVC, 0.010" Screen
Diameter (ID):	2 inch	2 inch
Coupling:	Flush-Threaded	Flush-Threaded

WELL DEVELOPMENT

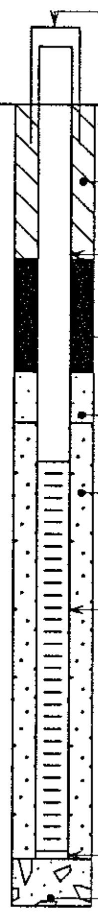
Method: *Surge Block/Dual Line Air*
Duration: *2 hours*
Gals. Purged: *30 gallons*
Slug Test: *8.3 x 10^{-4}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *144.4*
TWC: *146.8*
TPC: *147.0*
North: *686,601.13*
East: *595,237.84*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	S-1	1-1-2-4	1.1'	MH	0	LACUSTRINE DEPOSITS Brown SILT & CLAY, little f Sand, moist	
5–7	S-2	1-10-11-9	1.3'	SM / GP	0	@ 5.0' brown f SAND, some to no Silt & Clay, damp @ 5.6' grading to gray mf GRAVEL and cmf SAND, little Clayey Silt, damp	
10–12	S-3	34-100/1"	0.4'	GP	0		
15–17	S-4	17-63-38-37	1.2'	GP	0	@ 15.0' gray mf GRAVEL and cmf SAND, trace to little Clayey Silt, saturated	
20–20.5	S-5	45-100/0"	0.3'	GP	0	Bedrock @ 20.5 feet. End of Boring at 20.5 feet.	

Depth scale: 0, 5, 10, 15, 20, 25, 30

APPENDIX B

SOIL BORING AND MONITORING WELL LOGS

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: C-4

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *7/2/99*
Finish Date: *7/2/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No. (soil / rock)	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–16	Backfilled w/ Cement Grout	1	5-11-12-11				MF Sandy Silt	
		2	10-11-20-12				MF Brown Sandy Silt (-clay) damp	
5		3	5-6-7-10				F Sandy Silt (+clay), damp	
		4	10-11-12-10				Brown to gray Silty Clay to Clayey Silt, Damp	
		5	4-5-8-7				Gray Silty Clay, damp	
10		6	2-4-5-6					Boring backfilled w/ Grout.
		7	3-5-6-9				Gray Silty Clay, Pebbles, F SAND, saturated	
15		8	10-12-14-12				Brown F SAND, saturated	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: C-5

Project: *Vertical Delineation* — Project No.: *60192.001* — Start Date: *7/2/99*
Client: *Dyno-Nobel* — Finish Date: *7/2/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0	Backfilled w/ Cement Grout (0–16')	1	8-10-5-6				MF Gravel, Sand and Silt	
		2	7-7-11-10				MF Brown Clayey Silt to Silt	
5		3	3-5-8-10				Brown F Silt (-sand), damp	
		4	10-10-12-10				Brown F Clayey Silt, moist, mottled	
		5	2-4-6-6					
10		6	1-3-5-6				Red Brown to gray, F Silty Clay to Clay, mottled	Boring backfilled w/ Grout.
		7	5-8-8-5				Gray Silty Clay, saturated	
15		8	5-5-5-5					
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 1–1

Project: *Vertical Delineation*	Project No.:	Start Date: *7/26/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/26/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Tripod/Barge*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments: *Detonation Pond*

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	Boring collapse (0–4)	1	1-1-1-1				Gray ClAY, w/ Live Detonators, wire, ash	Live Detonator, wire, ash
2–4		2	1-1-1-1					
4							End of Boring @ 4'	
5								
10								
15								
20								
25								
30								

(soil / rock)

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 1–2

Project: *Vertical Delineation*	Project No.:	Start Date: *7/27/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/27/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Tripod/Barge*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA*
(cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments: *Detonation Pond*

Depth (feet)	WELL CONSTRUCTION	Samp. No. (soil) / Run No. (rock)	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	Boring collapse	1	1-1-1-1				Gray ClAY, 4 Live Detonators, wire, ash	Live Detonator, wire, ash
2–4		2	1-1-1-1					
4							End of Boring @ 4'	
5–10								Boring was Canceled by Dyno-Nobel due to the presence of Live Detonators in split-spoon, deemed IDLH..
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 1-5

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *7/26/99*
Finish Date: *7/26/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *550 ATV Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split-Spoon	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA DATUM: NA

Grade: NA
TWC: NA
TPC: NA
North: NA
East: NA

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	Backfilled w/ Cement Grout	1	1-3-5-5				Gray ClAY, w/ plant material	
2–4		2	1-3-5-7				Gray/Red Brown Silty Clay to Clayey Silt	Dead plants/root material create 3' gap above soil, samples were collected where soil began
4–6		3	5-7-8-9				Red Brown F Silty Clay to Clayey Silt, Varved & Mottled	
6–8		4	4-5-5-7				Red Brown to Gray CLAY, (+) Clayey Silt (-) Silty Clay, Saturated	
8–10		5	1-2-3-4				Gray CLAY, Plastic, saturated	
10–12		6	5-3-3-2					
12–14		7	1-1-2-2					Boring backfilled w/ Grout.
14–16		8	1-2-2-3					
16							End of Boring @ 16'	
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 1-7

Project: *Vertical Delineation* Project No.: *60192.001*

Client: *Dyno-Nobel*

Start Date: *7/26/99*

Finish Date: *7/26/99*

DRILLING DATA

Inspector: *Marc Conger*

Contractor: *Maxim Technologies*

Equipment: *550 ATV Auger Rig*

Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*

Duration: *NA*

Gals. Purged: *NA*

Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*

TWC: *NA*

TPC: *NA*

North: *NA*

East: *NA*

Geophysical Log: ☐ yes ☒ no

Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	1-1-1-1				Gray ClAY, w/ wire, plant material	
		2	2-2-4-4				Gray/Blue CLAY to Clayey Silt	Dead plants/root material create 3' gap above soil, samples were collected where soil began
5	Boring Collapse	3	5-10-12-10					
		4	6-4-3-4				Gray CLAY, Plastic, saturated	
		5	2-12-100/.4				End of Boring @ 9'	
10								Boring collapse.
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 2-01

Project: *Vertical Delineation* — Project No.: *60192.001*
Client: *Dyno-Nobel*
Start Date: *7/12/99*
Finish Date: *7/12/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION / SAMPLE DATA (soil / rock)

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0–2		1	8-18-16-18				Debris, Brown MF Sandy Silt to Silty Sand	
2–4		2	6-12-8-14				Fill, Asphault material @ 4'	
4–6	Backfilled w/ Cement Grout	3	3-2-1-1				Fill, Wood, Brick, Concrete, Orange MF Sand, damp	Boring backfilled w/ Grout. Refusal @ 12.6'
6–8		4	2-3-4-5					
8–10		5	5-6-9-10					
10–12		6	12-16-17-12					
12–12.6	Split Spoon Refusal @ 12.6'		12-100/.4				Split Spoon Refusal @ 12.6 End of Boring @ 12.6	

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 2-7 Page 1 of 1
Project: *Vertical Delineation* Client: *Dyno-Nobel*	Project No.: *60192.001*	Start Date: *7/14/99* Finish Date: *7/14/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2		1	2-18-20-35				Debri, fill, rock, wood, ash, wire (green Cu Stains)	
2–4		2	35-12-10-9					
4–6	Backfilled w/ Cement Grout	3	0-12-30-80				Orange F Silty Sand w/ pebbles	Boring backfilled w/ Grout.
6–8	Split Spoon Refusal @ 6.9	4	30-100/.4				Split Spoon Refusal @ 6.9 End of Boring @ 6.9	Refusal @ 6.9'

Depth scale: 0, 5, 10, 15, 20, 25, 30

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 2-18

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *7/13/99*
Finish Date: *7/13/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split-Spoon	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0		1	4-6-7-9				LT Brown F Clayey Silt to Silt	
		2	8-19-20-20				Red Brown F Clayey Silt to Silt	
5		3	4-7-9-11					
		4	13-13-15-16				Red Brown MF Silty Clay to Clayey Silt, damp, varved, mottled	
	Backfilled w/ Cement Grout	5	4-6-7-9					
10		6	2-4-4-6					Boring backfilled w/ Grout.
		7	5-5-3-4				Dark gray CLAY, platic, moist	
15		8	2-3-4-4					
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 3-2

Project: *Vertical Delineation* — Project No.: *60192.001*
Client: *Dyno-Nobel*
Start Date: *7/14/99*
Finish Date: *7/14/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	7-11-4-4				Debris fill, rock, slag, ash, wire, Sand & Silt	
		2	4-5-10-6					
5	BackfiIled w/ Cement Grout	3	2-4-8-12				Orange MF Silty Sand, mottled	Boring backfilled w/ Grout.
		4	8-10-10-35					
	Split Spoon Refusal @ 8.1'		100/.3				Split Spoon Refusal @ 8.1 End of Boring @ 8.1'	Refusal @ 8.1'
10								
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 3-8

Project: *Vertical Delineation* | Project No.: *60192.001* | Start Date: *7/14/99*

Client: *Dyno-Nobel* | Finish Date: *7/14/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0–2		1	7-5-4-3				Debris fill, rock, wood, ash, wire, Sand & Silt	
2–4		2	1-2-2-1					
4–6	Backfilled w/ Cement Grout	3	1-1-1-1				Pink Ash, Clay, wires, Sand & Silt	Boring backfilled w/ Grout.
6–8		4	7-9-13-12				F Orange SAND	
8–10		5	9-14-14-22				Orange Pebbly Conglmerate, MF SAND	
10–10.7	Split Spoon Refusal @ 10.7		45-100/.2				Split Spoon Refusal @ 10.7 End of Boring @ 10.7	Refusal @ 10.7'

Depth scale: 0, 5, 10, 15, 20, 25, 30

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 4-5

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *7/12/99*
Finish Date: *7/12/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split-Spoon	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA

DATUM: NA
Grade: NA
TWC: NA
TPC: NA
North: NA
East: NA

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	16-19-14-13				Orange to brown MF Silty Sand	
		2	24-40-30-40					
5	Backfilled w/ Cement Grout	3	45-60-60-40					Boring backfilled w/ Grout.
	Split Spoon Refusal @ 7.6'	4	20-10-100/.3				Split Spoon Refusal @ 7.6 End of Boring @ 7.6	Refusal @ 7.6'
10								
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 4-8

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *7/13/99*
Finish Date: *7/13/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split-Spoon	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA DATUM: NA

Grade: NA
TWC: NA
TPC: NA
North: NA
East: NA

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0		1	1-5-2-1				LT Brown F SILT, roots, top soil	
		2	3-5-10-20				LT Brown F Clayey Silt to Silt	
5		3	8-12-15-16					
	Backfilled w/ Cement Grout	4	36-34-36-27				Red Brown MF Silty Clay to Clayey Silt, damp, varved, mottled	
		5	5-6-9-10					
10		6	3-6-6-7					Boring backfilled w/ Grout.
		7	10-10-9-8					
15		8	5-6-6-5				Dark gray CLAY, platic, moist	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 9-7 Page 1 of 0
Project: *Vertical Delineation*	Project No.:	Start Date: *7/12/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/12/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	11-8-8-8				Top Soil, mf brown Silty Clay, loose, dry	
		2	12-12-15-17				Gravel, MF Sand to F Silty Clay, dry	
5		3	6-7-10-13				Red, F Silty Sand and Sandy Silt, to Silty Clay	
	Backfilled w/ Cement Grout	4	20-15-19-15				CMF Silty Clay and Gravel	
10		5	2-4-7-11				CMF SAND to brown Silty Clay, moist	
		6	2-2-3-3					Boring backfilled w/ Grout.
		7	3-7-4-5				Dark gray F CLAY w/ Sand & Gravel	
15		8	2-2-2-2				Gray Clay, w/ trace Silt, some Sand (+) Gravel	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 6-2

Project: *Vertical Delineation*	Project No.:	Start Date: *7/14/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/14/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	Refusal @ 1.6'	1	4-20-100/.4					Refusal @ 1.6'
5								
10								
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 6-7

Project: *Vertical Delineation*	Project No.:	Start Date: *7/15/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/15/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No. (soil / rock)	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	Refusal @ 1'							Refusal @ 1'
5								
10								
15								
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 6-10 Page 1 of 0
Project: *Vertical Delineation* Client: *Dyno-Nobel*	Project No.: *60192.001*	Start Date: *7/14/99* Finish Date: *7/14/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	3-3-5-4				Ash, Rock Debris, Caps, wire, Sulfer odor	
			3-4-20-100/.1				Ash, Bedrock	
4.0	Refusal @ 4.0'							Refusal @ 4.0'
5								
10								
15								
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 6-19 Page 1 of 1
Project: *Vertical Delineation*	Project No.:	Start Date: *7/15/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/15/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	4-18-5-6				brown Silty Sand w/slag material	
	BackFilled w/ Cement Grout	2	4-6-7-11					Boring backfilled w/ Grout.
5	Split Spoon Refusal @ 5'	3	20-100/.4				Split Spoon Refusal @ 5' End of Boring @ 5'	Refusal @ 5'
10								
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 6-25

Project: *Vertical Delineation*	Project No.: *60192.001*	Start Date: *7/14/99*
Client: *Dyno-Nobel*		Finish Date: *7/14/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil / rock: Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	Refusal @ 2.3'	1	12-13-9-9					
			20-100/.4					Refusal @ 2.3'
5								
10								
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 6-30

Project: *Vertical Delineation* Project No.: *60192.001*
Client: *Dyno-Nobel*
Start Date: *7/15/99*
Finish Date: *7/15/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	Refusal @ 1'							Refusal @ 1'
5								
10								
15								
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 6-32

Project: *Vertical Delineation*	Project No.:	Start Date: *7/16/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/16/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

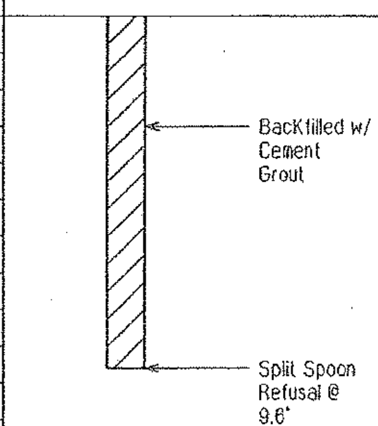
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	1	4-9-11-13				Brown/Orange MF SAND (+) Silt	
2–4	2	10-10-34-39					Boring backfilled w/ Grout.
4–6	3	16-18-16-19					
6–8	4	23-32-46-53				Brown w/ Black Ash/Peat, F SILT (+) Sand	
8–10		65-88-100/.2				Split Spoon Refusal @ 9.6' End of Boring @ 9.6'	Refusal @ 9.6

Depth scale: 0, 5, 10, 15, 20, 25, 30

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 6-36

Project: *Vertical Delineation*	Project No.:	Start Date: *7/19/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/19/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA
DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD %	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2		1	4-6-16-16				Dark Brown SILT (+) Sand, roots	
2–4	Backfilled w/ Cement Grout	2	6-18-28-28				Brown MF Sandy Silt, damp	Boring backfilled w/ Grout.
4–6		3	10-12-18-28					
6–8	Split Spoon Refusal @ 7'		24-100/.4				Split Spoon Refusal @ 7' End of Boring @ 7'	Refusal @ 7.0'
10								
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 10-04

Project: *Vertical Delineation* | Project No.: *60192.001* | Start Date: *7/9/99*
Client: *Dyno-Nobel* | Finish Date: *7/9/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION / SAMPLE DATA (soil / rock)

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0	Backfilled w/ Cement Grout (0–16 ft)	1	5-6-11-14				Top Soil, grass, roots, loose F SILT, dry	
		2	14-19-15-17				F Red to Brown Silty Clay to Clayey Silt, varved	
5		3	5-7-10-11				F Brown to Gray CLSY and Silt, moist	
		4	6-12-16-16				(3") MF FLowing Sand, MF Silty Sand, saturated	
		5	4-4-6-6				Red Brown F Silty Clay, varved	
10		6	4-4-2-5				Red Brown CLAY, varved, mottled, damp	Boring backfilled w/ Grout.
		7	4-5-5-4					
15		8	5-4-4-4				Dark gray CLAY, platic, moist	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 10-06

Project: *Vertical Delineation* — Project No.: *60192.001* — Start Date: *7/8/99*

Client: *Dyno-Nobel* — Finish Date: *7/8/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0	Backfilled w/ Cement Grout (0–16 ft)	1	1-6-8-9				Top Soil, grass, roots, loose F SILT, dry	
		2	9-10-11-12				F Gray to Brown Silty Clay to Clayey Silt	
5		3	4-6-8-10				F Brown to Gray CLSY and Silt, moist	
		4	8-12-12-12				F Silty Clay and Silty Sand, varved, moist	
		5	4-6-7-8				Red Brown F Silty Clay	
10		6	2-3-4-4				Red Brown CLAY, varved, mottled, damp	Boring backfilled w/ Grout.
		7	4-4-4-4					
15		8	3-3-4-4				Dark gray CLAY, platic, moist	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 10-19

Project: *Vertical Delineation*	Project No.:	Start Date: *7/8/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/8/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

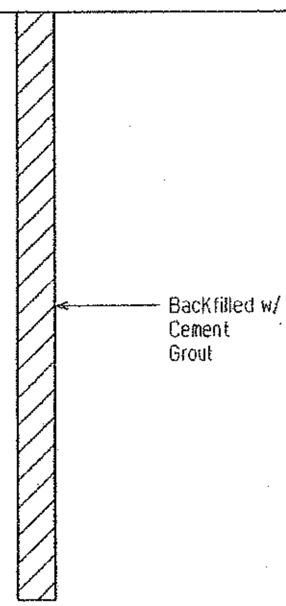
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	1	5-6-11-14				Top Soil, grass, roots, loose F SILT, dry	
	2	0-19-20-20				F Gray to Brown Silty Clay to Clayey Silt	
5	3	7-7-9-11				F Brown to Gray CLSY and Silt, moist	
	4	8-12-12-18				F Silty Clay and Silty Sand, varved, moist	
	5	5-7-10-9				Red Brown F Silty Clay	
10	6	3-4-4-5				Red Brown CLAY, varved, mottled, damp	Boring backfilled w/ Grout.
	7	5-7-6-5					
15	8	4-4-4-4				Dark gray CLAY, platic, slight fuel odor, moist	
						End of Boring @ 16'	
20							
25							
30							

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 11-03

Project: *Vertical Delineation*	Project No.: *60192.001*	Start Date: *7/12/99*
Client: *Dyno-Nobel*		Finish Date: *7/12/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

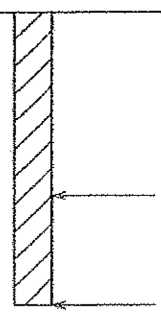
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION / soil / rock / **SAMPLE DATA**



Backfilled w/ Cement Grout

Split Spoon Refusal @ 8'

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	1	4-35-55-11				Orange to brown CMF Sand, Silt, and F Gravel	
2–4	2	5-14-30-25					
4–6	3	20-12-19-18				F Brown to Gray CLAY and Silt	Boring backfilled w/ Grout. Refusal @ 8'
6–8	4	3-19-27-32					
8–10		100/.2				Split Spoon Refusal @ 8' End of Boring @ 8'	

Depth scale: 0, 5, 10, 15, 20, 25, 30

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 13-09

Project: *Vertical Delineation* | Project No.: *60192.001* | Start Date: *6/29/99*
Client: *Dyno-Nobel* | Finish Date: *6/29/99*

DRILLING DATA	
Inspector:	*Marc Conger*
Contractor:	*Maxim Technologies*
Equipment:	*Acker Auger Rig*
Method:	*Direct Push*

SAMPLING METHODS	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA
Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0–1	Backfilled w/ Cement Grout (0–16')	1	12-8-9-10				light brown Clayey Silt and top soil, dry	
2–3		2	12-8-12-10				brown to gray Clayey Silt, varved	
4–5		3	5-28-23-18				dark brown SILT to Clayey Silt, moist	
6–7		4	18-17-19-20				Gray to Brown Clayey Silt to Silty Clay, varved, moist	
8–9		5	4-8-7-10					
10–11		6	7-6-10-8				red to brown CLAY to Silty Clay, mottled, varved	Boring backfilled w/ Grout.
12–13		7	4-5-7-7				Brown to gray plastic CLAY, varved, moist	
14–15		8	7-12-14-8				Dark gray CLAY, platic, wet	
16							End of Boring @ 16'	

Depth scale: 0, 5, 10, 15, 20, 25, 30

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 13–10

Project: *Vertical Delineation*	Project No.:	Start Date: *6/29/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *6/29/99*

DRILLING DATA	SAMPLING METHODS			
		Sampler	Tube	Core
Inspector: *Marc Conger*	Type:	*Split-Spoon*	*NA*	*NA*
Contractor: *Maxim Technologies*	Diameter:	*2"*	*NA*	*NA*
Equipment: *Acker Auger Rig*	Other:	*NA*	*NA*	*NA*
Method: *Direct Push*				

WELL CONSTRUCTION	Riser	Screen	WELL DEVELOPMENT	SURVEY DATA DATUM: NA
Material:	*NA*	*NA*	Method: *NA*	Grade: *NA*
Diameter (ID):	*NA*	*NA*	Duration: *NA*	TWC: *NA*
Coupling:	*NA*	*NA*	Gals. Purged: *NA*	TPC: *NA*
			Slug Test: *NA* (cm/sec)	North: *NA*
				East: *NA*

Geophysical Log: ☐ yes ☒ no

Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	Backfilled w/ Cement Grout (0–16')	1	5-8-8-8				light brown Clayey Silt and top soil, dry	
		2	25-28-18-12				brown to gray Clayey Silt	
5		3	8-9-11-12				dark brown SILT to Clayey Silt, moist	
		4	11-18-14-12				red, brown to gray Silty Clay, varved, moist	
		5	4-4-8-10					
10		6	9-20-18-14				red to brown CLAY to Silty Clay, mottled, varved	Boring backfilled w/ Grout.
		7	3-4-7-8				brown to gray plastic CLAY, varved, moist	
15		8	7-8-7-8					
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 13–19

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *6/30/99*
Finish Date: *6/30/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split-Spoon	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA DATUM: NA

Grade: NA
TWC: NA
TPC: NA
North: NA
East: NA

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0–16	Backfilled w/ Cement Grout	1	3-4-9-11				loose, mf SILT to Silty Clay, dry	
		2	8-10-14-13				F Clayey Silt to Silty Clay, damp	
		3	5-8-15-14				F Clayey Silt w/ Silty Clay, varved	
		4	6-14-20-22				Brown to Gray CLAY, varved, moist	
		5	5-6-8-11				F Gray to Brown Clay (-silt) damp, varved	
		6	8-10-10-10				Gray CLAY, moist, varved	Boring backfilled w/ Grout.
		7	10-8-9-15				Gray plastic CLAY, varved, moist	
		8	2-2-5-4					
16							End of Boring @ 16'	

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 21-01

Project: *Vertical Delineation*	Project No.:	Start Date: *7/1/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/1/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No. (soil / rock)	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	Backfilled w/ Cement Grout (0–16)	1	4-10-7-5				Light Brown, MF Clayey Silt, dry	
2–4		2	2-3-4-6				F Brown Silty Clay, ReDox staining	
4–6		3	5-6-7-11				Red to brown Clayey Silt with thin gray CLAY layers, moist	
6–8		4	11-12-19-15					
8–10		5	4-6-10-12				Red to Brown, gray Silty Clay, mottled, varved	
10–12		6	2-3-5-4					Boring backfilled w/ Grout.
12–14		7	12-13-12-11				Red to gray CLAY, moist mottled, varved, saturated	
14–16		8	2-2-2-2				Dark Gray CLAY, platic, no structure, saturated	
16							End of Boring @ 16'	

Depth scale: 0, 5, 10, 15, 20, 25, 30

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 21-10

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *7/1/99*
Finish Date: *7/1/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION — Backfilled w/ Cement Grout (0–16 ft)

SAMPLE DATA (soil / rock)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–2	1	3-4-4-7				Light Brown, MF Clayey Silt, dry	
2–4	2	7-7-10-11				F Brown Silty Clay, ReDox staining	
4–6	3	4-6-10-11				Red to brown Clayey Silt with thin gray CLAY layers, moist	
6–8	4	12-14-16-18					
8–10	5	9-9-13-13				Red to Brown, gray Silty Clay, mottled, varved	Boring backfilled w/ Grout.
10–12	6	3-8-12-12					
12–14	7	10-11-10-7				Red to gray CLAY, moist mottled, varved, saturated	
14–16	8	1-2-1-3				Dark Gray CLAY, platic, no structure, saturated	
16						End of Boring @ 16'	

Depth scale: 0, 5, 10, 15, 20, 25, 30

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 21-16 Page 1 of 0

Project: *Vertical Delineation*	Project No.:	Start Date: *7/1/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/1/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. (soil) / Run No. (rock)	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	Backfilled w/ Cement Grout (0–16 ft)	1	2-7-8-10				Light Brown, MF Clayey Silt, dry	
		2	5-10-15-12				F Brown Clayey Silt, loose	
5		3	6-10-16-19				Red to brown Clayey Silt with thin gray CLAY layers, moist	
		4	17-17-19-16					
		5	3-6-8-9				Red to Brown, gray Silty Clay, mottled, varved	
10		6	2-3-5-4					Boring backfilled w/ Grout.
		7	3-4-4-4				Red to gray CLAY, moist mottled, varved, saturated	
15		8	1-1-1-1				Dark Gray CLAY, platic, no structure, saturated	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 22-14

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *7/23/99*
Finish Date: *7/23/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *550 ATV Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–1		1	1-1-1-1				Plant Material, wire, metal, Red Brown Silty Clay	Dead plants/root material create 2' gap above soil, samples were collected where soil began
2–3	Backfilled w/ Cement Grout	2	1-1-2-1				Red Brown Silty Clay	
4–5		3	H-1-H-1				Gray to Red Brown Silty Clay (+) Clay	H= Wiehgt of Hammer (140lbs), no blows
6–7		4	1-2-3-4				Gray CLAY, Plastic, saturated	
8–9		5	1-2-2-4					Boring backfilled w/ Grout.
10–11		6	3-7-4-17					
12–13.5	Split Spoon refusal @ 13.5'	7	17-100/.4				End of Boring @ 13.5'	

Depth scale: 0, 5, 10, 15, 20, 25, 30

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 22-18

Project: *Vertical Delineation*
Project No.: *60192.001*
Client: *Dyno-Nobel*
Start Date: *7/20/99*
Finish Date: *7/20/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *550 ATV Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split-Spoon	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA DATUM: NA

Grade: NA
TWC: NA
TPC: NA
North: NA
East: NA

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0–2	Backfilled w/ Cement Grout (0–16')	1	3-4-5-6				Red/Gray MF Sandy Silt to Silty Clay	
2–4		2	5-5-5-5				Gray/Brown Silty Clay	
4–6		3	2-3-3-4				Gray/Brown Clayey Silt	Dead plants/root material create 4' gap above soil, samples were collected where soil began
6–8		4	1-1-4-2				Gray/Black (salt & pepper) F SAND (+) Silt	
8–10		5	3-2-2-2				Gray Clay, Plastic	
10–12		6	1-1-1-1					
12–14		7	3-7-10-12				Layered F Gravel (clean) w/ F SAND, Gray to Black	Boring backfilled w/ Grout.
14–16		8	22-22-20-24				F Gravel, F SAND (+) Silt (−) Clay, saturated	
16							End of Boring @ 16'	

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 22-21 Page 1 of 0
Project: *Vertical Delineation* Client: *Dyno-Nobel*	Project No.: *60192.001*	Start Date: *7/19/99* Finish Date: *7/19/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *550 ATV Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0–16	Backfilled w/ Cement Grout							
~1		1	1-2-3-5				Gray ClAY, w/ plant material (Diesel Odor)	
~3		2	5-15-12-7				Gray CLAY to brown Silty Clay	
5		3	4-6-4-3					Dead plants/root material create 4' gap above soil, samples were collected where soil began
		4	1-2-1-1					
		5	1-1-1-1					
10		6	1-1-1-2					
		7	7-8-5-4				Layered F Gravel (clean) w/ F SAND, Gray to Black	Boring backfilled w/ Grout.
15		8	5-4-4-4				F Gravel, F SAND (+) Silt (-) Clay, saturated	
16							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 22-26

Project: *Vertical Delineation* | Project No.: *60192.001* | Start Date: *7/20/99*
Client: *Dyno-Nobel* | | Finish Date: *7/20/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *550 ATV Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	2-3-5-7				Red/Gray/brown MF Silty Clay, (diesel odor)	
		2	6-5-5-5				Gray/Brown Silty Sand to Silty Clay	Dead plants/root material create 4' gap above soil, samples were collected where soil began
5		3	3-2-1-1					
	Backfilled w/ Cement Grout	4	2-5-10-7					
		5	6-7-13-7				Layered F Gravel (clean) w/ F SAND, Gray to Black	
10	Split Spoon refusal @ 10.6'	6	20-100/.3				End of Boring @ 10.6'	Boring backfilled w/ Grout.
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 22-2~~0~~8

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *7/22/99*
Finish Date: *7/22/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *550 ATV Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA*
(cm/sec)

SURVEY DATA
DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION / SAMPLE DATA

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	2-4-7-3				Blue/Gray Silty Clay to Clay, mottled	
		2	2-2-7-12					
5		3	2-7-12-7				Gray Silty Clay to Clayey Silt	Dead plants/root material create 4' gap above soil, samples were collected where soil began
		4	3-5-5-6					
	Backfilled w/ Cement Grout	5	13-22-45-100	.3				Boring backfilled w/ Grout.
10	Split Spoon refusal @ 10'						End of Boring @ 10'	
15								
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 22-30

Project: *Vertical Delineation*	Project No.:	Start Date: *7/23/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/23/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim-Technologies*
Equipment: *550 ATV Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	1-1-3-4				Gray/Blue Gray, CLAY to Silty Clay, Roots	
		2	2-4-3-3					
5		3	1-2-7-8				Gray CLAY, Mottles, plastic	Dead plants/root material create 4' gap above soil, samples were collected where soil began
		4	4-9-7-9				Gray F Silty Clay to Clayey Silt	
	Backfilled w/ Cement Grout	5	1-1-1-2				Gray Clay, Mottled, Plastic	
10		6	1-1-1-1					
		7	1-1-1-1					Boring backfilled w/ Grout.
15		8	1-3-8-7					
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 22-32 Page 1 of 1
Project: *Vertical Delineation*	Project No.:	Start Date: *7/23/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/23/99*

DRILLING DATA		SAMPLING METHODS		
		Sampler	Tube	Core
Inspector: *Marc Conger*	Type:	*Split-Spoon*	*NA*	*NA*
Contractor: *Maxim Technologies*	Diameter:	*2"*	*NA*	*NA*
Equipment: *550 ATV Auger Rig*	Other:	*NA*	*NA*	*NA*
Method: *Direct Push*				

WELL CONSTRUCTION	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT	SURVEY DATA DATUM: NA
Method: *NA*	Grade: *NA*
Duration: *NA*	TWC: *NA*
Gals. Purged: *NA*	TPC: *NA*
Slug Test: *NA* (cm/sec)	North: *NA*
	East: *NA*

Geophysical Log: ☐ yes ☒ no

Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	Backfilled w/ Cement Grout	1	1-1-2-4				Gray/Brown CLAY to Silty Clay, Mottled	
		2	9-5-5-6					Dead plants/root material create 2' gap above soil, samples were collected where soil began
5		3	2-100/.2				End of Boring @ 16'	Boring backfilled w/ Grout.
10								
15								
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 26D-4 Page 1 of 0

Project: *Vertical Delineation* Project No.: *60192.001*
Client: *Dyno-Nobel*
Start Date: *7/1/99*
Finish Date: *7/1/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split-Spoon	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA DATUM: NA

Grade: NA
TWC: NA
TPC: NA
North: NA
East: NA

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	18-15-12-15				brown to Blakc MF SILT to Clayey Silt	
		2	12-12-18-19				F Brown Clayey Silt, loose	
5		3	4-6-11-22				Red to brown Clayey Silt with thin gray CLAY layers, moist	
	Backfilled w/ Cement Grout	4	4-6-12-13					
		5	4-7-11-11				Red to Brown, gray Silty Clay, mottled, varved	
10		6	3-5-9-10					Boring backfilled w/ Grout.
		7	8-4-6-10				Red to gray CLAY, moist mottled, varved	
15		8	1-1-3-3				Dark gray CLAY, platic, wet	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 26D-8

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *6/30/99*
Finish Date: *6/30/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split-Spoon	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA (cm/sec)

SURVEY DATA DATUM: NA

Grade: NA
TWC: NA
TPC: NA
North: NA
East: NA

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0	Backfilled w/ Cement Grout (0–16 ft)	1	3-5-5-5				Asphault, F brown Clayey Silt, loose	
		2	6-6-10-11				F Brown Clayey Silt, loose	
5		3	4-6-9-10				Red to brown Clayey Silt with thin gray CLAY layers, moist	
		4	7-9-12-15					
		5	3-6-9-11				Red to Brown, gray Silty Clay, mottled, varved	
10		6	8-9-12-13					Boring backfilled w/ Grout.
		7	9-9-13-18				Red to gray CLAY, moist mottled, varved	
15		8	1-2-3-5				Dark gray CLAY, platic, wet	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 26G-11

Page 1 of 0

Project: *Vertical Delineation*	Project No.:	Start Date: *7/2/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/2/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0–2	Backfilled w/ Cement Grout (0–16)	1	4-3-3-3				Fill, Brown Clayey Silt	
2–4		2	5-5-8-8				Brown F Clayey Silt, damp	
4–6		3	5-2-9-11					
6–8		4	11-11-14-15				Lt. Brown to red Clayey Silt, moist	
8–10		5	5-7-10-12				Lt. Brown to red Clay and Silty Clay	
10–12		6	3-4-7-7					Boring backfilled w/ Grout.
12–14		7	4-8-9-8					
14–16		8	3-5-7-9				Brown to Gray CLAY, saturated	
16							End of Boring @ 16'	

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 26G-16 Page 1 of 0

Project: *Vertical Delineation*
Client: *Dyno-Nobel*
Project No.: *60192.001*
Start Date: *7/6/99*
Finish Date: *7/6/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	4-4-3-4				Fill, gravel, wire, brown Silty Clay	
		2	4-5-9-9				Brown to red Clayey Silt, damp	
5		3	4-5-7-10					
		4	10-12-13-14				Lt. Brown to red Clayey Silt w/ trace Sand	
	Backfilled w/ Cement Grout	5	3-4-6-7				Lt. Brown to red Clay and Silty Clay	
10		6	2-5-5-5				Brown to Gray Silty Clay, moist	Boring backfilled w/ Grout.
		7	5-9-10-10					
15		8	6-9-9-9				Gray CLAY and Silty Clay	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 33-04

Project: *Vertical Delineation*	Project No.: *60192.001*
Client: *Dyno-Nobel*	
Start Date: *7/12/99*	Finish Date: *7/12/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0								
2.0	Refusal @ 2.0'							Refusal @ 2.0 '
5								
10								
15								
20								
25								
30								

Brown and Caldwell

Subsurface Boring Log

Well Name/Location: 33-13

Project: *Vertical Delineation*	Project No.:	Start Date: *7/12/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/12/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. (soil) / Run No. (rock)	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	4-7-8-24				Red F Sand, Rock Frags, & F Gravel	
		2	34-10-18-20				Orange F Sand, trace Silt (-) Clay	
5		3	5-4-4-3				Red-Brown F Sand, trace Silt (-) Clay	
		4	6-5-10-8					
	Backfilled w/ Cement Grout	5	4-6-11-12					
10		6	2-3-3-3					Boring backfilled w/ Grout.
		7	3-4-4-5				MF Brown Silty Clay to Clayey Silt, Moist	
15		8	8-5-5-6				Gray Clay, w/ trace Silt, some Sand (+) Gravel	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 39-09 Page 1 of 0
Project: *Vertical Delineation* Client: *Dyno-Nobel*	Project No.: *60192.001*	Start Date: *6/30/99* Finish Date: *6/30/99*

DRILLING DATA	
Inspector:	*Marc Conger*
Contractor:	*Maxim Technologies*
Equipment:	*Acker Auger Rig*
Method:	*Direct Push*

SAMPLING METHODS	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT	SURVEY DATA DATUM: NA
Method: *NA*	Grade: *NA*
Duration: *NA*	TWC: *NA*
Gals. Purged: *NA*	TPC: *NA*
Slug Test: *NA* (cm/sec)	North: *NA*
	East: *NA*

Geophysical Log: ☐ yes ☒ no

Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0		1	5-5-10-12				Lt. to Dark MF Silty Clay to Clay and Silt, dry	
		2	10-10-19-13				Dark brown F Clayey Silt	
5		3	9-9-11-12				Red to brown Clayey Silt to Silty Clay, moist, varved	
		4	10-9-12-8					
	Backfilled w/ Cement grout	5	6-8-9-10					
10		6	2-2-3-4					Boring backfilled w/ Grout.
		7	2-4-1-2				Red to gray CLAY, moist mottled, varved	
15		8	1-1-1-1				Dark gray CLAY, platic, wet	
							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 42-07

Project: *Vertical Delineation* — Project No.: *60192.001* — Start Date: *7/7/99*
Client: *Dyno-Nobel* — Finish Date: *7/8/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	Backfilled w/ Cement Grout (0–16')	1	9-10-12-17				CMF Top Soil, roots, Silt, dry	
		2	25-32-38-38				M Clayey Silt, w/ some Sandy Silt	
5		3	38-38-38-28				MF Sandy Silt to Silty Clay	
		4	11-19-28-25				Red Brown F Silty Clay, moist	
		5	25-26-32-38					
10		6	26-28-34-30					Boring backfilled w/ Grout.
		7	28-36-28-24				Red to Brown Silty Clay to Clayey Silt, varved	
15		8	14-14-12-14					
16							End of Boring @ 16'	
20								
25								
30								

Brown and Caldwell	Subsurface Boring Log	Well Name/Location: 47-02 Page 1 of 0
Project: *Vertical Delineation*	Project No.:	Start Date: *7/1/99*
Client: *Dyno-Nobel*	*60192.001*	Finish Date: *7/1/99*

DRILLING DATA

Inspector: *Marc Conger*
Contractor: *Maxim Technologies*
Equipment: *Acker Auger Rig*
Method: *Direct Push*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split-Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NA

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	Well Construction	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
0		1	1-1-2-2				Dark Brown to Black top soil, MF SILT, moist	
		2	3-7-11-12				Red to Gray, and Brown, MF Silty Clay to Clayey Silt, damp	Smell of Selenium, fuse powder
5		3	5-8-12-16				Red to brown Clayey Silt to Silty Clay, moist, varved	
		4	8-10-20-22					
	Backfilled w/ Cement Grout	5	4-6-11-13					
10		6	4-5-6-8					Boring backfilled w/ Grout.
		7	1-4-6-10				Red to gray CLAY, moist mottled, varved	
15		8	1-3-3-3				Dark gray CLAY, platic, wet	
							End of Boring @ 16'	
20								
25								
30								

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-19S
		Page 1 of 1

Project: *RFI*	Project No.: *0192.02*	Start Date: *09/16/97*
Client: *DYNO Nobel, Port Ewen, NY*		Finish Date: *09/16/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *4 1/4" HAS*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb/30 inch*	*NA*	*NA*

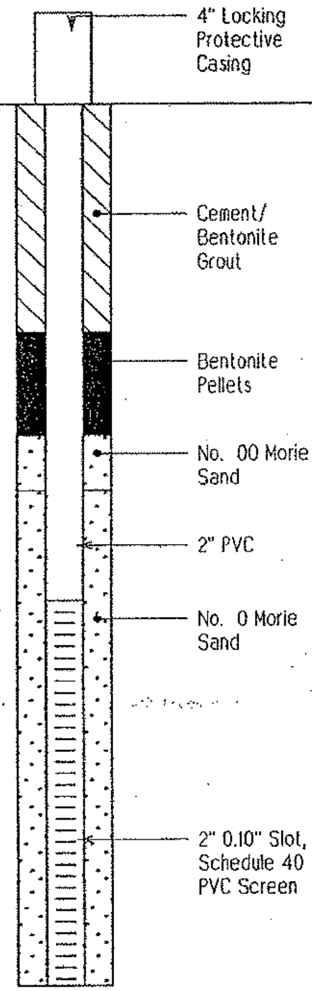
WELL CONSTRUCTION

	Riser	Screen
Material:	*Schd. 40 PVC*	*Schd. 40 pvc .010 slot*
Diameter (ID):	*2"*	*2"*
Coupling:	*Flush-threaded*	*Flush-threaded*

WELL DEVELOPMENT	SURVEY DATA DATUM:
Method:	Grade:
Duration:	TWC: *156.2*
Gals. Purged:	TPC:
Slug Test: (cm/sec)	North: *686911.12*
	East: *594141.46*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	2-2-3-7	1.4'			LACUSTRINE DEPOSITS Dark brown f SAND and silty CLAY	
	S-2	7-10-13-22	1.2'			Dry Light-brown Silty CLAY, trace (-) f Sand, trace (-) to no c Sand	
5	S-3	8-12-14-20	1.4'				
	S-4	21-20-25-24	1.8'			Slightly moist Silty CLAY tace (-) to no cf Sand	
	S-5	4-8-8-12	2.0'				
10	S-6	5-5-6-6	1.2'			Moist brownish-gray Silty CLAY	
	S-7	6-6-7-6	2.0'				
	S-8	2-2-3-3	1.7'			Moist Gray Silty CLAY with brown mottling	
15	S-9	5-5-3-5	1.5'				
	S-10	3-1-2-3	1.7'			Wet Gray Silty CLAY	Water table @ 18'
20	S-11	1-2-2-3	1.3'				
	S-12	1-2-1-1	1.8'			24.0	
25						End of Boring at 24.0 feet.	
30							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-20D Page 1 of 2
Project: *RFI* Client: *DYNO Nobel, Port Ewen, NY*	Project No.: *0192.02*	Start Date: *09/12/97* Finish Date: *09/15/97*

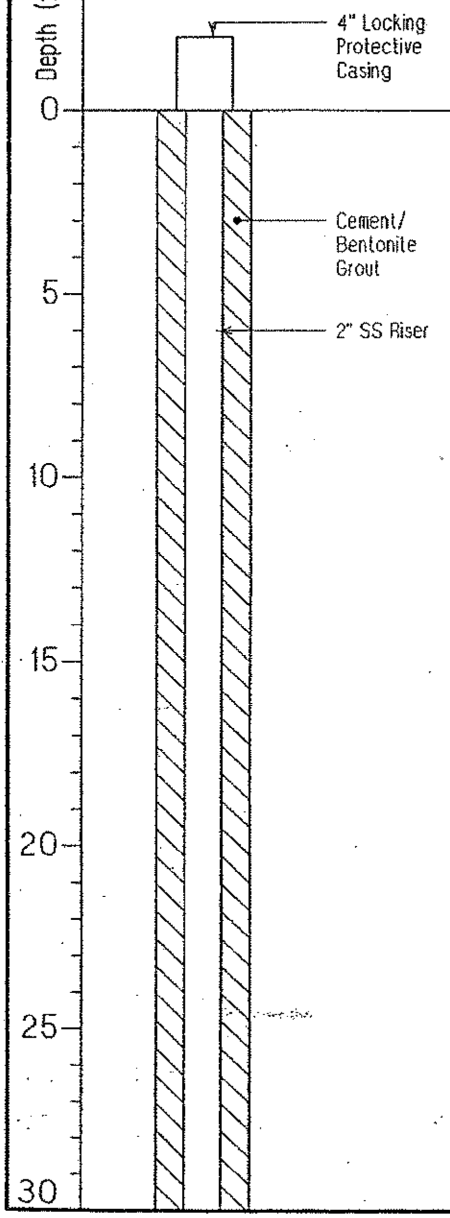
DRILLING DATA	SAMPLING METHODS			
		Sampler	Tube	Core
Inspector: *E.R.Limbrick*				
Contractor: *Maxim Technologies, Inc., C.Dinovo*	Type:	*Split Spoon*	*NA*	*NA*
Equipment: *Acker Soil Max*	Diameter:	*2 inch*	*NA*	*NA*
Method: *4 1/4" HAS*	Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION	Riser	Screen
Material:	*type 304 S.S*	*type 304 S.S. .010 slot*
Diameter (ID):	*2 inch ID*	*2"*
Coupling:	*Flush-threaded*	*Flush-threaded*

WELL DEVELOPMENT	SURVEY DATA DATUM:
Method:	Grade:
Duration:	TWC: *161.40*
Gals. Purged:	TPC:
Slug Test: (cm/sec)	North: *685366.27*
	East: *594189.91*

Geophysical Log: ☐ yes ☒ no

Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0–30							For soil description between the 0-44'interval refer to the boring log MW-20R.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-20D

Project: *RFI*

Client: *DYNO Nobel, Port Ewen, NY*

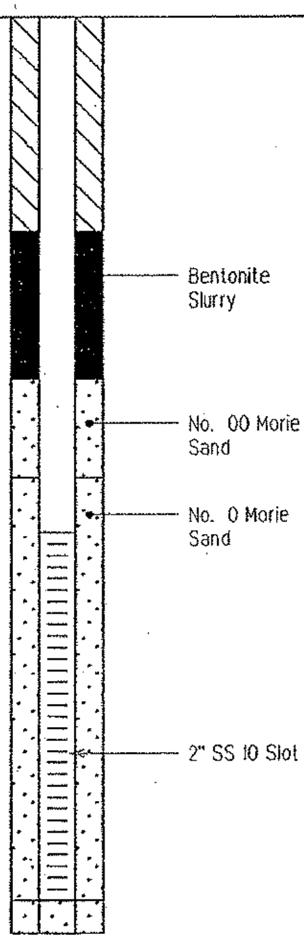
Project No.: *0192.02*

Start Date: *09/12/97*

Finish Date: *09/15/97*

(CONTINUATION)

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
44						SAND & GRAVEL	
45	S-1	3-4-15-18	0.0'			Gray cm SAND, some (+) Silty CLAY, little (+) Gravel	
	S-2	14-5-17-16	1.1'				
	S-3	13-31-18-22	0.5'			c GRAVEL, lens of brown Silty CLAY	
50	S-4	58-24-29-32	0.9'			cm SAND and to trace c GRAVEL, trace (+) Silty CLAY	
	S-5	28-37-36-41	1.8'			c GRAVEL, sone (+) cm SAND, trace silty CLAY	
54.9	S-6	76-100/4"	0.7'			Weathered Shale-- BEDROCK @ 54.0'	
						End of Boring at 54.9 feet.	

Depth (feet): 30, 35, 40, 45, 50, 55, 60, 65, 70

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-21D

Project: RFI	Project No.: 0192.02	Start Date: 09/08/97
Client: DYNO Nobel, Port Ewen, NY		Finish Date: 09/09/97

DRILLING DATA

Inspector: E.R.Limbrick
Contractor: Maxim Technologies, Inc., C.Dinovo
Equipment: Acker Soil Max
Method: 4 1/4" HAS

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2"	NA	NA
Other:	NA	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	Type 304 S.S.	Type 304 S.S .010" slo
Diameter (ID):	2 inch ID	2"
Coupling:	Flush-threaded	Flush-threaded

WELL DEVELOPMENT

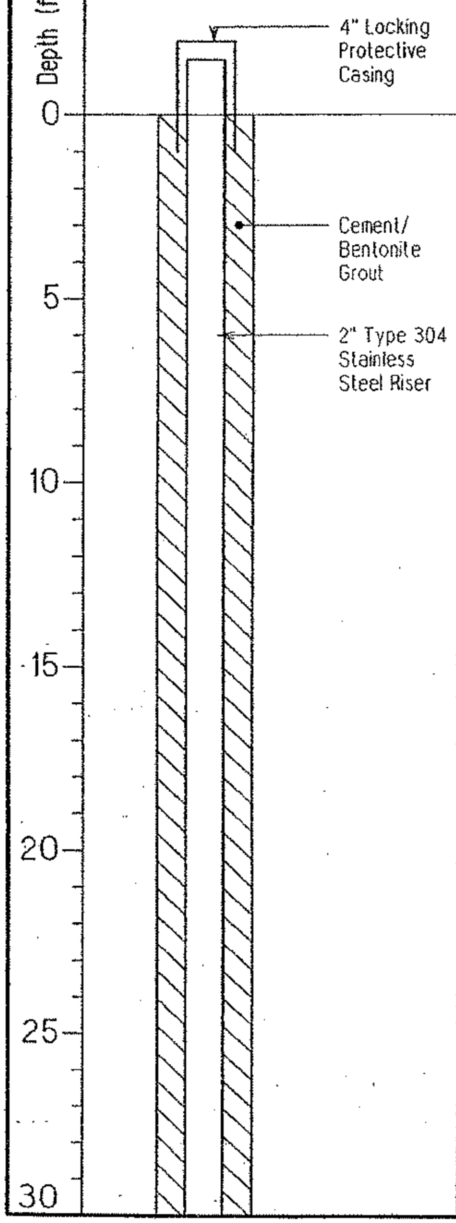
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: 164.10
TPC:
North: 685492.08
East: 594355.78

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0							OVERBURDEN/LACUSTRINE DEPOSIT	
10							Refer to the MW-21R log for soil descriptions.	

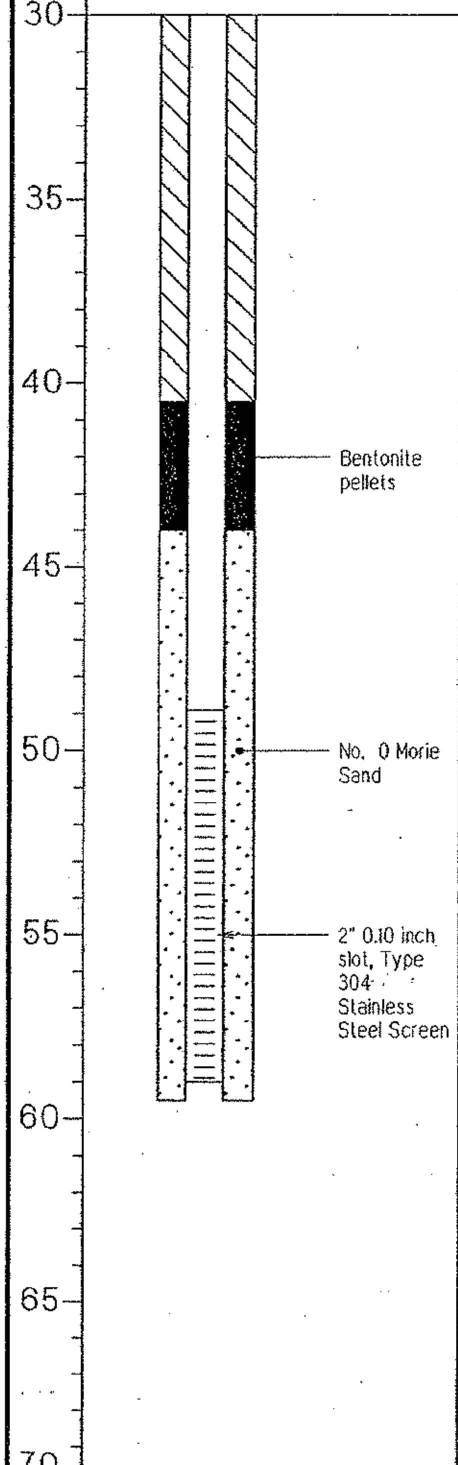


ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-21D

Project: *RFI*	Project No.:	Start Date: *09/08/97*
Client: *DYNO Nobel, Port Ewen, NY*	*0192.02*	Finish Date: *09/09/97*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No. (soil / rock)	SAMPLE DATA: Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
30–48								
48–59							SAND & GRAVEL	
59–70							BEDROCK-GRAY SHALE	



ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-22D

Project: *RFI*	Project No.: *0192.02*
Client: *DYNO Nobel, Port Ewen, NY*	Start Date: *09/24/97*
	Finish Date: *09/24/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *4 1/4" HAS*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*stainless steel*	*stainless steel*
Diameter (ID):	*2 inch ID*	*2 1/8*
Coupling:	*npt*	*npt*

WELL DEVELOPMENT

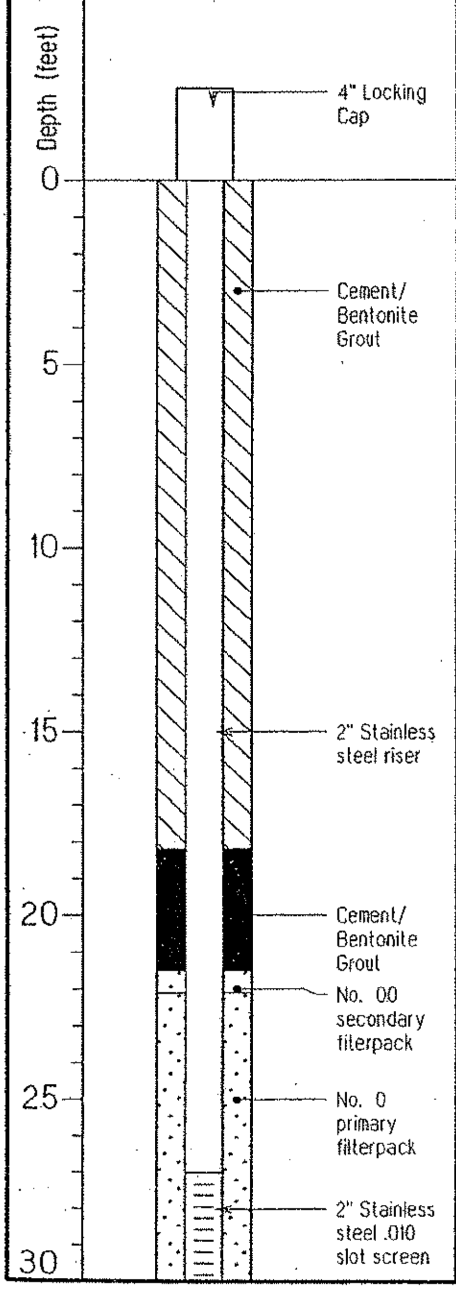
Method: *na*
Duration: *na*
Gals. Purged: *na*
Slug Test: *na* (cm/sec)

SURVEY DATA DATUM: na

Grade: *na*
TWC: *151.9*
TPC:
North: *685412.14*
East: *594639.41*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
S-1	2-1-2-3			
S-2	5-7-11-13			

VISUAL CLASSIFICATION	REMARKS
OVERBURDEN?LACUSTRINE DEPOSIT	
For soil descriptions above and below the 27.5'-32.2' interval refer to the MW-22R log.	
Gray f GRAVEL, little silty clay and cmf sand.	
Gray cmf GRAVEL and cmf SAND.	

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-22D *Page 2 of 2*
Project: *RFI*	Project No.: *0192.02*	Start Date: *09/24/97*
Client: *DYNO Nobel, Port Ewen, NY*		Finish Date: *09/24/97*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
30		S-2	5-7-11-13				Gray cm SAND, trace silty clay. 32.2	
		S-3	6-9-9-10				Refusal @ 32.2'.	
35								
40								
45								
50								
55								
60								
65								
70								

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-23S
		Page 1 of 1

Project: *RFI*	Project No.: *0192.02*	Start Date: *09/16/97*
Client: *DYNO Nobel, Port Ewen, NY*		Finish Date: *09/16/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *4 1/4" HAS*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*Type 304 S.S.*	*Type 304 S.S.*
Diameter (ID):	*2" ID*	*2" ID*
Coupling:	*Flush-threaded*	*Flush-threaded*

WELL DEVELOPMENT

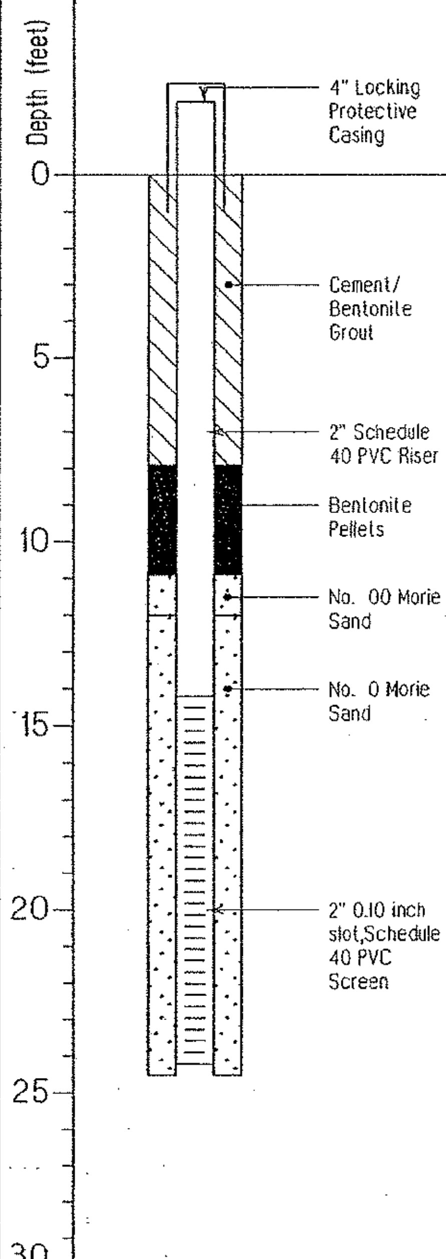
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: *165.2*
TPC:
North: *686049.27*
East: *593751.85*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
S-1	5-6-7-10	0.4'		0	Slightly moist Medium brown Silty CLAY, some roots present	
S-2	5-6-5-7	1.1'		0		
S-3	3-4-5-8	1.2'		0	Moist Brown Silty CLAY with brown mottling	
S-4	8-11-14-15	0.8'		0	Wet Brown Silty CLAY with brown mottling	
S-5	5-5-6-8	2.0'		0	Reddish-brown Silty CLAY with thin lenses of Gray SILT	
S-6	3-3-3-2	1.2'		0	Wet Gray to Greenish-gray Silty CLAY	
S-7	3-4-4-4	1.7'		0		
S-8	2-2-2-1	1.0'		0	Gray with lens of orange Silty CLAY	
S-9	3-2-1-3	2.0'		0	Saturated Gray and Reddish-Gray Silty CLAY	
S-10	WOR-WOR-WOH-WOH	2.0'		0	Saturated Gray Silty CLAY	
S-11	WOR-WOH 1-1	2.0'		0		
S-12	1-1-2-1	2.0'		0		
					End of Boring at 24.0 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW−22R

Project: *RFI* | Project No.: *0192.02*
Client: *DYNO Nobel, Port Ewen, NY*
Start Date: *09/22/97*
Finish Date: *09/22/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *6 1/4" HAS/5 7/8 Roller Bit/NX Core*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon/NX Core Barrel*	*NA*	*NX*
Diameter:	*2 inch*	*NA*	*3 inch*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*black steel*	*NA*
Diameter (ID):	*4 inch ID*	*2 1/8*
Coupling:	*NPT*	

WELL DEVELOPMENT

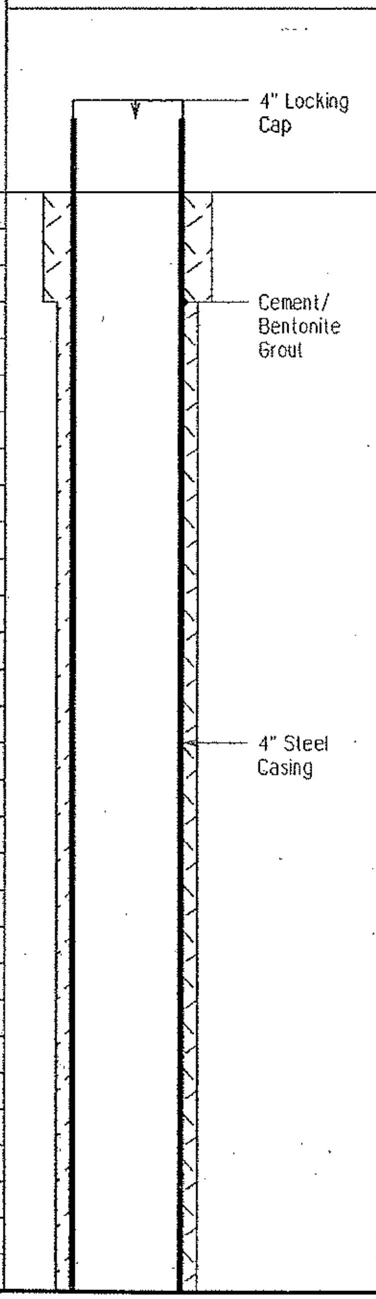
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: *151.6*
TPC:
North: *685413.44*
East: *594645.86*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



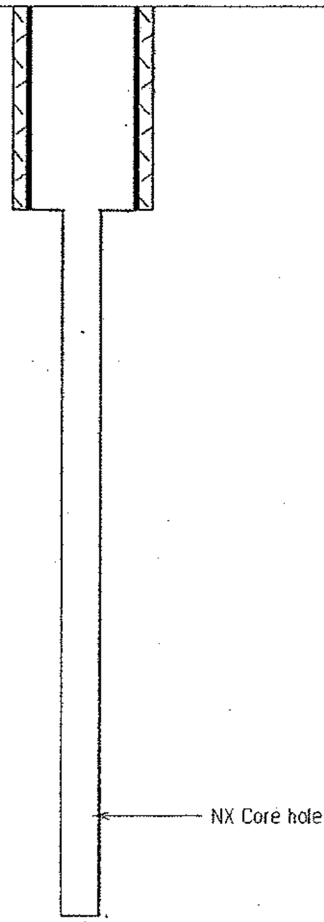
SAMPLE DATA (soil / rock)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	2-1-2-3	1.5'			OVERBURDEN/LACUSTRINE DEPOSITS Brown SILT/ SILT and CLAY, trace roots.	
	S-2	6-7-11-13	1.2'			Brown SILT and CLAY, mottled.	
5	S-3	6-9-9-10	1.7'				
	S-4	7-8-8-8	0.0			Brown Silty CLAY	
	S-5	4-2-3-2	1.5'				
10	S-6	2-3-3-4	0.0'				
	S-7	3-2-3-3	1.7'			@ 12.7' change to gray Silty CLAY. Saturated	Saturated @ 12.7 feet.
15	S-8	woh-woh 2-2	1.2'				
	S-9	3-2-2-2	1.0'				
	S-10	woh-woh woh-1	1.3'				
20	S-11	1-1-2-1	1.2'				
	S-12	1-1-2-1	1.4'				
25	S-13	WOH-WOH 1-1	2.0'			Gray cmf SAND and gray Silty CLAY, some mf Gravel grading to cmf SAND.	
	S-14	10-19 22-12	2.0'			@ 28.5 brown Silty CLAY and c GRAVEL, some silty clay.	
30	S-15	9-7-8-8	2.0'				

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-22R

Project: *RFI*	Project No.:	Start Date: *09/22/97*
Client: *DYNO Nobel, Port Ewen, NY*	*0192.02*	Finish Date: *09/22/97*

(CONTINUATION)



Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-16	13-32 15-10	0.6'			Gray cmf GRAVEL (weathered rock), some cmf Sand, some silty clay.	
33	S-17	58-100/4	1.1'			BEDROCK-GRAY SHALE	
35	S-18	100/4	0.1'				
35.5–40				NA			
40.5–45				55%			
45–50				74%			
50–55				33%			

Depth scale: 30, 35, 40, 45, 50, 55, 60, 65, 70

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-21R

Project: *RFI*	Project No.:	Start Date: *09/04/97*
Client: *DYNO Nobel, Port Ewen, NY*	*0192.02*	Finish Date: *09/08/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinova*
Equipment: *Acker Soil Max*
Method: *6 1/4" HAS/5 7/8 Roller Bit/NX Core*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon/NX Core Barrel*	*NA*	*NX*
Diameter:	*2 inch*	*NA*	*3 inch*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*black steel*	*NA*
Diameter (ID):	*4 inch ID*	*2 1/8*
Coupling:	*NPT*	

WELL DEVELOPMENT

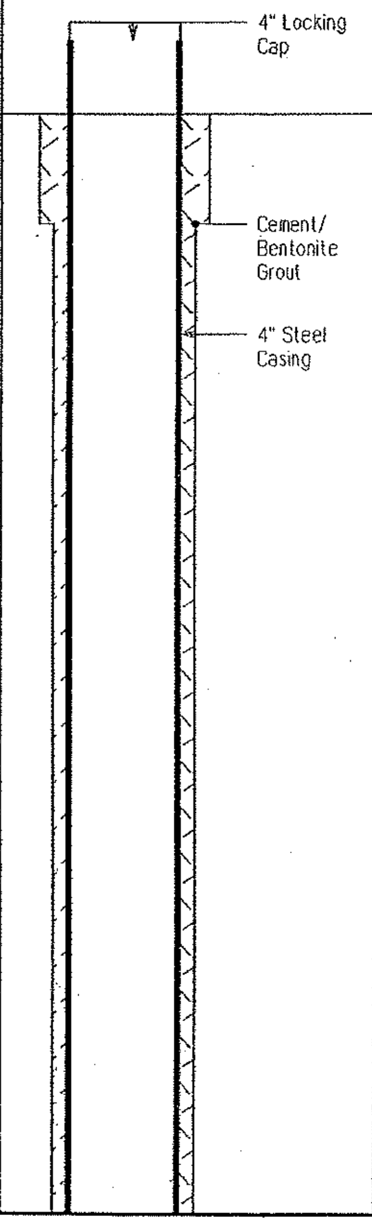
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: *162.80*
TPC:
North: *685486.17*
East: *594352.10*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	7-7-9-13	1.7'			OVERBURDEN/LACUSTRINE DEPOSITS	
	S-2	14-23-21-23	1.6'			Brown SILT, little f Sand Slightly moist Brown SILT & CLAY	
5	S-3	4-10-11-18	1.5'				
	S-4	10-11-11-12	1.2'				
	S-5	4-5-6-9	1.5'			Moist Brown SILT & CLAY, some gray mottling, trace Gravel	
10	S-6	4-4-8-8	1.4'			@ 9.6' becoming more moist, Moist Brown SILT & CLAY, some gray mottling	
	S-7	9-8-11-11	1.5'			Moist Brown to Reddish-brown CLAY & SILT	
15	S-8	3-5-5-6	1.7'				
	S-9	6-6-6-5	2.0'			Moist Brown to Reddish-brown CLAY & SILT, few lens of f SAND	
	S-10	1-1-1-3	1.3'			@ 18.5 Saturated Wet, Gray CLAY & SILT to Silty CLAY with brown mottling Gray Silty Clay	Saturated @ 18.5 feet.
20	S-11	1-1-3-4	1.2'				
	S-12	4-4-5-5	0.0'				
25	S-13	WOH-WOH-3-4	1.2'				
	S-14	3-4-4-5	2.0'				
30	S-15	WOH-1-1-2	0.8'				

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-21R

Project: *RFI*
Client: *DYNO Nobel, Port Ewen, NY*
Project No.: *0192.02*
Start Date: *09/04/97*
Finish Date: *09/08/97*

(CONTINUATION)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-16	2-3-2-2	0.9'				
	S-17	WOR-WOR-WOH-2	1.6'				
35	S-18	WOH-2-2-3	1.4'				
	S-19	WOH-2-2-3	2.0'				
	S-20	2-1-3-2	1.8'				
40	S-21	WOR-1-3-4	2.0'			Gray Silty Clay, trace (–) f Sand	
	S-22	3-4-3-4	2.0'				
45	S-23	WOR-WOR-2-3	2.0'			Gray Silty Clay	
	S-24	WOH-1-2-3	2.0'			Gray Silty Clay, little (–) f Sand	
						48.75	
	S-25	1-4-9-6	2.0'			SAND & GRAVEL	
50	S-26	4-5-7-8	0.8'			c SAND, and Silty CLAY, little Gravel cmf GRAVEL (chips of weathered Shale), some c Sand, some Silty Clay	
	S-27	4-4-7-7	1.3'				
55	S-28	7-8-17-24	1.6'			Gray f SAND, trace (+) Gravel (chips of weathered Shale) Gray to black cmf Gravel (chips of weathered Shale), little c Sand, little silty Clay, grading to all c Gravel	
	S-29	8-18-15-16	2.0'				
	S-30	18-14-24-56	1.4'				
						59.9	
60				100%		BEDROCK- GRAY SHALE *No core collected from 60.0' to 66.0'.*	No core collected from 60.0' to 66.0'
65							
	R-1		5.0'	83%		Gray Shale, few small fractures with no staining, dipping at a steep angle, from 67.3' to 69.5'.	
70							

Well construction: NX Core hole

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-21R

Project: *RFI* | Project No.: *0192.02* | Start Date: *09/04/97*

Client: *DYNO Nobel, Port Ewen, NY* | Finish Date: *09/08/97*

(CONTINUATION)

Depth (feet)	Well Construction	Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD	HNU (ppm)	Visual Classification	Remarks
70		R-1		5.0'				
71–75		R-2		5.0'	83%		Gray Shale, few small fractures, some with calcite and brown staining, dipping at steep angle. Steep angle Calcite vein from 73.4' to 73.6' Smaller Calcite veins from at 75.5' and 75.8'	
75–80		R-3		5.0'	87%		Large fracture, steep angle, some calcite mineralization. Horizontal fracture, in-filled with some clay. Fractures from 77.3' to 79.5' no staining. Small veins of Calcite from 79.0' to 81.6'	
80–86		R-4		5.0'	96%		Badly fractured zone, little mineralization. Slightly angled fractues at 85.2' and 85.5' no staining	
86							End of Boring at 86.0 feet.	
90								
95								
100								
105								
110								

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-20R

Project: *RFI*
Client: *DYNO Nobel, Port Ewen, NY*
Project No.: *0192.02*
Start Date: *09/09/97*
Finish Date: *09/12/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *6 1/4" HAS/5 7/8 Roller Bit/NX Core*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*S.S./NX Core Barrel*	*NA*	*NX*
Diameter:	*2 inch*	*NA*	*3 inch*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*black steel*	*NA*
Diameter (ID):	*4 inch ID*	*2 1/8*
Coupling:	*NPT*	

WELL DEVELOPMENT

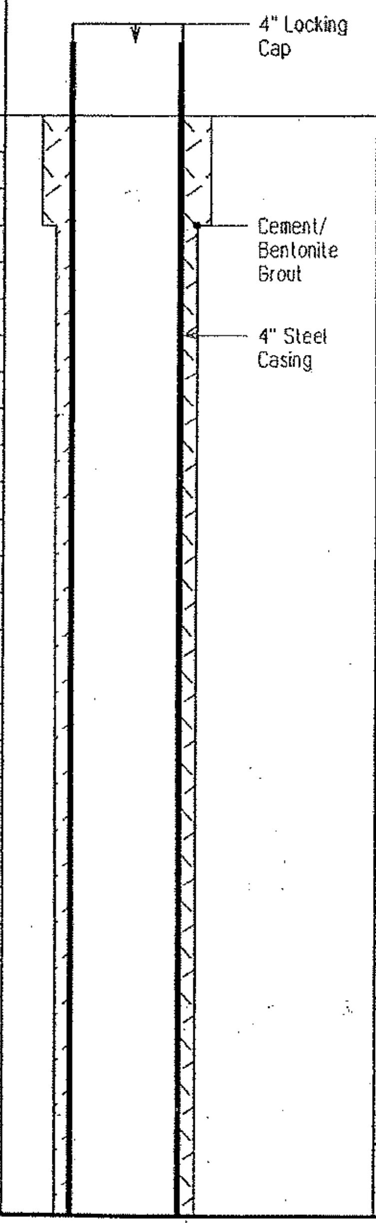
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: *161.00*
TPC:
North: *685362.95*
East: *594182.84*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	5-7-9-10	1.7'				
	S-2	11-11-12-13	1.5'				
5	S-3	7-11-12-13	2.0'			Slightly moist Brown SILT to Brown SILT & CLAY, few thin lens of c Sand, some red staining	
	S-4	11-12-12-16	2.0'			Moist Brown Clayey SILT, some red mottling @ 7.6' very moist dark Gray c SAND	
10	S-5	7-7-8-11	2.0'			Mottled Brown SILT & CLAY, lens of f Gray SAND, some dark staining	
	S-6	3-5-6-8	1.6'			Reddish-brown with Gray mottling, SILT & CLAY, seams of f Gray Sand	
	S-7	8-8-9-8	1.7'				
15	S-8	3-3-4-4	1.4'				
	S-9	5-5-5-6	1.8'			@ 16.4 change to Gray Silty CLAY	
	S-10	1-1-2-3	1.1'			@ 18.3 Saturated Wet, Gray Silty CLAY with brown mottling	Saturated @ 18.3 feet.
20	S-11	WOR-WOH-2-2	0.6'				
	S-12	2-2-2-2	1.6'				
25	S-13	WOH-2-1-2	1.1'			Gray Silty Clay	
	S-14	2-2-3-2	2.0'				
30	S-15	WOR-WOH-1-2	1.2'				

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-20R

Project: *RFI* | Project No.: *0192.02* | Start Date: *09/09/97*

Client: *DYNO Nobel, Port Ewen, NY* | Finish Date: *09/12/97*

(CONTINUATION)

Depth (feet)	Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	Visual Classification	Remarks
30	S-16	WOR-WOH-1-3	1.0'				
	S-17	2-3-1-4	2.0'				
35	S-18	WOR-WOR-WOR-WOR	1.9'			Gray Silty CLAY and Orange-brown SILT	
	S-19	WOH-2-2-3	2.0'			Gray Silty CLAY	
	S-20	1-2-2-3	2.0'				
40	S-21	WOR-WOH-WOH-2	2.0'				
	S-22	1-2-2-4	2.0'			Gray with Orange and Olive streaking and mottling, Silty CLAY	
45	S-23	2-58-24-43	1.4'			SAND & GRAVEL c GRAVEL and Gray with olive mottling Silty CLAY, little cmf Sand	
	S-24	13-15 25-28	1.6'			Orange-brown f SAND and CLAY & SILT	
	S-25	79-64-32-51	2.0'			Olive-gray c GRAVEL, some silty CLAY, little cmf SAND	
50	S-26	13-15-24-26	2.0'			c GRAVEL,little c to cmf Sand, little gading to trace (+) Silty Clay	
	S-27	10-13-27-28	1.6'			54.0	
55	S-28	50/0"	0.0'			BEDROCK - GRAY SHALE *No core collected from 54.0' to 59.1'.*	No core collected from 54.0' to 59.1'
60	R-1		1.8'	78%		Gray Shale, some fractures with no staining, dipping from vertical, to steep, to horizontal from 60.0' to 61.3'. Badly fractured from 61.1' to 61.3' d=61.7 Few fractures from 61.7' to 62.4', no staining	
65	R-2		4.8'	56%		Few horizontal fractures some clay in-filling, and some calcite mineralization Large horizontal fracture @ 64.7', heay calcite mineralization Several small fractures from 64.9' to 65.8', trace to no staining	Formation taking a lot of water from 62.5' to 66.5'
70	R-3		4.8'	63%		Fractures @ 67.5' and 67.6', some calcite mineralization Badly fractured zone from 68.7' to 71.2', some calcite	

Well construction: NX Core hole

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-20R

Project: *RFI*

Client: *DYNO Nobel, Port Ewen, NY*

Project No.: *0192.02*

Start Date: *09/09/97*

Finish Date: *09/12/97*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
70		R-3		4.8'	63%			
75		R-4		4.5'	79%			
							End of Boring at 77.0 feet.	
80								
85								
90								
95								
100								
105								
110								

110 Commerce Drive
Allendale, New Jersey 07401

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BROWN AND CALDWELL

December 30, 2002

23167.001

Mr. Paul Patel
NYSDEC
Bureau of Solid Waste & Corrective Action, 8th Floor
625 Broadway
Albany, New York 12233

Subject: DYNO Nobel, Inc. Facility
Port Ewen, New York

Dear Mr. Patel:

Enclosed for your records, please find completed well and boring logs for the new monitoring wells installed at the Dyno Facility in Port Ewen, New York. These wells were sampled as part of the semi-annual groundwater sampling event and the analytical results were forwarded to the Department on December 3, 2002. Groundwater samples collected from these newly installed wells do not indicate the presence of site related constituents above naturally occurring background levels (inorganics) or above the detection limits for volatile organic constituents.

Please do not hesitate to contact us with any questions you may have.

Sincerely,

Brown and Caldwell Associates

Timothy R. Roeper
Supervising Hydrogeologist

Elyse J. Apicello
Assistant Hydrogeologist

Attachment
cc: Fred Jardinico (Dyno Nobel)
Dennis Amorose (Hercules)
Keith Gronwald (NYSDEC)

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12/30/02

BROWN AND CALDWELL	BORING LOG	Well Name/Location: MW-24S

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/28/02*
Finish Date: *8/28/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

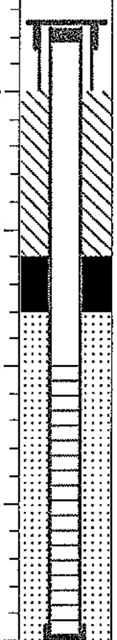
Method: *Bailer*
Duration: *2 Hours*
Gals. Purged: *4*
Slug Test: *NA*

SURVEY DATA

Datum:
Grade: *154.60* **North:** *687631.81*
TWC: *157.19* **East:** *594854.61*
TPC:

SOIL / ROCK — **SAMPLE DATA**

Geophysical Log: ☐
Comments:



Depth (feet)	Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.)	RQD. / USCS	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0						OVERBURDEN	
10	1	4-4-4-4	1.0			Brown silty CLAY, moist	
	2	3-5-6-4	1.0			Brown f SAND and silty CLAY, grading into grey silty CLAY in tip, wet	
15	3	wh-wh-1-1	2.0			Grey silty CLAY, saturated	
	4	1-2-1-2	1.0			Grey silty CLAY, saturated	
	5	2-1-1-2	1.0			Grey silty CLAY, saturated	
20						End of Borehole	

BROWN AND CALDWELL	BORING LOG	Well Name/Location: MW-24D

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/29/02*
Finish Date: *8/29/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	Tube Type: *NA*	Core Type: *NA*
Diameter: *2"*	Diameter: *NA*	Diameter: *NA*
Other: *NA*	Other: *NA*	Other: *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	Screen Material: *PVC*
Diameter (ID): *2"*	Diameter (ID): *2"*
Coupling: *Flush-Threaded*	Coupling: *Flush-Threaded*

WELL DEVELOPMENT

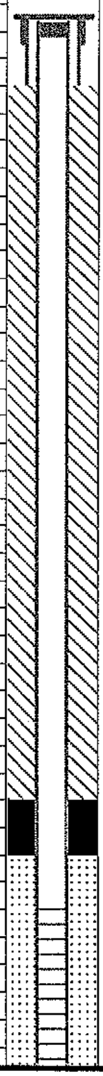
Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *120*
Slug Test: *NA*

SURVEY DATA

Datum:
Grade: *154.75* **North:** *687637.80*
TWC: *157.21* **East:** *594853.24*
TPC:

SOIL / ROCK — SAMPLE DATA

Geophysical Log: ☐
Comments:



Depth (feet)	WELL DETAIL	Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.)	RQD. / USCS	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
	Locking protective casing							
0		1	5-6-7-6	2.0			**OVERBURDEN** Brown f SAND and SILT, trace organics	
	Cement/Bentonite Grout	2	6-7-8-9	2.0				
5		3	2-5-6-6	2.0			Brown clayey SILT and f SAND, moist	
		4	5-7-6-6	1.0			Brown clayey SILT, trace f SAND, wet	
		5	4-5-5-5	2.0			Grey/brown silty CLAY, some Clay, trace f Sand, wet	
10		6	3-4-4-4	2.0			Grey silty CLAY, trace f Sand, wet	
		7	5-4-5-6	2.0			Grey/brown silty CLAY, wet	
15		8	wh-wh-wh-1	2.0			Grey silty CLAY, saturated	
		9	1-1-wh-wh	2.0				
		10	wh-wh-3-3	2.0				
20		11	wh-wh-wr-wr	1.0			Grey silty CLAY, saturated	
		12	wh-3-3-3	2.0				
25		13	wh-wh-wh-wh	2.0				
	Bentonite Seal	14	wh-wh-1-1	2.0				
	Sand Pack (#0)	15	wr-wr-wh-wh	2.0			Grey silty CLAY, some f Gravel, saturated	
30		16	wh-wh-wh-wh	2.0			Grey CLAY and f GRAVEL	
	PVC Screen (.010" slot)	17	10-6-6-10	2.0			Grey CLAY and fm GRAVEL, trace Silt, saturated	
35				1.0				

BROWN AND CALDWELL	BORING LOG	Well Name/Location: MW-24D
Project: *Off Site Well Installation* **Client:** *Dyno Nobel*	**Project No.:** *23167.001*	**Start Date:** *8/29/02* **Finish Date:** *8/29/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *120*
Slug Test: *NA*

SURVEY DATA

Datum:

Grade: *154.75*	**North:** *687637.80*
TWC: *157.21*	**East:** *594853.24*
TPC:	

SOIL / ROCK — **SAMPLE DATA**

Geophysical Log: ☐
Comments:

Depth (feet)	WELL DETAIL	Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.) / Rec. (ft.)	RQD. / USCS	HNU (ppm) / HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
		18	4-5-5-3	1.0				
		19	8-11-10-8	2.0			Grey silty CLAY and fm GRAVEL, saturated	
40		20	10-11-10-16	1.0			Grey silty CLAY and fm GRAVEL, trace Rock fragements, saturated	
							End of Borehole	
45								
50								
55								
60								
65								
70								
75								

BROWN AND CALDWELL | **BORING LOG** | **Well Name/Location: MW-25S**

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/26/02*
Finish Date: *8/26/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

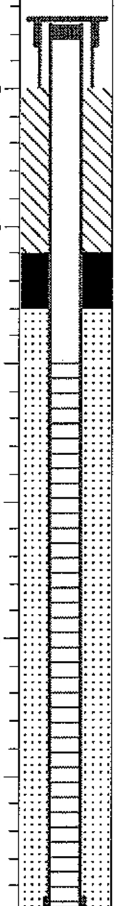
Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *30*
Slug Test: *NA*

SURVEY DATA

Datum:
Grade: *156.70* **North:** *685314.40*
TWC: *159.71* **East:** *594639.53*
TPC:

SOIL / ROCK — **SAMPLE DATA**

Geophysical Log: ☐
Comments:



Depth (feet)	WELL DETAIL	Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.)	RQD. / USCS	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
	Locking protective casing							
0		1	3-4-6-6	1.5			**OVERBURDEN** Brown/tan fm SAND, some Silt, trace c Sand, dry	
	Cement/Bentonite Grout	2	7-9-11-11	2.0			Light brown f SAND and SILT, little clay, dry	
5		3	5-7-8-11	2.0			Brown/reddish CLAY and f SAND, little Silt, moist at tip	
	Bentonite Seal	4	11-9-9-8	2.0			Medium Brown CLAY, some Silt, moist	
	Sand Pack (#0)	5	3-4-4-4	2.0			Medium Brown silty CLAY, trace f Sand, wet	
10		6	4-4-5-2	2.0			Brown f SAND and silty CLAY, moist	
		7	wh-wh-2-2	1.0				
15	PVC Screen (.010" slot)	8	wh-wh-1-2	2.0			Brown silty CLAY in top 2", grading into grey CLAY, some Silt, trace f Sand, saturated	
		9	wh-1-2-2	1.0			Grey CLAY, trace Silt, saturated	
		10	wh-wh-wh-1	1.5				
20		11	wh-wh-wh-wh	2.0			Grey CLAY, some silty Clay, saturated	
		12	wh-2-3-3	2.0			Grey silty CLAY, saturated	
25		13	wr-1-1-1	2.0				
		14	wh-wh-2-3	2.0				
		15	wh-wh-wh-wh	2.0				
30							End of Borehole	
35								

BROWN AND CALDWELL	BORING LOG	Well Name/Location: MW-26S
Project: *Off Site Well Installation* **Client:** *Dyno Nobel*	**Project No.:** *23167.001*	**Start Date:** *8/28/02* **Finish Date:** *8/28/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

Method: *Bailer*
Duration: *2 Hours*
Gals. Purged: *3*
Slug Test: *NA*

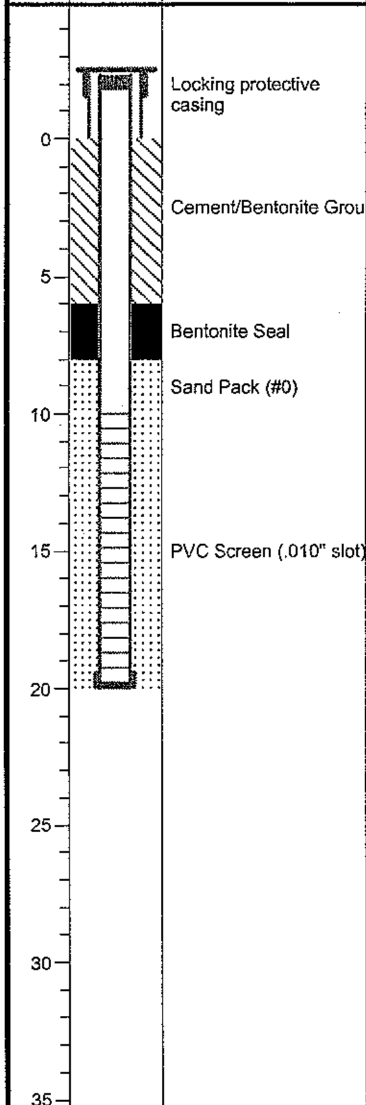
SURVEY DATA

Datum:

Grade: *151.70*	**North:** *687255.69*
TWC: *154.49*	**East:** *594867.10*
TPC:	

SOIL / ROCK — SAMPLE DATA

Geophysical Log: ☐
Comments:



Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.)	RQD. / USCS	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
					OVERBURDEN	
1	3-4-4-4	2.0			Brownish/red f SAND and silty CLAY, moist	
2	2-4-5-6	2.0			Reddish brown silty CLAY, trace f Sand grading into grey Clay in the tip, moist	
3	2-1-2-2	1.5			Grey f SAND and silty CLAY, wet	
4	2-3-2-2	1.5			Grey CLAY, trace Silt, wet	
5	1-1-2-1	1.5			Grey silty CLAY, saturated	
					End of Borehole	

BROWN AND CALDWELL | **BORING LOG** | **Well Name/Location: MW-26D**

Project: *Off Site Well Installation* **Project No.:** *23167.001*
Client: *Dyno Nobel*
Start Date: *8/27/02*
Finish Date: *8/27/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *85*
Slug Test: *NA*

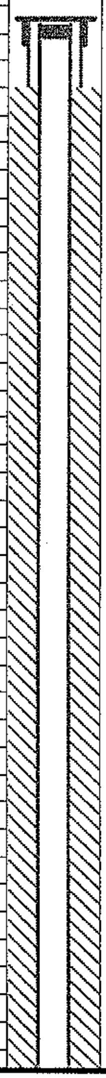
SURVEY DATA

Datum:
Grade: *150.96* **North:** *687260.02*
TWC: *153.70* **East:** *594875.20*
TPC:

SOIL / ROCK — **SAMPLE DATA**

Geophysical Log: ☐
Comments:

WELL DETAIL



Locking protective casing

Cement/Bentonite Grout

Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.)	RQD. / USCS	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
1	2-3-5-9	2.0			**OVERBURDEN** Light brown fm SAND, some Silt, trace Clay, dry	
2	10-9-11-12	2.0			Light brown f SAND and clayey SILT, dry	
3	4-6-7-8	2.0			Brown f SAND and clayey SILT, dry	
4	5-5-5-6	2.0			Brown silty CLAY, some f Sand, moist	
5	3-3-5-5	2.0			Brown/grey silty Clay, trace f Sand, moist	
6	1-4-3-5	2.0				
7	4-6-5-5	2.0			Brown f SAND and CLAY, trace Silt, moist	
8	1-2-2-2	1.0			Brown/grey CLAY, trace Silt, wet	
9	1-3-2-3	1.5			Grey CLAY and SILT, some silty Clay, wet	
10	wh-wh-wh-wh	2.0			Grey CLAY, trace Silt, wet	
11	wh-wh-wh-1	2.0				
12	wh-wh-wh-wh	2.0				
13	wh-wh-wh-1	2.0				
14	wh-wh-2-2	2.0				
15	wh-wh-wh-wh	2.0				
16	wr-wh-wh-wh	2.0				
17	wh-wh-wh-wh	2.0				
		2.0				

Depth (feet): 0, 5, 10, 15, 20, 25, 30, 35

BROWN AND CALDWELL | **BORING LOG** | **Well Name/Location: MW-26D**

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/27/02*
Finish Date: *8/27/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

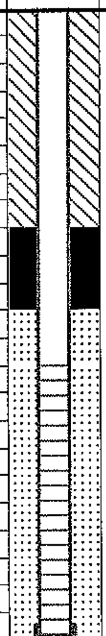
Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *85*
Slug Test: *NA*

SURVEY DATA

Datum:
Grade: *150.96* **North:** *687260.02*
TWC: *153.70* **East:** *594875.20*
TPC:

SOIL / ROCK — **SAMPLE DATA**

Geophysical Log: ☐
Comments:



Depth (feet): 40, 45, 50, 55, 60, 65, 70, 75

Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.)	RQD. / USCS	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
18	wr-wh-wh-wh	2.0				
19	wh-wh-1-1	2.0			Grey silty CLAY, saturated	
20	wr-wr-wh-wh	2.0				
21	wr-wh-wh-wh	2.0				
22	wr-wr-wh-wh	2.0			Grey CLAY, trace Silt, saturated	
23	wh-wh-wh-wh	2.0			Grey f SAND and silty CLAY, trace m Sand, saturated	
24	wh-2-3-4	2.0			Grey CLAY and SILT, trace f Sand, saturated	
25	wh-wh-wh-wh	2.0				
26	1-2-2-3	2.0			Grey silty CLAY, trace f Gravel, saturated	
28	4-6-7-8	1.5			Grey CLAY and f SAND, some c Sand, little fm Gravel, saturated	
30	11-15-20-30	2.0			Grey mc SAND, some fm Gravel, trace Silt, saturated	
31	27-28-38-49	2.0			Grey weathered bedrock (shale?) / Grey fmc SAND and fm Gravel, some c Gravel, trace Silt, saturated	
					End of Borehole	

EHS Support

Monitoring Well ID: MW-27R

Project / Site: Port Ewen	
Location: Hercules, Inc. Site #356001, Port Ewen, NY	
Date Started:	Date Finished:
Ground Surface Elevation (NAVD 88): 163.70	Top of Casing Elevation (NAVD 88): 164.82
NY State Plane Coordinates (NAD 83): 1110730.3 632085.33	Total Depth: 67.5 feet (ft)
Drilling Method:	Borehole Diameter:
Rig Type:	Tooling Type:
Drilling Co:	Sampler Type:
Drilled by:	Logged by:

Sketch Map: Refer to Figure

Client: Dyno Nobel, Inc.

Project Number: REM_C00363_2022

EHS Support PM: Kristen VanLandingha

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
	0					
	1					Top of Lacustrine Silt and Clay
162	2					
	3					
160	4					
	5					
158	6					
	7					
156	8					
	9					
154	10					
	11					
152	12					
	13					
150	14					
	15					
148	16					
	17					
146	18					
	19					
144	20					
	21					
142	22					
	23					
140	24					
	25					

Well Construction
- Open Hole
- Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS).

Depth to water in borehole during drilling (ft bgs):____

Depth to water in well after drilling (ft bTOC): ____

Boring: MW-27R

EHS Support

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
	25					
138	26					
	27					
136	28					
	29					
134	30					
	31					
132	32					
	33					
130	34					
	35					
128	36					
	37					
126	38					
	39					
124	40					
	41					
122	42					
	43					
120	44					
	45					
118	46					
	47					
116	48					
	49					
114	50					

Well Construction

Open Hole

Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs):

Depth to water in well after drilling (ft bTOC):

Boring: MW-27R

EHS Support

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
	50					Top of Glacial Outwash
	51					
112	52					
	53					
110	54					
	55					Top of Austin Glen
108	56					
	57					
106	58					
	59					
104	60					
	61					
102	62					
	63					
100	64					
	65					
98	66					
	67					
96	68					
	69					
94	70					
	71					
92	72					
	73					
90	74					
	75					

Well Construction

Open Hole

Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs): ____

Depth to water in well after drilling (ft bTOC): ____

Boring: MW-27R

EHS Support

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
	75					
88	76					
	77					
86	78					
	79					
84	80					
	81					
82	82					
	83					
80	84					
	85					
78	86					
	87					
76	88					
	89					
74	90					
	91					
72	92					
	93					
70	94					
	95					
68	96					
	97					
66	98					
	99					
64	100					

Well Construction

Open Hole

Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs): ____

Depth to water in well after drilling (ft bTOC): ____

Boring: MW-27R

EHS Support

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
38	125					
	126					
36	127					
	128					
34	129					
	130					
32	131					
	132					
30	133					
	134					
28	135					
	136					
26	137					
	138					
24	139					
	140					
22	141					
	142					
20	143					
	144					
18	145					
	146					
16	147					
	148					
14	149					
	150					

WELL CONSTRUCTION

Open Hole   Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs): ____

Depth to water in well after drilling (ft bTOC): ____

Boring: MW-27R

EHS Support

Monitoring Well ID: MW-27R

Project / Site: Port Ewen	
Location: Hercules, Inc. Site #356001, Port Ewen, NY	
Date Started:	Date Finished:
Ground Surface Elevation (NAVD 88): 166.59	Top of Casing Elevation (NAVD 88): 168.43
NY State Plane Coordinates (NAD 83): 1110016.6 632077.29	Total Depth: 77.5 feet (ft)
Drilling Method:	Borehole Diameter:
Rig Type:	Tooling Type:
Drilling Co:	Sampler Type:
Drilled by:	Logged by:

Sketch Map: Refer to Figure

Client: Dyno Nobel, Inc.

Project Number: REM_C00363_2022

EHS Support PM: Kristen VanLandingha

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
	0					
166	1					Top of Lacustrine Silt and Clay
	2					
164	3					
	4					
162	5					
	6					
160	7					
	8					
158	9					
	10					
156	11					
	12					
154	13					
	14					
152	15					
	16					
150	17					
	18					
148	19					
	20					
146	21					
	22					
144	23					
	24					
142	25					

Well Construction
- Open Hole
- Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS).

Depth to water in borehole during drilling (ft bgs):____

Depth to water in well after drilling (ft bTOC): ____

Boring: MW-28R

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
	25					
	26					
140						
	27					
	28					
138						
	29					
	30					
136						
	31					
	32					
134						
	33					
	34					
132						
	35					
	36					
130						
	37					
	38					
128						
	39					
	40					
126						
	41					
	42					
124						
	43					
	44					
122						
	45					
	46					
120						
	47					
	48					
118						
	49					
	50					

Well Construction

Open Hole

Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs): ____

Depth to water in well after drilling (ft bTOC): ____

EHS Support

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
116	50					
	51					
	52					
114	53					
	54					
112	55					
	56					
110	57					
	58					
108	59					Top of Glacial Outwash
	60					
106	61					
	62					
104	63					
	64					
102	65					Top of Austin Glen
	66					
100	67					
	68					
98	69					
	70					
96	71					
	72					
94	73					
	74					
92	75					

Well Construction

Open Hole

Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs): ____

Depth to water in well after drilling (ft bTOC): ____

Boring: MW-28R

EHS Support

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
	75					
	76					
90	77					
	78					
88	79					
	80					
86	81					
	82					
84	83					
	84					
82	85					
	86					
80	87					
	88					
78	89					
	90					
76	91					
	92					
74	93					
	94					
72	95					
	96					
70	97					
	98					
68	99					
	100					

Well Construction

Open Hole

Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs): ____

Depth to water in well after drilling (ft bTOC): ____

Boring: MW-28R

EHS Support

Elevation (NAVD 88)	Depth (feet)	Lithologic Column	Lithologic Description	PID (PPM)	Well Diagram	Notes
	125					
	126					
40	127					
	128					
38	129					
	130					
36	131					
	132					
34	133					
	134					
32	135					
	136					
30	137					
	138					
28	139					
	140					
26	141					
	142					
24	143					
	144					
22	145					
	146					
20	147					
	148					
18	149					
	150					

WELL CONSTRUCTION

Open Hole   Steel Casing

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs):

Depth to water in well after drilling (ft bTOC):

Boring: MW-28R

Page: 5 of 5

EHS Support

APPENDIX E – PUBLIC AND PRIVATE WELL SEARCH REPORT

Port Ewen
161 Ulster Avenue
Ulster Park, NY 12487

Inquiry Number: 5620274.1s
April 12, 2019

The EDR GeoCheck® Report

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION | **PAGE**

GEOCHECK ADDENDUM

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

GEOCHECK® - PHYSICAL SETTING SOURCE REPORT

TARGET PROPERTY ADDRESS

PORT EWEN
161 ULSTER AVENUE
ULSTER PARK, NY 12487

TARGET PROPERTY COORDINATES

Latitude (North):	41.881692 - 41˚ 52' 54.09''
Longitude (West):	73.987834 - 73˚ 59' 16.20''
Universal Tranverse Mercator:	Zone 18
UTM X (Meters):	583983.1
UTM Y (Meters):	4636922.5
Elevation:	166 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	41073-H8 KINGSTON EAST, NY
Version Date:	1980
South Map:	41073-G8 HYDE PARK, NY
Version Date:	1997
Southwest Map:	41074-G1 ROSENDALE, NY
Version Date:	1980
West Map:	41074-H1 KINGSTON WEST, NY
Version Date:	1997

EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principle investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

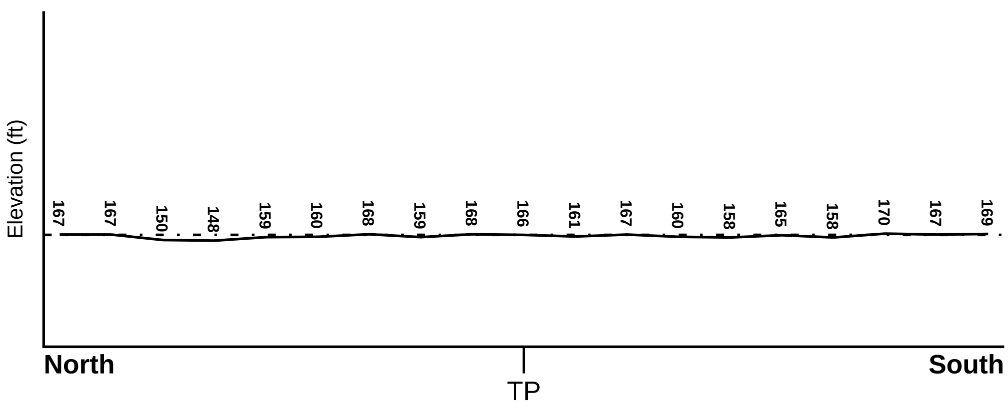
TOPOGRAPHIC INFORMATION

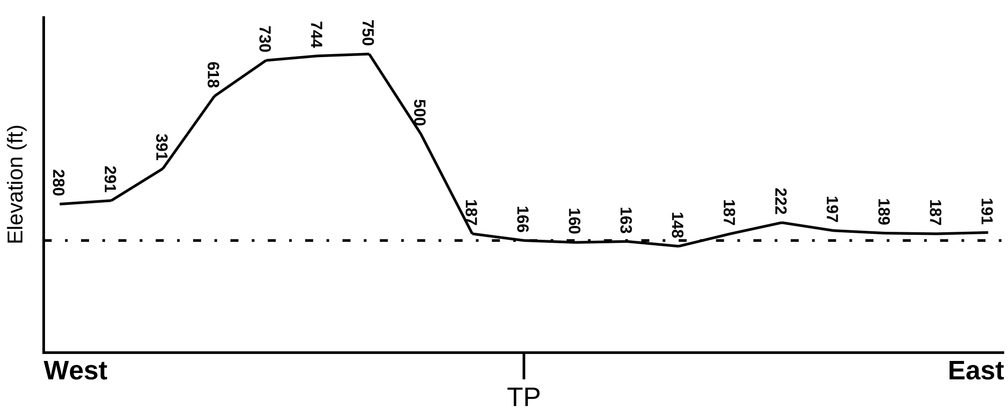
Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General East

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES





Target Property Elevation: 166 ft.

Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Flood Plain Panel at Target Property	FEMA Source Type
36111C0490E	FEMA FIRM Flood data

Additional Panels in search area:	FEMA Source Type
36111C0470E	FEMA FIRM Flood data
36111C0610E	FEMA FIRM Flood data
36111C0630E	FEMA FIRM Flood data

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
KINGSTON EAST	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Site-Specific Hydrogeological Data*:

Search Radius: 1.25 miles
Status: Not found

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

GEOLOGIC AGE IDENTIFICATION

Era:	Paleozoic
System:	Ordovician
Series:	Middle Ordovician (Mohawkian)
Code:	O2 *(decoded above as Era, System & Series)*

Category: Stratified Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	VARYSBURG
Soil Surface Texture:	gravelly - loam
Hydrologic Group:	Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.
Soil Drainage Class:	Well drained. Soils have intermediate water holding capacity. Depth to water table is more than 6 feet.

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel:	HIGH
Depth to Bedrock Min:	> 60 inches
Depth to Bedrock Max:	> 60 inches

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	9 inches	gravelly - loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 6.00 Min: 0.60	Max: 6.00 Min: 5.10
2	9 inches	21 inches	very gravelly - loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 6.00 Min: 0.60	Max: 6.00 Min: 5.10
3	21 inches	28 inches	very gravelly - loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 6.00 Min: 0.60	Max: 7.80 Min: 6.10
4	28 inches	41 inches	silty clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 0.06 Min: 0.00	Max: 7.80 Min: 6.10
5	41 inches	60 inches	silty clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 0.06 Min: 0.00	Max: 7.80 Min: 6.10

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: silt loam
silty clay loam
channery - silt loam

Surficial Soil Types: silt loam
silty clay loam
channery - silt loam

Shallow Soil Types: gravelly - loam
silty clay loam
loam

	channery - silt loam channery - sandy loam silt loam sandy clay loam gravelly - sandy clay loam silty clay
Deeper Soil Types:	stratified very gravelly - fine sandy loam silt loam very channery - silt loam

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	1.000
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
1	USGS40000848350	1/2 - 1 Mile SSE
2	USGS40000848349	1/2 - 1 Mile SE
3	USGS40000848457	1/2 - 1 Mile NNE
A5	USGS40000848472	1/2 - 1 Mile North
A6	USGS40000848471	1/2 - 1 Mile North

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
4	NY0003382	1/2 - 1 Mile North
7	NY0021830	1/2 - 1 Mile South
8	NY0003382	1/2 - 1 Mile North

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

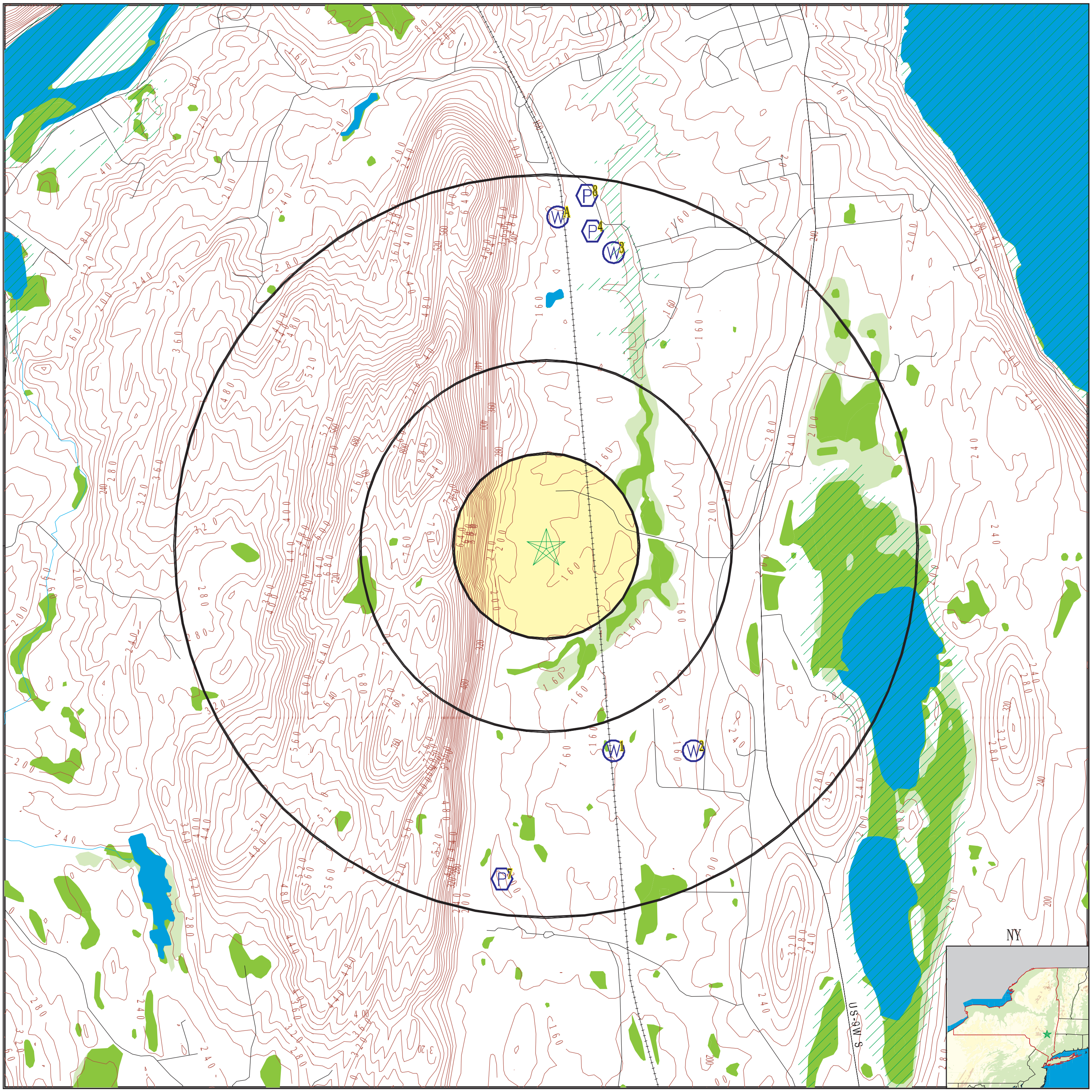
MAP ID	WELL ID	LOCATION FROM TP

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

PHYSICAL SETTING SOURCE MAP - 5620274.1s



County Boundary
Major Roads
Contour Lines
Earthquake epicenter, Richter 5 or greater
Water Wells
Public Water Supply Wells
Cluster of Multiple Icons

Groundwater Flow Direction
Indeterminate Groundwater Flow at Location
Groundwater Flow Varies at Location
Closest Hydrogeological Data
Oil, gas or related wells
100-year flood zone
500-year flood zone
National Wetland Inventory

SITE NAME: Port Ewen ADDRESS: 161 Ulster Avenue Ulster Park NY 12487 LAT/LONG: 41.881692 / 73.987834	CLIENT: EHS Support CONTACT: Brianna Sadoski INQUIRY #: 5620274.1s DATE: April 12, 2019 12:40 pm

Map ID Direction Distance Elevation		Database	EDR ID Number
1 **SSE** **1/2 - 1 Mile** **Lower**		**FED USGS**	**USGS40000848350**

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1184	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Not Reported	Formation Type:	Paleozoic Erathem
Aquifer Type:	Not Reported	Construction Date:	Not Reported
Well Depth:	68	Well Depth Units:	ft
Well Hole Depth:	Not Reported	Well Hole Depth Units:	Not Reported

2 **SE** **1/2 - 1 Mile** **Higher**		**FED USGS**	**USGS40000848349**

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1183	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Not Reported	Formation Type:	Conneaut Group
Aquifer Type:	Not Reported	Construction Date:	Not Reported
Well Depth:	100	Well Depth Units:	ft
Well Hole Depth:	Not Reported	Well Hole Depth Units:	Not Reported

3 **NNE** **1/2 - 1 Mile** **Lower**		**FED USGS**	**USGS40000848457**

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1203	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Sand and gravel aquifers (glaciated regions)		
Formation Type:	Sand and Gravel	Aquifer Type:	Not Reported
Construction Date:	Not Reported	Well Depth:	50
Well Depth Units:	ft	Well Hole Depth:	Not Reported
Well Hole Depth Units:	Not Reported		

4 **North** **1/2 - 1 Mile** **Lower**		**FRDS PWS**	**NY0003382**

PWS ID:	NY0003382	PWS type:	System Owner/Responsible Party
PWS name:	MABIE ROGER	PWS address:	PORT EWEN WD
PWS address:	TOWN HALL-BROADWAY	PWS city:	PORT EWEN

PWS state:	NY	PWS zip:	12466
PWS ID:	NY0003382	Activity status:	Active
Date system activated:	Not Reported	Date system deactivated:	Not Reported
Retail population:	00004800	System name:	PORT EWEN WATER DISTRICT
System address:	Not Reported	System address:	RIVER ROAD
System city:	PORT EWEN	System state:	NY
System zip:	12466		
County FIPS:	055	City served:	ESOPUS (T)
Latitude:	415338	Longitude:	0735909
Latitude:	415343	Longitude:	0735910
Latitude:	415312	Longitude:	0735734

A5
North
1/2 - 1 Mile
Lower

FED USGS **USGS40000848472**

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1206	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Sand and gravel aquifers (glaciated regions)		
Formation Type:	Sand and Gravel	Aquifer Type:	Not Reported
Construction Date:	Not Reported	Well Depth:	61
Well Depth Units:	ft	Well Hole Depth:	Not Reported
Well Hole Depth Units:	Not Reported		

A6
North
1/2 - 1 Mile
Lower

FED USGS **USGS40000848471**

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1204	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Not Reported	Formation Type:	Paleozoic Erathem
Aquifer Type:	Not Reported	Construction Date:	Not Reported
Well Depth:	220	Well Depth Units:	ft
Well Hole Depth:	Not Reported	Well Hole Depth Units:	Not Reported

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7
South
1/2 - 1 Mile
Higher

FRDS PWS **NY0021830**

PWS ID:	NY0021830	PWS type:	System Owner/Responsible Party
PWS name:	MOMMSEN MARCUS	PWS address:	HUTTERIAN BRETHREN SOCIETY
PWS address:	ROSENTHAL LANE	PWS city:	ESOPUS
PWS state:	NY	PWS zip:	12487
PWS ID:	NY0021830	Activity status:	Active

Date system activated:	Not Reported	Date system deactivated:	Not Reported
Retail population:	00000280	System name:	HUTTERIAN PLEASANT VIEW
System address:	Not Reported	System address:	ROSENTHAL LANE
System city:	ULSTER PARK	System state:	NY
System zip:	12487		
County FIPS:	055	City served:	ESOPUS (T)
Population served:	101 - 500 Persons	Treatment:	Treated
Latitude:	415207	Longitude:	0735926
Latitude:	415158	Longitude:	0735917
Latitude:	415158	Longitude:	0735918

8
North
1/2 - 1 Mile
Lower

FRDS PWS NY0003382

PWS ID:	NY0003382	PWS type:	System Owner/Responsible Party
PWS name:	MABIE ROGER	PWS address:	PORT EWEN WD
PWS address:	TOWN HALL-BROADWAY	PWS city:	PORT EWEN
PWS state:	NY	PWS zip:	12466
PWS ID:	NY0003382	Activity status:	Active
Date system activated:	Not Reported	Date system deactivated:	Not Reported
Retail population:	00004800	System name:	PORT EWEN WATER DISTRICT
System address:	Not Reported	System address:	RIVER ROAD
System city:	PORT EWEN	System state:	NY
System zip:	12466		
County FIPS:	055	City served:	ESOPUS (T)
Latitude:	415338	Longitude:	0735909
Latitude:	415343	Longitude:	0735910
Latitude:	415312	Longitude:	0735734

AREA RADON INFORMATION

State Database: NY Radon

Radon Test Results

County	Town	Num Tests	Avg Result	Geo Mean	Max Result
ULSTER	DENNING	6	13.02	6.92	45.4
ULSTER	ESOPUS	50	3.52	2.41	15.6
ULSTER	GARDINER	48	4.3	2.76	24.6
ULSTER	HARDENBURGH	3	3.33	2.22	7.6
ULSTER	HURLEY	75	5.05	3.41	30.2
ULSTER	KINGSTON	229	4.09	2.88	21.6
ULSTER	LLOYD	96	5.7	3.31	38.1
ULSTER	MARBLETOWN	65	5.96	3.15	99.5
ULSTER	MARLBOROUGH	44	5.41	3.79	17.1
ULSTER	NEW PALTZ	132	4.18	2.75	44.3
ULSTER	OLIVE	45	5.09	3.37	27.6
ULSTER	PLATTEKILL	29	3.23	2.15	14
ULSTER	ROCHESTER	38	4.27	2.63	21.3
ULSTER	ROSENDALE	39	3.08	2.3	10.3
ULSTER	SAUGERTIES	169	7.41	2.59	175.7
ULSTER	SHANDAKEN	13	6.82	3.71	24.2
ULSTER	SHAWANGUNK	82	7.22	3.78	56.1
ULSTER	ULSTER	52	3.44	2.48	11.4
ULSTER	WAWARSING	48	4.8	2.63	31.2
ULSTER	WOODSTOCK	105	5.12	2.71	114.3

Federal EPA Radon Zone for ULSTER County: 1

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for ULSTER COUNTY, NY

Number of sites tested: 95

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area	1.190 pCi/L	95%	4%	1%
Basement	2.610 pCi/L	68%	29%	2%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

HYDROLOGIC INFORMATION

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Freshwater Wetlands
Source: Department of Environmental Conservation
Telephone: 518-402-8961

HYDROGEOLOGIC INFORMATION

AQUIFLOW[R] Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Service, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

New York Public Water Wells
Source: New York Department of Health
Telephone: 518-458-6731

OTHER STATE DATABASE INFORMATION

Oil and Gas Well Database
Source: Department of Environmental Conservation
Telephone: 518-402-8072
These files contain records, in the database, of wells that have been drilled.

RADON

State Database: NY Radon
Source: Department of Health
Telephone: 518-402-7556
Radon Test Results

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Earthquake Fault Lines: The fault lines displayed on EDR’s Topographic map are digitized quaternary faultlines, prepared in 1975 by the United State Geological Survey

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

APPENDIX F – EXCAVATION WORK PLAN (EWP)

F-1 NOTIFICATION

At least 15 days prior to the start of any activity that is anticipated to encounter remaining Site contamination, the site owner or their representative will notify the NYSDEC contacts listed in the table below. Table 1 includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of site-related contact information is provided in **Appendix C** of this ISMP.

Table 1: Notifications*

Mark Domaracki, P.G., NYSDEC Project Manager	(518) 402-9832 mark.domaracki@dec.ny.gov
Kerry Maloney, NYSDEC Project Manager's Supervisor	(518) 402-9629 kerry.maloney@dec.ny.gov

* Note: Notifications are subject to change and will be updated, as necessary.

This notification will include:

- A detailed description of the work to be performed, including the location and areal extent of excavation, plans/drawings for site re-grading, intrusive elements or utilities to be installed below the soil cover, estimated volumes of contaminated soil to be excavated, any modifications of truck routes, and any work that may impact an engineering control;

- A summary of environmental conditions anticipated to be encountered in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;
- A schedule for the work, detailing the start and completion of all intrusive work, and submittals (e.g., reports) to the NYSDEC documenting the completed intrusive work;
- A summary of the applicable components of this EWP;
- A statement that the work will be performed in compliance with this EWP, 29 CFR 1910.120 and 29 CFR 1926 Subpart P;
- A copy of the contractor's health and safety plan (HASP), in electronic format;
- Identification of disposal facilities for potential waste streams; and
- Identification of sources of any anticipated backfill, along with the required request to import form and all supporting documentation including, but not limited to, chemical testing results.

The NYSDEC project manager will review the notification and may impose additional requirements for the excavation that are not listed in this EWP. The alteration, restoration and modification of engineering controls must conform with Article 145 Section 7209 of the Education Law regarding the application professional seals and alterations.

F-2 SOIL SCREENING METHODS

Visual, olfactory, and instrument-based (e.g., photoionization detector) soil screening will be performed during all excavations into known or potentially contaminated material (remaining contamination). A qualified environmental professional as defined in 6 NYCRR Part 375, a PE who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York State will perform the screening. Soil screening will be performed when invasive work is done and will include all excavation and invasive work performed during development, such as excavations for foundations and utility work.

Soils will be segregated based on previous environmental data and screening results into material that requires off-site disposal and material that requires testing to determine if the material can be reused on-site as soil beneath a cover or if the material can be used as cover soil. Further discussion of off-site disposal of materials and on-site reuse is provided in Sections F-6 and F-7 of this Appendix.

F-3 SOIL STAGING METHODS

Soil stockpiles will be continuously encircled with a berm and/or silt fence. Hay bales will be used as needed near catch basins, surface waters and other discharge points.

Stockpiles will be kept covered at all times with appropriately anchored tarps. Stockpiles will be routinely inspected and damaged tarp covers will be promptly replaced.

Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC.

F-4 MATERIALS EXCAVATION AND LOAD-OUT

A qualified environmental professional as defined in 6 NYCRR Part 375, a PE who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York State will oversee all invasive work and the excavation and load-out of all excavated material.

The owner of the property and remedial party (if applicable) and its contractors are responsible for safe execution of all invasive and other work performed under this Plan.

The presence of utilities and easements on the site will be investigated by the qualified environmental professional. It will be determined whether a risk or impediment to the planned work under this SMP is posed by utilities or easements on the site. A site utility stakeout will be completed for all utilities prior to any ground intrusive activities at the site.

Loaded vehicles leaving the site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements). Trucks transporting contaminated soil must have either tight-fitting opaque covers that are secured on the sides and/or back, or opaque covers that are locked on all sides.

A truck wash will be operated on-site, as appropriate. The qualified environmental professional will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the site until the activities performed under this section are complete. Truck wash waters will be collected and disposed of off-site in an appropriate manner.

Locations where vehicles enter or exit the site shall be inspected daily for evidence of off-site soil tracking.

The qualified environmental professional will be responsible for ensuring that all egress points for truck and equipment transport from the site are clean of dirt and other materials derived from the site during intrusive excavation activities. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to site-derived materials. Material accumulated from the street cleaning and egress cleaning activities will be disposed off-site at a permitted landfill facility in accordance with all applicable local, State, and Federal regulations.

F-5 MATERIALS TRANSPORT OFF-SITE

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Material transported by trucks exiting the site will be secured with either tight-fitting opaque covers that are secured on the sides and/or back, or opaque covers that are locked on all sides. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

Truck transport routes will be determined based on the waste characterization results and the selected off-site disposal facility allowing deliveries at the time of the Site work. All trucks loaded with site materials will exit the vicinity of the site using only these approved truck routes. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport;

Trucks will be prohibited from stopping and idling in the neighborhood outside the project site.

Egress points for truck and equipment transport from the site will be kept clean of dirt and other materials during site remediation and development.

Queuing of trucks will be performed on-site in order to minimize off-site disturbance. Off-site queuing will be prohibited.

F-6 MATERIALS DISPOSAL OFF-SITE

All material excavated and removed from the site will be treated as contaminated and regulated material and will be transported and disposed off-site in a permitted facility in accordance with all local, State and Federal regulations. If disposal of material from this site is proposed for unregulated off-site disposal (i.e., clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC project manager. Unregulated off-site management of materials from this site will not occur without formal NYSDEC project manager approval.

Off-site disposal locations for excavated soils will be identified in the pre-excavation notification. This will include estimated quantities and a breakdown by class of disposal facility if appropriate, (e.g., hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, C&D debris recovery facility). Actual disposal quantities and associated documentation will be reported to the NYSDEC in the Periodic Review Report. This documentation will include, but will not be limited to: waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and contaminated soils taken off-site will be handled consistent with 6 NYCRR Parts 360, 361, 362, 363, 364 and 365. Material that does not meet Unrestricted SCOs is prohibited from being taken to a New York State C&D debris recovery facility (6 NYCRR Subpart 361-5 registered or permitted facility).

F-7 MATERIALS REUSE ON-SITE

The qualified environmental professional, as defined in 6 NYCRR Part 375, will ensure that procedures defined for materials reuse in this SMP are followed and that unacceptable material (i.e., contaminated) does not remain on-site. Contaminated on-site material, including historic fill and contaminated soil, that is acceptable for reuse on-site will be placed below the demarcation layer or impervious surface, and will not be reused within the cover system or within landscaping berms. Contaminated on-site material may only be used beneath the site cover as backfill for subsurface utility lines with prior approval from the DEC project manager.

Proposed materials for reuse on-site must be sampled for full suite analytical parameters including per- and polyfluoroalkyl substances (PFAS) and 1,4-dioxane. The sampling frequency will be in accordance with DER-10 Table 5.4(e)10 unless prior approval is obtained from the NYSDEC project manager for modification of the sampling frequency. The analytical results of soil/fill material testing must meet the site use criteria presented in NYSDEC DER-10 Appendix 5 – Allowable Constituent Levels for Imported Fill or Soil for all constituents listed, and the NYSDEC Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (April 2023 or date of current version, whichever is later) guidance values. Approvals for modifications to the analytical parameters must be obtained from the NYSDEC project manager prior to the sampling event.

Soil/fill material for reuse on-site will be segregated and staged as described in Sections F-2 and F-3 of this EWP. The anticipated size and location of stockpiles will be provided in the 15-day notification to the NYSDEC project manager. Stockpile locations will be based on the location of site excavation activities and proximity to nearby site features. Material reuse on-site will comply with requirements of NYSDEC DER-10 Section 5.4(e)4. Any modifications to the requirements of DER-10 Section 5.4(e)4 must be approved by the NYSDEC project manager.

Any demolition material proposed for reuse on-site will be sampled for asbestos and the results will be reported to the NYSDEC for acceptance. Concrete crushing or processing on-site will not be performed without prior NYSDEC approval. Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the site may only be reused on-site with written approval from the NYSDEC project manager.

F-8 FLUIDS MANAGEMENT

All liquids to be removed from the site, including but not limited to, excavation dewatering, decontamination waters and groundwater monitoring well purge and development waters, will be handled, transported, and disposed off-site at a permitted facility in accordance with applicable local, State, and Federal regulations. Dewatering, purge, and development fluids will not be recharged back to the land surface or subsurface of the site, and will be managed off-site, unless prior approval is obtained from NYSDEC.

Discharge of water generated during large-scale construction activities to surface waters (i.e., a local pond, stream, or river) will be performed under a SPDES permit.

F-9 COVER SYSTEM RESTORATION

After the completion of soil removal and any other invasive activities the current land surface will be replaced in kind. A demarcation layer, consisting of geotextile or equivalent material, etc. will be replaced to provide a visual reference to the top of the remaining contamination zone, the zone that requires adherence to special conditions for disturbance of remaining contaminated soils defined in this ISMP.

F-10 BACKFILL FROM OFF-SITE SOURCES

All materials proposed for import onto the site will be approved by the qualified environmental professional, as defined in 6 NYCRR Part 375, and will be in compliance with provisions in this SMP prior to receipt at the site. A Request to Import/Reuse Fill or Soil form, which can be found at http://www.dec.ny.gov/regulations/67386.html, will be prepared and submitted to the NYSDEC project manager allowing a minimum of 5 business days for review. A copy of the form is presented in **Appendix I**.

Material from industrial sites, spill sites, other environmental remediation sites, or potentially contaminated sites will not be imported to the site.

All imported soils will meet the backfill and cover soil quality standards established in 6 NYCRR 375-6.7(d) and DER-10 Appendix 5 for commercial use. Based on an evaluation of the land use, protection of groundwater and protection of ecological resources criteria, the resulting soil quality standards can be found at https://govt.westlaw.com/nycrr/Document/I4eadfca8cd1711dda432a117e6e0f345?transitionType=Default&contextData=%28sc.Default%29. Soils that meet 'general' fill requirements under 6 NYCRR Part 360.13, but do not meet backfill or by NYSDEC project manager. Soil material will be sampled for the full suite of analytical parameters, including PFAS and 1, 4-dioxane. Solid waste will not be imported onto the site.

Trucks entering the site with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials and covered to prevent dust releases.

F-11 STORMWATER POLLUTION PREVENTION

Barriers and hay bale checks will be installed and inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments will be removed as required to keep the barrier and hay bale check functional.

All undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

Erosion and sediment control measures identified in the SMP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters.

Silt fencing or hay bales will be installed around the entire perimeter of the construction area.

F-12 EXCAVATION CONTINGENCY PLAN

If underground tanks or other previously unidentified contaminant sources are found during post-remedial subsurface excavations or development related construction, excavation activities will be suspended until sufficient equipment is mobilized to address the condition. The NYSDEC project manager will be promptly notified of the discovery.

Sampling will be performed on product, sediment and surrounding soils, etc. as necessary to determine the nature of the material and proper disposal method. Chemical analysis will be performed for a full list of analytes [TAL metals, TCL volatiles and semi-volatiles (including 1,4-dioxane), TCL pesticides and PCBs, and PFAS], unless the site history and previous sampling results provide sufficient justification to limit the list of analytes. In this case, a reduced list of analytes will be proposed to the NYSDEC project manager for approval prior to sampling. Any tanks will be closed as per NYSDEC regulations and guidance.

Identification of unknown or unexpected contaminated media identified by screening during invasive site work will be promptly communicated by phone within two hours to NYSDEC's Project Manager. Reportable quantities of petroleum product will also be reported to the NYSDEC spills hotline. These findings will be also included in the Periodic Review Report.

F-13 COMMUNITY AIR MONITORING PLAN

This Community Air Monitoring Plan (CAMP) has been designed to conform to the guidelines presented by the New York State Department of Health (NYSDOH) in Appendix 1A of the New York State Department of Conservation (NYSDEC), Division of Environmental Remediation (DER)-10, *Technical Guidance for Site Investigation and Remediation*.

This CAMP has been prepared for the Hercules, Inc. site located in Port Ewen, Ulster County, New York (NYS 356001). The purpose of the CAMP is to provide a measure of protection for the downwind community from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind communities from potential airborne contaminant releases as a direct result of investigative and remedial activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shut down. Additionally, the CAMP helps to confirm that work activities did not spread contaminants off-site through the air.

Activities completed under this scope of work include land survey, soil sampling, groundwater sampling, monitoring well installation, and investigation derived waste management (i.e., handling soil and groundwater in drums), as well as, installation of exploratory trenching. The primary COCs at the Site are metals and volatile organic compounds (VOCs).

Real-time air monitoring for VOCs at the perimeter of the exclusion zone will be conducted. Monitoring for odors will also be conducted, and odor suppressant foams and water sprays will be readily available to address dust and odor emissions. The following procedures will be implemented during field activities as appropriate:

- Continuous monitoring will be completed for all ground intrusive activities. Site specific Continuous monitoring will be conducted with a flame ionization detector (FID) or photoionization detector (PID) within the work zone to monitor changes in site conditions. Any sustained readings above background for greater than 15 minutes will require a stop work action.
- Continuous monitoring will include screening soil cores, workers breathing zone, establishing background concentrations and downwind perimeter of the immediate work area.

Periodic monitoring will be completed during non-intrusive activities. Site specific non-intrusive activities include groundwater gauging, groundwater sampling and surveying. Periodic monitoring will be conducted with a FID or PID within the work zone during each sampling event to monitor changes in site conditions. Any sustained reading above background for greater than 15 minutes will require a stop work action. "Periodic" monitoring includes taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil monitoring during well bailing/purging and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

VOCs will be monitored with the work zone and at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present (i.e., FID or PID). The equipment will be calibrated at a minimum daily. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind

of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shut down and corrective action taken.
4. All 15-minute readings must be recorded and be available for State (NYSDEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than micrometers in size (PM-10) and capable of integrating over a period of minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 150 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

All readings must be recorded and be available for the State (DEC and NYSDOH) personnel to review.

The air sampling locations will be adjusted on a daily or more frequent basis based on actual wind directions to provide an upwind and at least two downwind monitoring stations.

Exceedances of action levels listed in the CAMP will be reported to NYSDEC and NYSDOH Project Managers.

F-13A: Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures

When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices should be considered to prevent exposures related to the work activities and to control dust and odors. Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

- If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 part-per-million, monitoring should occur within the occupied structure(s). Depending upon the nature of contamination, chemical-specific colorimetric tubes of sufficient sensitivity may be necessary for comparing the exposure point concentrations with appropriate pre-determined response levels (response actions should also be pre-determined). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.

- If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 micrograms per cubic meter, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 micrograms per cubic meter or less at the monitoring point.

- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen sulfide, carbon monoxide) may also need to be monitored. Response levels and actions should be pre-determined, as necessary, for each site.

F-14 ODOR CONTROL PLAN

This odor control plan is capable of controlling emissions of nuisance odors off-site and on-site if there are tenants on the property. Specific odor control methods to be used on a routine basis will include fans, etc. If nuisance odors are identified at the site boundary, or if odor complaints are received, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified of all odor events and of any other complaints about the project. Implementation of all odor controls, including the halt of work, is the responsibility of the remedial party's Remediation Engineer, and any measures that are implemented will be discussed in the Periodic Review Report.

All necessary means will be employed to prevent on- and off-site nuisances. At a minimum, these measures will include: (a) limiting the area of open excavations and size of soil stockpiles; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

If nuisance odors develop during intrusive work that cannot be corrected, or where the control of nuisance odors cannot otherwise be achieved due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering the excavation and handling areas in a temporary containment structure equipped with appropriate air venting/filtering systems.

F-15 DUST CONTROL PLAN

Particulate monitoring must be conducted according to the Community Air Monitoring Plan (CAMP) provided in Section F-13. If particulate levels at the site exceed the thresholds listed in the CAMP or if airborne dust is observed on the site or leaving the site, the dust suppression techniques listed below will be employed. The remedial party will also take measures listed below to prevent dust production on the site.

A dust suppression plan that addresses dust management during invasive on-site work will include, at a minimum, the items listed below:

- Dust suppression will be achieved using a dedicated on-site water truck for road wetting. The truck will be equipped with a water cannon capable of spraying water directly onto off-road areas including excavations and stockpiles.
- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.
- Gravel will be used on roadways to provide a clean and dust-free road surface.
- On-site roads will be limited in total area to minimize the area required for water truck sprinkling.

F-16 OTHER NUISANCES

A plan for rodent control will be developed and utilized by the contractor prior to and during site clearing and site grubbing, and during all remedial work.

A plan will be developed and utilized by the contractor for all remedial work to ensure compliance with local noise control ordinances.

APPENDIX G - SITE MANAGEMENT FORMS

Low-Flow Groundwater Sampling Form

Project Name: ______________________

Project Number: ______________________

Time (Initial): ______________________

Initial Water Level: ______________________ ft

Depth to Product: ______________________ ft

Total Well Depth: ______________________ ft

Well Identification: ______________________

Sample Date: ______________________

Field Technician(s): ______________________

Inner Casing Diameter (in): ______________________

Pump and Tubing Type: ______________________

Start Purge Time: ______________________

Time	Flow Rate	Water Level	Temp.	pH	Conductivity	Turbidity	DO	ORP	Odor	Color	Comments
	__L/min	ft	°C / °F	S.U.	__S/cm	NTU	mg/L	mV			

Comments: ______________________

End Purge Time: ______________________

Final Water Level: ______________________ ft

Total Volume Purged: ______________________ gal

One Well Volume (prior to purging, if applicable): __________ gal

Well Purged Dry? ☐ Yes ☐ No

Tubing Inlet Depth: ______________________

SAMPLE ID	TIME	ANALYSES	QA/QC SAMPLE	REMARKS

Gas Concentration in Well:________ ppm

Formula for Calculating Well Casing Volume

$$[A] = \frac{\pi D^2 L}{4} * 7.48 \frac{gal}{ft^3}$$

D = Well casing inner diameter *(converted to feet)*

L = Height of water column (ft)

Parameter	Stabilization Criteria*
Temperature	± 3% of reading (minimum of ± 0.2 C)
pH	+/- 0.1
Specific Conductance	+/- 3%
ORP	+/- 10 millivolts
Dissolved Oxygen	+/- 0.3 milligrams per liter
Turbidity	Not a stabilization criteria; however, the lower the turbidity the better

* - USEPA, 1996 (Puls and Barcelona) Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures

Signature: ______________________

APPENDIX H – STANDARD OPERATING PROCEDURES

SOP-41 Fluid Measurement

Purpose

This SOP provides personnel procedures to use in measuring the depth to water, the depth to non-aqueous phase liquids, and the total depths in monitoring wells, piezometers, water bores, or other wells or access points (extraction wells, injection wells, etc.). For this SOP, the term “well,” “monitoring well,” or “water bore” will be used as the generic term for a water monitoring point.

Relevant EHS Support SOPs

- SOP-04 Field Documentation
- SOP-09 Field Equipment Decontamination
- SOP-42 Well Development
- SOP-43 Low Flow Groundwater Sampling
- SOP-44 Volume-Purge Method for Groundwater Sampling
- SOP-45 No Purge Groundwater Sampling
- SOP-46 Water Sampling for Chemical Analysis
- SOP-47 Microbial Sampling
- SOP-48 Continuous Water Level Monitoring
- SOP-49 Slug Test
- SOP-50 Aquifer Pumping Test

Attachments

- Attachment A Fluid Level Monitoring Forms

Required Materials

- Air monitoring instrumentation (e.g., photoionization detector [PID]) and supplies
- Field logbook and field documentation
- Site plan showing borehole locations
- Health and Safety Plan (HASP)
- Indelible ink pens and waterproof marking pens
- Fluid measurement device (e.g., water level indicator, interface probe)
- Extra batteries
- Paper towels and trash bags
- Decontamination supplies
- Information about the well or borehole including well construction details, previous well gauging data, if available.

1 Fluid Level Monitoring

Water level data is used for several purposes during a site investigation, including:

- Determination of horizontal and vertical hydraulic gradients
- Monitoring of changes in groundwater levels over time
- Assessment of surface water/groundwater interaction that occurs during various flow conditions
- Estimation of aquifer properties after aquifer testing
- Calculation of purge volume of standing water in the well for well development or water sampling
- Monitoring recharge during and after purging and aquifer testing

A water level meter will typically be used to measure the groundwater levels and total depths. If non-aqueous phase liquid (NAPL) is present in the well, an oil-water interface probe will be used. NAPL level data is generally used to estimate NAPL volume, extent, properties, and NAPL stabilization or stability.

Several devices are available to collect fluid level measurements in monitoring wells. The most commonly used include an electric water level sounder and an interface probe, which is also referred to as a membrane interface probe or an oil-water interface probe. Other types of water level indicators and recorders include weighted steel tape, chalked tape, sliding float method, airline pressure method, and automatic recording methods (data loggers). These methods are primarily used for closed systems or permanent monitoring wells.

1.1 General Well Monitoring Considerations

General knowledge of the well construction, former fluid levels, and groundwater analytical data is helpful before field mobilization. This data can be useful in determining the monitoring order of the well (less contaminated to more contamination) and can be used to confirm or deny that current measurements comply (within a certain level of accuracy) with historical measurements.

Fluid levels and well depth measurements should be made relative to an established reference point on the well casing and should be documented in the field records. This reference point is usually identified by a marking on the top of a polyvinyl chloride (PVC) well riser with a permanent marker or by notching the top of casing with a chisel for stainless steel wells. Whether a marking is present or not, the north side of the top of casing is considered the general convention reference point.

Fluid levels should be allowed to equilibrate to atmospheric conditions after removing the sealing caps. Changes in fluid levels generally occur due to:

- Atmospheric pressure changes
- Tidal influences
- Changes in river stage, impoundments levels, or flow in unlined ditches
- Pumping of nearby wells
- Precipitation.

There are no set guidelines, and appropriate equilibration times can range from minutes to hours depending on well recharge, local geology and topography, and project objectives. If fluid levels appear to rise or fall during the measurement process, allow at least three to five minutes to assess if levels have stabilized. If levels appear to change, a best determination should be made (i.e., allow more stabilization time) when to collect the water level.

2 Water Level Monitoring

Water level meters use a battery-powered probe assembly attached to a cable marked in 0.01-foot (5 millimeters) increments. These types of instruments consist of a spool of dual conductor wire and a probe attached to the end and an indicator. When the probe comes in contact with a fluid, the circuit is closed and a meter light and/or audible buzzer attached to the spool will signal contact. Note: A water level indicator is not capable of distinguishing between water and other fluids with a density close to that of water. Commonly used water level indicators are shown in **Figure 1**.

Figure 1 Water Level Indicators (Solinst and Heron)

Water level measurements are commonly taken in each monitoring well as follows:

- Immediately prior to, during, and following well development (SOP-42)
- Prior to, during, and after well purging and sampling, depending on the sampling method (SOP-43 to SOP-47)
- For any aquifer testing (SOP-48 to SOP-50).

Water level measurements may also be taken to monitor or generate water table or piezometric surfaces. When measuring wells for monitoring potentiometric surface, and if the analytical concentrations in groundwater is known for each of the wells, it is advisable to collect water levels beginning with the least contaminated well(s) and progressing to the most contaminated well(s).

2.1 Water Level Measurement Procedures

To measure water level, proceed with the following:

1. Decontaminate the water level indicator in accordance with the procedures described in SOP-09 Field Equipment Decontamination.
2. Note well ID, time of day, and date in site logbook or the appropriate field form.
3. Open well and remove well cap.
4. If required by the Project Work Plan, monitor headspace of well with a photoionization detector (PID) or plan-specified detector to assess presence of volatile organic compounds. Record results.
5. Turn on the indicator. Depress the “test button” to ensure the indicator is operating correctly. When the “test button” is depressed, the meter light should illuminate, and the audible buzzer should emit a tone. If not, assess problem.
6. Ensure the indicator’s reel is not “locked.” If it is, loosen the lock.

7. Slowly lower the water level indicator probe down the monitoring well until the probe contacts the water surface, as indicated by the audible alarm. Do not let the probe tip and tape free-fall down the well. Always hold onto the meter's reel handle.
8. Raise the probe slowly out of the water until the audible alarm stops. Continue raising and lowering the probe until a precise level is determined within 0.01 foot or 5 millimeters.
9. Record the water level in the field logbook or approved field documentation.
10. Decontaminate the water level indicator for measurement at the following well.

2.2 Total Well Depth Measurements Procedures

Total depth measurements should be routinely conducted on wells as part of routine maintenance (i.e., ensuring the well has not been compromised or is filling with sediment). Collection of total depths for this SOP refers to wells or boreholes that do not have dedicated pumps or extraction equipment (e.g., monitoring wells, piezometers). If total depths are requested on wells that have dedicated equipment, construction, operation, and extraction equipment details should be made available to assess the ability to collect a total depth reading, if a system needs to be de-energized, etc.

A water level indicator should be used to measure the total depths of wells that do not contain a separate-phase liquid.

Use the following procedures to measure the total depth of a monitoring well:
1. Visually inspect the probe tip. Confirm the zero-measurement point (**Figure 2**).
2. Slowly lower the water level meter until the cable goes slack (assume to be the bottom of the well). Do not let the probe tip and tape free-fall down the well. Always hold onto the meter's reel handle.
3. Gently raise and lower the water level meter probe to tap the bottom of the well.
4. Record the reading on the cable at the established reference point to the nearest 0.01 foot or 5 millimeters.
5. If there is an offset [e.g., 0.3 feet (9 centimeters) for some Solinst or Heron indicators] between the bottom of the probe and the water level sensor (**Figure 2**), adjust the total depth measurement accordingly (i.e., add the additional length from the zero measurement point).
6. Record the total depth measurement in the field logbook or approved field documentation.

Figure 2 Comparison of Zero Measurement Points at the Top of the Probe and 0.3 feet (9 centimeter) above the Tip of the Probe

3 NAPL Monitoring and Procedures

- Interface probe device is very similar to a water level indicator. The probe is operated from a 9-volt battery
- The probe is connected to a measuring tape that measures to the nearest 0.01 foot or 5 millimeters
- The probe contains a receiver with an audio and/or visual signal that indicates when phase changes occur.

The difference from the water level indicator is that the interface probe device detects the difference in conductivity or specific gravity between the aqueous and nonaqueous phases in the well. The device detects the presence of both light NAPL (LNAPL; floating) and dense NAPL (DNAPL; sinking) in water wells.

1. Decontaminate the interface probe in accordance with the decontamination procedure described in SOP-09 Field Equipment Decontamination.
2. Note well ID, time of day, and date in site logbook or the appropriate field form.
3. Open well and remove well cap.
4. If required in the Project Work Plan, monitor headspace of well with a PID or plan-specified detector to assess presence of volatile organic compounds. Record results.
5. Turn on the indicator. Depress the "test button" to ensure the indicator is operating correctly. When the "test button" is depressed, the meter light should illuminate, and the audible buzzer should emit a tome. If not, assess problem.
6. Ensure the indicator's reel is not "locked." If it is, loosen.
7. Slowly lower the indicator probe down the monitoring well until the probe contacts the water surface or LNAPL, as indicated by the audible alarm. Do not let the probe tip and tape free-fall down the well. Always hold onto the meter's reel handle.
8. For LNAPL:
    - Raise probe out of LNAPL until the audible alarm stops. Continue raising and lowering the probe until a precise top measurement level is determined within 0.01 foot. Record the depth.
    - Very slowly lower the probe through the LNAPL until any audio (or visual queue) is emitted from the indicator (it is important to go slowly to avoid potential mixing at the LNAPL and water interface). The audio (or visual queue) indicates the phase has passed into water. Raise and lower the probe slowly through the alternative sound depth 2 to 3 times to achieve a better lower depth for the LNAPL depth.
    - Measure the lower LNAPL depth to the nearest 0.01 foot or 5 millimeters. Record the depth.
9. For DNAPL:
    - Once the water level depth has been recorded, continue to lower the interface probe through the water column slowly. Do not let the probe tip and tape free-fall down the well.
    - Measure the upper depth of the DNAPL once an audio or visual change is emitted from the indicator. Raise and lower the probe through the alternative sound depth two to three time to achieve a better upper depth measurement for the DNAPL. Record the depth.
    - Do not continue any measurements through the DNAPL. Retrieve the probe.
10. Decontaminate the interface probe for NAPL measurement at the following well.

Note any change in the tone emitting from the interface probe when gaging for NAPL (along the length of the water column). If changes are noted at a mid-well depth, the indicator may be sensing a NAPL phase or dissolved phase present in the middle of the aquifer (i.e., neither LNAPL nor DNAPL).

3.1 Common Problems and Corrective Actions

All measuring tapes should be inspected prior to use for kinks, cracks, or tears and, if present, repaired or replaced with undamaged equipment. Bends and kinks may affect depth accuracy. The most-common problems that occur during fluid level measurement include:

- No signal (audible or visible) when unit is turned on.
    - Corrective Actions:
        - The battery is discharged. Check or change battery.
        - The circuit is malfunctioning.
- No indication of water.
    - Corrective Actions:
        - The conductive contact is dirty. Clean the contact.
        - There is an open connection in the tape. Replace tape and/or probe. The circuit is malfunctioning.
- The signal (audible or visible) is intermittent.
    - Corrective Actions:
        - There is an open connection in the tape. Replace tape and/or probe.
        - There is a loose connection in the circuit or the probe. Repair the connection.
        - Water may be cascading in from a damaged well riser or in from soil or rock layers is in an open-hole or rock well. Continue to lower the tape until the probe contacts water to emit a solid tone.
- The signal (audible or visible) is continuous when not in water.
    - Corrective Actions:
        - The conductive contact is dirty (causing bridging). Clean the contact.
        - There is a short in the tape and/or probe. A short in the tape usually is observed by missing plastic along the tape and exposure to the underlying wire. Replace tape and/or probe.

4 Records

Field notes will be kept in a bound field logbook or approved field documentation following the format specified in SOP-04 Field Documentation. The following information should be recorded when conducting fluid measurements:

- Well identification
- Depths to water, NAPL, and total depth
- Date and time
- Site conditions (e.g., floating oil or debris, gassing)
- Weather observations (e.g., wind speed, sunny or cloudy sky)
- Monitoring equipment used.
- Any unusual well or groundwater observations.

Attachment A Fluid Level Monitoring Forms

EHS Support

FLUID LEVEL MONITORING FORM

Project: ______________________________ Field Technician(s): ______________________________

Project Number: ______________________ Weather: ______________________________

Project Location: ______________________________ Equipment: ______________________________

Well ID	Top of Casing Elevation	Ground Surface Elevation	Well Info (from boring logs)			Date	Time	Product Level	Water Level	Total Depth	Comments
	(feet msl)	(feet msl)	Total Depth (feet bgs)	Screened Interval (feet bgs)	Screened Elevation (feet msl)			(feet bTOC)	(feet bTOC)	(feet bTOC)	

msl - mean sea level
bgs - below ground surface
bTOC - below top of casing

Signature: ______________________________

EHS Support

FLUID LEVEL MONITORING FORM

Project: ____________________________________

Project Number: ____________________________

Project Location: ____

Field Technician(s): ____________________________________

Weather: ____

Equipment: ____

Well ID	Date	Time	Product Level (feet bTOC)	Water Level (feet bTOC)	Total Depth (feet bTOC)	Comments

bTOC - below top of casing

Signature: ____

EHS Field Form 021
Issue Date: August 18, 2014
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Revision Date:

SOP-43 Low-Flow Groundwater Sampling

Purpose

The purpose of this SOP is to describe groundwater purging and collection procedures for groundwater samples from wells using low-flow purging and sampling techniques.

This procedure is based on the assumption that groundwater samples are able to be collected using low-flow (minimal drawdown) sampling techniques. Low-flow sampling techniques may not be practical or the best method for the collection of representative groundwater samples in all wells. In the event low-flow sampling techniques are insufficient for use, SOP 44 Volume Purge Method for Groundwater Sampling will be followed to collect the groundwater sample.

Relevant EHS Support SOPs

- SOP-04 Field Documentation
- SOP-05 Sample Management and Shipping
- SOP-07 Investigation-Derived Waste
- SOP-08 Field Equipment Operation and Calibration
- SOP-09 Field Equipment Decontamination
- SOP-41 Fluid Measurement
- SOP-44 Volume Purge Method for Groundwater Sampling
- SOP-46 Water Sampling for Chemical Analysis.

Attachments

- **Attachment A** EHS Support Low Flow Groundwater Sampling Form
- **Attachment B** Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures

Required Materials

- Air monitoring instrumentation (e.g., photoionization detector [PID]) and supplies
- Water quality meters for temperature, specific conductance, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity
- Field logbook and field documentation
- Site plan showing well or water bore locations
- Health and Safety Plan (HASP)
- Indelible ink pens and waterproof marking pen
- Pump, controller, and power source—generator or battery
- Teflon or polyethylene tubing
- Decontamination equipment and supplies
- Bucket, drums, or other large container for storing and/or transporting development water.

- Measuring equipment (tape, water level indicator)
- Global position system (GPS)
- Camera
- Appropriate sample containers, sampling kits, labels, coolers, ice, chain-of-custody forms, tape, plastic baggies
- Duct tape and wrapping tape.

1 Low-Flow Groundwater Sampling

Low-flow sampling purges stagnant water out of the well to allow sampling of formation water; however, it is intended to purge and sample only a limited interval of the well/formation. The term "low-flow" refers to the velocity at which water enters the pump or tubing intake from the surrounding formation in the immediate vicinity of the well screen. Purging at a low flow rate within the screened interval of a well should result in minimal drawdown of the water level, should minimize the mixing of stagnant water in the well with formation water, and should result in a representative sample of the formation water. The low-flow technique described in this SOP complies with the guidelines provided by Puls and Barcelona [United States Environmental Protection Agency (USEPA) Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures, 2017].

1.1 Low-Flow Groundwater Sampling Considerations

Low-flow purging has advantages and disadvantages.

Advantages	Disadvantages
• Improved sample quality by minimizing the disturbance in the well • Less mixing of the stagnant casing water with the formation water • Samples are more representative of the mobile load of contaminants present in the aquifer reducing the need for filtering the water samples • Turbidity can be lower due to the slower discharge rate • The purging and sampling time is reduced • Less operator variability; greater operator control • Better sample consistency; reduced artificial sample variability • Purge quantity is smaller resulting in less wastewater	• The necessity for more equipment such as variable speed pump with the capability to pump at low rates, a flow-through cell that includes pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), temperature, specific conductance, and a turbidity probe and meter(s) • Additional cost and time can be incurred since stabilization of water parameters may require relatively longer times • Sample results may not be reproducible if the pump is placed at a different depth within the screened interval each time the well is sampled
Low-flow purging is generally most effective with short-screened intervals (e.g., < 20 feet, < 6 meters).	Low-flow purging is generally not suitable for: • Aquifers with very low hydraulic conductivities where minimal drawdown cannot be maintained • Long screened intervals (e.g., > 9 meters) or open-hole wells where the hydraulic flow pathways are unknown • When the aquifer is contaminated by non-aqueous phase liquids (NAPL).

Selecting equipment for purging and sampling a well requires site- and project-specific considerations to ensure that all collected samples meet the project objectives and data quality requirements. Groundwater chemistry can be altered by changes in temperature, pressure, and exposure to air that are brought on by the sampling process. Therefore, it is important to select sample equipment and follow sampling procedures that minimize changes.

Factors to consider when selecting sample equipment include:

- The analytes being evaluated
- The type and location of the well being sampled
- Physical characteristics of the well (diameter and total depth)
- Depth to water
- Geology adjacent to the screened interval
- The groundwater chemistry

1.2 Equipment

1.2.1 Pumps

Pumps transport water from depth to the land surface by two methods, suction lift or positive pressure. The pumping mechanism for most suction-lift pumps is at land surface. Positive-displacement pumps (e.g., submersible and bladder) are placed below the static water level.

Control of the pumping rate is an important consideration when selecting dedicated or portable pumps. Sampling rates should be high enough to fill sample containers efficiently and with minimal exposure to the atmosphere, but low enough to minimize sample alteration by agitation or aeration. This is especially important for sensitive analytes, such as volatile organic compounds (VOCs) and trace metals. Other considerations in pump selection include:

- Suction pumps (e.g., peristaltic pumps) may be inappropriate for collecting VOCs, semi-volatile organic compounds (SVOCs), volatile petroleum compounds, and some (pH-dependent) metals. Suction lift pumps are not recommended for sampling VOCs because a vacuum is created at the intake to draw the sample to the land surface and can result in the loss of volatile organics or other dissolved gases. The lift capacity of the peristaltic pump is about 25 feet (8 to 10 meters) below ground surface.
- Positive-displacement pumps are generally preferred over suction-lift pumps.
- Dedicated pumps are preferable to portable pumps because portable pumps can create a disturbance in the water column during installation and require decontamination between wells.
- If a portable pump is selected for low-flow pumping, new or dedicated tubing must be used at each sampling location, and the pump must be lowered gently into the well to minimize disturbance to the water column.
- Depth to water effects positive-displacement pump operation. The pumping rate will typically decrease with increased depth to water.
- If a gasoline- or diesel-powered generator is used to energize the sampling pump, the power source must be located at least 10 to 20 feet (5 to 10 meters) downwind of the wellhead.

- Inertial pumps (e.g., Waterra) or bailers should never be used for low-flow sampling because they generate turbulence in the well and exacerbate degassing.

1.2.2 Tubing

Teflon or Teflon-lined polyethylene tubing is preferred when sampling VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), and inorganics. Polyvinyl chloride (PVC), polypropylene, or polyethylene tubing are to be used when collecting samples for metal and other inorganic analyses. Tubing used in low-flow purging effort generally range have an inside diameter ranging from ¼ inch or ⅜ inch (4 to 8 millimeters).

Silastic tubing is recommended for the section of tubing around the rotor head of the peristaltic pump and should be less than a foot in length.

1.2.3 Other Equipment

A multi-parameter instrument, capable of measuring pH, specific conductance, temperature, ORP, DO, and turbidity, with a flow-through cell is preferred when measuring indicator field parameters. Field instruments will be calibrated in accordance with SOP-08 Field Equipment Calibration and Operation. Details about a multi-probe water quality meter is included as Attachment B of SOP-08.

1.3 Low-Flow Sampling Precautions

The following precautions should be considered when collecting groundwater samples using low-flow sampling procedures.

- Inaccurate sample results may be caused by using contaminated equipment, cleaning materials, or sample containers.
- Establish the order the wells will be sampled. Sample order is based on logistics or the known or suspected water quality of a sample location. For contaminated sites, wells should be sampled in order of increasing chemical concentrations (known or anticipated). This minimizes the possibility for cross contamination of the sample equipment.
- Uncontrolled ambient/surrounding air conditions (i.e., truck/vehicle exhaust) can also influence the samples.
- If groundwater is extremely turbid on initiation of purge, consider bypassing the flow-through cell until groundwater clears to a visually lower turbidity level. The length of time this may take can vary on how turbid the water is, the formation around the well screen, and the analysis required on the sample. If turbidity does not decrease, the well may need to be re-developed.
- The pump or tubing intake must be in an appropriate depth within the well screen and located at a depth specified in the Project Work Plan or Quality Assurance Project Plan (QAPP). The sample depth should be consistent from sample event to sample event. Suggested intake depths might consider the following:
    - For wells with screens <10-feet (<5 m) in length, the intake should be placed approximately in the middle of the saturated portion of the screen.

- For wells with well screens greater than 10 feet (>5 meters), the primary flow zones and contaminant concentration intervals must be identified. Recommendations may include the middle of the saturated portion of the screen or mid-screen.
- For wells that have measurable non-aqueous phase liquid (NAPL), a determination if the well should be sampled should be discussed with the Project Manager. Groundwater that has NAPL may interfere with laboratory analytical equipment and has a higher potential of cross-contamination if a displacement-pressure pump is used. If low-flow sampling in a well that has NAPL is determined to be appropriate, the following is recommended:
  - Choose a purge technique such as a peristaltic pump in which the tubing can be discarded after use. A displacement-pressure pump is not recommended.
  - The preferred procedure is to remove the light NAPL (LNAPL) from the top of the water column prior to purging the well. Removal is generally accomplished by using a bailer, pumping/skimming the LNAPL, or absorbent pads.
  - If the NAPL is LNAPL and the LNAPL is not removed, lower the tubing intake a minimum of 2 feet (0.5 meters) below the LNAPL/water interface. Purge at a low discharge rate and monitor the interface depth, so the drawdown of the interface does not allow LNAPL into the tubing intake.
  - If the NAPL is dense NAPL (DNAPL), measure the depth to the DNAPL/water interface and place the tubing intake a minimum of 2 feet (0.5 meters) above the depth of the interface. Purge at a low discharge rate and monitor the water level for drawdown. Avoid purge rates that would disturb the DNAPL and allow the DNAPL to enter the tubing intake.

1.4 Low-Flow Sampling Procedures

The low-flow process can vary based on project work plan and well-specific details, and procedures may need to be adjusted to accompany variations. In general, the low-flow sampling procedures are as follows:

1. Field equipment will be calibrated in accordance with the guidelines provided in SOP-08 Field Equipment Operation and Calibration or the manufacturer's manual.
2. Field equipment will be decontaminated in accordance with SOP-09 Field Equipment Decontamination or new disposable equipment will be used as appropriate.
3. Open the well. If required, use a photoionization detector (PID) or equivalent to measure for the presence of VOCs. Record the results of the PID measurement in field logbook or approved field documentation.
4. Measure the depth to water and total depth of the well using a water level indicator. If NAPL is present, use an interface probe for fluid measurements and total depth. Fluid levels or total depths will be measured in accordance with the guidelines provided in SOP-41 Fluid Measurements. Record the measurements in the field logbook or approved field documentation.
5. Lower the pump or tubing intake slowly to the desired depth within the well screen. The determined depth should be outlined in the Project Work Plan or QAPP, or the midsection of the well screen or saturated water column of the well screen.

6. Once the pump or tubing intake is to depth, energize the pump. Set the pump controller to the desired pumping rate. Start the pump at a relatively low pumping rate, about 100 to 200 milliliters per minute (mL/min).
7. Record the purge start time.
8. Water levels, pump discharge rates, and groundwater field parameters will be measured and recorded at consistent intervals (e.g., 2- to 5-minute intervals) during purging activities.
9. Groundwater discharge rates will be measured using a graduated cylinder or equivalent to ensure purge rates are discharging between 100 to 500 mL/min. Preferably, pumping rates will be maintained between 200 to 300 mL/min.
10. Use water level measurements to help establish the optimum pump rate. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological condition. Water level measurements during the purge will be less than 0.33 feet from the initially measured groundwater depth. If drawdown is greater than 0.33 feet, lower the pumping rate and continue to monitor the water level. If drawdown continues, lower the pumping rate until water levels are consistent or rebound. If drawdown is greater than 0.33 feet but the water level depth remains at the same water level depth or rebounds, groundwater depths will be considered stable or re-entering faster than being discharged. If water level continues to drawdown at the lowest achievable pumping rate, note on field logs.
11. During purging and sample collection the water flow should be a smooth, solid stream of water with no air or gas bubbles in the tubing or flow cell. Gradually adjust the pumping rate to eliminate bubbles, if present and able.
12. Observations of clarity, color, and odor of the purged water should be recorded at successive intervals.
13. Field indicator parameters will be recorded during purging for pH, temperature (°C or °F), specific conductance (microsiemens per centimeter [µS/cm] or mS/cm), ORP (millivolts [mV]), DO (milligrams per liter [mg/L]), and turbidity (nephelometric turbidity unit [NTU]). If other units of measurement are used, the unit of measurement will be documented in the field logbook or approved field documents.
14. Turbidity will be monitored as turbidity may potentially interfere with some laboratory analyses, such as metals. Turbidity may be reduced in the sample by lowering the pumping rate.
15. Purging is considered complete when the water extraction rate and water level are consistent, and the indicators parameters have stabilized for three consecutive readings as outlined below:

Parameter	Stabilization Criteria
Temperature	± 3% of reading (minimum of ± 0.2 C)
pH	+/- 0.1
specific conductance	+/- 3%
ORP	+/- 10 millivolts
DO	+/- 0.3 milligrams per liter
Turbidity	No stabilization criteria, however, an NTU reading less than 10 NTU is preferred

16. If the field indicator parameters do not stabilize, a groundwater sample will be collected after removal of 1 well volume, or 1 hour, whichever occurs first. Calculation of a well volume is provided in SOP-44 Volume Purge Method for Groundwater Sampling.
17. If the well purges dry, the well should be sampled as soon as a sufficient volume of groundwater has re-entered the well.
18. Re-purging of the well will be performed if a well is inactive for more than 24 hours after full recharge.
19. Record the volume of water discharged during the purge event from the start time to the time of sample collection.
20. The pump should not be moved or turned off between purging and sampling. The pumping rate can be decreased for sample collection but should never be increased.
21. Prior to sampling, disconnect the tubing leading to the flow-through cell.
22. Groundwater samples will be collected in laboratory-supplied jars once purging is completed. Groundwater samples will be collected directly from the tubing (i.e., the sample will not be collected from the flow-through cell port) with the pump rate consistent with stabilization purging flow rates.
23. Groundwater samples will be collected in accordance with the Project Work Plan or QAPP and will follow the sampling guidelines provided in SOP-46 Water Sampling for Chemical Analysis.
24. Collected samples will be placed in insulated coolers containing ice to maintain a temperature of 4°C. Samples will be labeled, managed, and shipped in accordance SOP-05 Sample Management and Shipping.
25. Place the discharged water into a bucket or pump directly into an appropriate container. Dispose of the discharge water or wastes in accordance with SOP-07 Investigation-Derived Waste.
26. Secure the well and restore the location and area to previous site conditions.

2 Records

Field notes will be kept in a bound field logbook or approved field documentation following the format specified in SOP-04 Field Documentation. Specific documentation may include health and safety documentation, precipitation data, and photographs. Hardcopy discharge records, including all related quality control documentation, must be maintained in permanent project files. A Low-Flow Sample Sheet is contained as **Attachment A**. Documentation of the sampling event should include (at a minimum):

- Required site maps and HASP forms
- Instrument calibration
- Equipment calibration sheet from rental agency
- Well identification and location
- Type of equipment and supplies
- Well construction details
- Previous sample event or water level details
- Air monitoring readings, if required
- Low-Flow Sampling Form details
  - Physical water observation
  - Containment and volume of water removed
  - Name of the sample collectors
  - Water level depth and total depth
  - Pump or tubing intake depth in screen
  - Pumping rates, drawdown, indicator field parameters values, calculated or measured total volume pumped, and clock time of each set of measurements.
  - Times (start, finish, sample time)
  - Laboratory information (sample ID, preservative, quality assurance/quality control [QA/QC])
- Weather observations (e.g., temperature, wind speed and direction, cloud coverage).
- Any problems encountered or deviations from this SOP.
- Summary of daily activities and personnel onsite.

Attachment A Low-Flow Groundwater Sampling Form

Low-Flow Groundwater Sampling Form

Project Name: ____________ Well Identification: ____________

Project Number: ____________ Sample Date: ____________

Time (Initial): ____________ Field Technician(s): ____________

Initial Water Level: ____________ ft Inner Casing Diameter (i

Depth to Product: ____________ ft Pump and Tubing Type:

Total Well Depth: ____________ ft Start Purge Time: ____________

Time	Flow Rate	Water Level	Temp.	pH	Conductivity	Turbidity	DO	ORP	Odor	Color	Comments
	__L/	f	°C	S.	__S,	NT	mg,	mV			

Comments: ____________

End Purge Time: ____________ One Well Volume (prior to pur

Final Water Level: ____________ ft ☐ ☐ Well Purged Dry? Ye

Total Volume Purged: ____________ gal Tubing Inlet Depth: _____

SAMPLE ID	TIME	ANALYSES		QA/QC SAMPLE

R

Gas Concentration in Well: ________

Parameter	Stabilization Criteri
Temperature	± 3% of reading (minimu
pH	+/- 0.1
Specific Conductance	+/- 3%
ORP	+/- 10 millivolts
Dissolved Oxygen	+/- 0.3 milligrams
Turbidity	Not a stabilization crite the better

* - USEPA, 1996 (Puls and Barcelona) Low-Flow (Minim Procedures

Formula for Calculating Well Casing Volume

$$[A] = \frac{\pi D^2 L}{4} * 7.48 \frac{gal}{ft^3}$$

D = Well cas *(converted to feet)*

L = Height

Signature: ____________

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Attachment B Low-Flow (Minimal Drawdown) Groundwater Sampling Form (Puls and Barcelona, 1996)

United States Environmental Protection Agency | Office of Research and Development | Office of Solid Waste and Emergency Response | EPA/540/S-95/504 April 1996

EPA Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

For further information contact: Robert Puls, 405-436-8543, Subsurface Remediation and Protection Division, NRMRL, Ada, Oklahoma.

I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

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chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

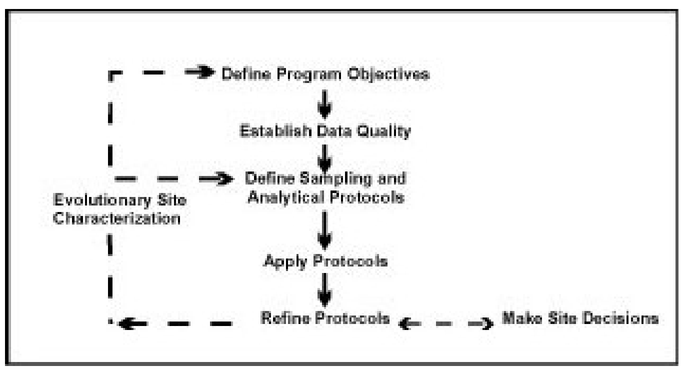

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

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Figure 2. **Ground Water Sampling Log**

Project _______________ **Site** _______________ **Well No.** _____________ **Date** _________________________

Well Depth ____________ **Screen Length** __________ **Well Diameter** _________ **Casing Type** ____________

Sampling Device _______________ **Tubing type** _____________________ **Water Level** __________________

Measuring Point ___________________ **Other Infor** ____

____

Sampling Personnel ____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi\ r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project _______________ Site _______________ Well No. _____________ Date _________________________

Well Depth ____________ Screen Length __________ Well Diameter _________ Casing Type ___________

Sampling Device _______________ Tubing type _____________________ Water Level _________________

Measuring Point ___________________ Other Infor ____

____

Sampling Personnel ____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi\ r^3$

SOP-44 Volume Purge Method for Groundwater Sampling

Purpose

The purpose of this SOP is to describe groundwater purging and collection procedures from wells using well-volume purging and sampling techniques. This SOP includes calculation of a well volume for specific well volume removal and high or unknown volume purging for wells containing in-place pumps (e.g., municipal, water treatment facility). The objective of purging wells with in-place pumps or without in-place pump is to collect a groundwater sample representative of aquifer conditions.

The well-volume method is based on purging three to five well volumes before sampling. This method is generally conducted with a bailer or pump. This method may be the selected sample method if groundwater parameter stabilization cannot be achieved using low-flow sampling techniques (SOP-43 Low-Flow Groundwater Sampling) or low-flow sampling techniques are not appropriate.

Relevant EHS Support SOPs

- SOP-04 Field Documentation
- SOP-05 Sample Management and Shipping
- SOP-06 Pre-Field Mobilization Procedures
- SOP-07 Investigation-Derived Waste
- SOP-08 Field Equipment Operation and Calibration
- SOP-09 Field Equipment Decontamination
- SOP-41 Fluid Measurement
- SOP-43 Low-Flow Groundwater Sampling
- SOP-46 Water Sampling for Chemical Analysis.

Attachments

- **Attachment A** EHS Support Groundwater Sampling Form

Required Materials

- Air monitoring instrumentation (e.g., photoionization detector [PID]) and supplies, if required
- Water quality meters (e.g., temperature, pH, conductance, dissolved oxygen [DO], oxidation-reduction potential [ORP], turbidity)
- Field logbook and field documentation
- Site plan showing well or water bore locations
- Health and Safety Plan (HASP)
- Personal protective equipment
- Indelible ink pens and waterproof marking pen

- Bailer, bailer string or rope, as appropriate
- Pump, controller, and power source, generator or battery, as appropriate
- Teflon or polyethylene tubing, as appropriate
- Decontamination equipment and supplies
- Bucket, drums, or other large container for storing and/or transporting purged water
- Measuring equipment (tape, water level indicator)
- Camera
- Appropriate sample containers, sampling forms, shipping equipment, wrapping tape.

1 Volume Purging Method

The well-volume method is a traditional technique where a pre-determined volume or fixed volume of water is removed from the well, including any stagnant water located above the well screen. Stabilization groundwater field-measured parameters are not specific to the volume purging method; however, field-measured parameters may be part of the project work plan and is highly recommended.

Two common well-volume purging methods are outlined in this SOP: using a bailer and using a pump. The advantages and disadvantages of each purging equipment are outlined in **Table 1**.

Table 1 Groundwater Technique Considerations

Purging Method	Advantages	Disadvantages
Volume Purging Method Using a Bailer	• Represents water as a composite across the well screen • Standard and accepted method • Easy to understand and implement • Less mixing of the stagnant casing water with the formation water • Bailers are inexpensive, portable, and easy to operate	• Generates more investigation derived waste • Small scale heterogeneities are not possible • Method can mobilize solids • Little concern is given to how purging protocols and devices (e.g., bailers) affect the chemistry of groundwater samples • Can cause underestimation of maximum contaminant concentrations due to dilution • Can cause overestimation due to contaminant mobilization, degassing, or increased sample turbidity • Dewatering lower-yield wells causes losses of volatile organic compounds, affects dissolved oxygen and carbon dioxide concentrations / levels • Excessive drawdown can cause overestimation from soil gas or mobilization of soil-bound contaminants in the overlying formation or “smear zone”
Volume Purging Method Using a Pump	• Most effective in soils with low to high hydraulic conductivities and Monitoring wells with any screen length	• Generates more investigation-derived waste • Is not a good method in low-yield formation groundwater, fractured bedrock, or very turbid water • Can cause underestimation of maximum contaminant concentrations due to dilution • Can cause overestimation due to contaminant mobilization, degassing, or increased sample turbidity • May affect some field-measured parameters (DO, ORP) • Long-screened intervals (e.g., >9 m) or open-hole wells where the hydraulic flow pathways are unknown • Use where the aquifer is contaminated by non-aqueous phase liquids; however, a bailer can be a preferable method for collection of non-aqueous phase liquid

Note: Both bailer and pump methods can utilize equipment that requires decontamination. Decontamination will be conducted in accordance of SOP-09 Field Equipment Decontamination or the manufacturer’s recommendations.

1.1 Equipment Considerations

The following factors should be considered when selecting appropriate equipment:

- the analytes being evaluated
- The type and location of the well being sampled
- Physical characteristics of the well (diameter and total depth)
- Depth to water
- Geology adjacent to the screened interval
- The groundwater chemistry.

1.2 Calculating the Well Volume

The volume of water in the well will be calculated based on the height of the water column in the well and the well diameter. To calculate the well volume:

1. Open the well. If required, use a photoionization detector (PID) or equivalent to measure for the presence of volatile organic compounds. Record the results of the PID measurement in field logbook or approved field documentation.
2. Measure the depth to water and total depth of the well using a water level indicator. Fluid level and total depth will be measured in accordance with the guidelines provided in SOP-41 Fluid Measurements. Record the measurements in the field logbook or approved field documentation.
3. If non-aqueous phase liquid (NAPL) is present, use an interface probe for depth measurements.
4. If NAPL is present, collection or removal of NAPL should be conducted in accordance with the Project Work Plan.
5. Measure the nominal inside diameter of the well casing.
6. Calculate the volume of water in the well using one of the following equations:
   a. Calculation of 1 well volume using the formula:

      $$V = \pi r^2 L (cf)$$

   Where:
      V = well volume (gallons or litres)
      π = pi (3.14)
      r = radius of monitoring well in feet or meters (L)
      L = height of the water column in feet or meters (the height of the water column is determined by subtracting the depth to water from the total depth of the well).
      cf = conversion factor (V/L^3)
         US Customary Units = 7.48 gal/ft^3
         Metric Units = 1,000 L/m^3

   b. Column height and known volume.
      Locate the casing diameter using **Table 2** below. Multiply the corresponding Volume of 1 length (foot or meter) per water column (H1) times the height of the water column (L).
         V = L (H1)
7. Record the calculated well volume in the field logbook or field documentation.

Table 2 Approximate Casing Volumes for Common Casing Sizes

US Customary Units		**Metric Units**	
Casing Inner Diameter (inches)	***Volume of 1 foot per water column (H1) (gal)***	***Casing Diameter (mm)***	***Volume of 1 meter per water column (H1) (Liter)***
1	0.04	50	2
2	0.16	80	5
3	0.35	100	8
4	0.67	125	12.5
6	1.47	150	17.7

2 Groundwater Sampling Procedures using a Bailer

2.1 Equipment Considerations

The following factors should be considered conducting groundwater sampling via the bailer method:

- Bailers vary in construction and type (single-check or double-check valve, metal, polyvinyl chloride, polyethylene, or Teflon material, diameter, lengths,) and shall be selected based on chemical of interest and sample depth.
- If additional weights are needed for a bailer, the weights and any attaching materials for the weights shall be non-reactive.
- The bailer line (e.g., nylon, cotton, wire) type shall consider the chemical of interest and be non-reactive.

2.2 Bailer Method Procedure

The procedures below incorporate measurement of groundwater field-measured parameters. If these parameters are not necessary, the Project Work Plan will note the deviation.

To conduct groundwater sampling using a bailer:

1. Measure and record the fluid depth and total well depth. Calculate the volume of water in the well and volume of water to remove.
2. Don a new pair of disposable nitrile or surgical gloves.
3. Open the plastic wrap of a new disposable bailer or decontaminated bailer exposing the bailer hanger.
4. Securely tie the line to the bailer hanger. A slip knot is preferred. The knot should be checked periodically throughout the bailing process to ensure the knot stays secure (i.e., the bailer is not lost down the well).
5. Remove the plastic wrap from the bailer.
6. Slowly lower the bailer through the well and into the water column until the bailer is fully submerged.
7. Carefully remove the bailer from the well. Do not allow the bailer line to come into contact with the ground. If the bailer line must be placed on the ground, a clean, plastic sheet shall be placed on the ground below the line.
8. Empty the water from the bailer into a bucket, pail, or container. It is recommended the volume of the bailer or bucket be known to estimate the volume of water removed during purging.
9. Continue to remove groundwater via the bailer until one well volume or a known volume has been removed. Collect and record groundwater field-measured parameters. Generally, field-measured parameters should include temperature, pH, conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. Note and record any physical observations, such as color, odor, visual turbidity, effervescence, or presence of particulates. Field instruments shall be calibrated in accordance with SOP-08 Field Equipment Calibration and Operation.
10. Continue to bail groundwater from the well at a constant rate until another well volume or known volume is removed and the groundwater field-measured parameters are collected and recorded.

11. Continue alternating bailing and recording groundwater field-measured parameters until the required well volumes are removed.
12. Collect a final groundwater measurement after the well volumes have been removed.
13. If the well is purged dry, attempt to remove three well volumes prior to sampling. Groundwater field-measured parameters and final depth to groundwater should be recorded to the best extent practicable.
14. If three well volumes cannot be removed, purge the well dry and allow the well to recover until at least one of the following is met:
    - A minimum of 2 hours has elapsed since purging.
    - There is sufficient water volume present to obtain the sample.
    - The water in the well has recovered to 80 percent of the initial pre-well volume.
15. The well will be re-purged if more than 24 hours has elapsed since the well went dry and sampling begins.
16. Place representative groundwater directly into the sample bottles or sample container.
17. Follow the project work plan for sampling and in accordance with SOP-05 Sample Management and Shipping, and SOP-46 Water Sampling for Chemical Analysis.
18. Discard purge water and disposable equipment or supplies in accordance with the Project Work Plan or SOP-07 Investigation-Derived Waste.

3 Groundwater Sampling Procedures using a Pump

3.1 Wells with In-Place Pumps and Plumbing

Procedural Caution: Be aware of the site or well requirements for working with in-place pumps. Generally, wells with in-place pumps are positioned in large diameter wells and can produce large volumes of groundwater. The wells are commonly under the guidance or jurisdiction of a public or private entity with intended purposes (e.g., public water supply, water treatment, water cooling). Safety considerations can include electrical, mechanical, or other equipment components, flow and flow control, splashes, and chemicals used as part processing stream.

Wells with in-place plumbing are commonly found at municipal water treatment plants, industrial water supplies, private residences, etc. General limitations of in-place pump include the following:

- The pump is suspended in the well at a pre-selected depth (hard mounted) and cannot be moved up or down during purging and sampling.
- Not enough is generally known about the construction aspects of the wells to apply the same criteria as used for monitoring wells (i.e., 3 to 5 well volumes).

Generally, when collecting a groundwater sample from these wells, removal of three to five well volumes of groundwater may not be practical or required. The purge volume may depend on factors such as if the pumps are running continuously, intermittently, or haven't been operating for a length of time, layout of the pumping system (e.g., if storage/pressure tanks are located between the sampling point and the pump), and equipment operability. This SOP assumes the in-place pump and plumbing function properly.

There are certain situations where dedicated pumps and tubing are there for sampling purposes only which are the same as rented, non – dedicated pumps and are generally there for long term sampling purposes bought by the client.

To conduct groundwater sampling at wells with in-place pumps and plumbing:

1. Record details about sample location, equipment, or conditions.
2. Don a new pair of nitrile or surgical gloves.
3. If the pump runs continuously:
   a. No purging is necessary other than opening a valve or spigot and allowing groundwater to purge into a bucket or container for a few minutes.
   b. If a storage tank is present between the pump and the discharge point, a spigot, valve, or other sampling point should be located between the pump and the storage tank. If a spigot, valve, or other sampling point cannot be located, use a valve or spigot closest to the storage tank or container, if present. Once located, open the valve or spot and allow the water to purge into a bucket or container for a few minutes.
   c. Measure and record pH, specific conductance, temperature, and turbidity and any observations about the water (clarity, odor, color, sheen). DO and ORP is recommended; however, both may be biased due to pumping or storage conditions.
4. If the pumps run intermittently or infrequently, the pump should be energized as follows:

   a. Best judgment should be used to remove enough water from the plumbing to flush standing water from the piping and any storage tanks which may be present. The pumping flow rate should be taken into consideration when determining time to operate pump and purge groundwater. Generally, 15 to 30 minutes may be adequate.
   b. Measure and record at 3- to 5-minute intervals pH, specific conductance, temperature, and turbidity and any observations about the water (clarity, odor, color, sheen). DO and ORP is recommended; however, both may be biased due to pumping or storage conditions.
5. Place the representative groundwater directly into the sample bottles or sample container.
6. Follow the Project Work Plan for sampling and in accordance with SOP-05 Sample Management and Shipping and SOP-46 Water Sampling for Chemical Analysis.
7. Discard purge water and disposable equipment or supplies in accordance with the Project Work Plan or SOP-07 Investigation-Derived Waste.

3.2 Wells without In-Place Pumps

3.2.1 Equipment Considerations

The following factors should be considered conducting groundwater sampling at wells without in-place pumps:

- Tubing type (e.g., polyethylene, Teflon, etc.) shall consider the chemical of interest and be non-reactive.
- The pump shall be deep enough, so purging does not evacuate groundwater below the pump. Running the pump without water may cause damage.
- The pumping speed is not relative to the method; however, the discharge should not be operated at a rate which causes the well to go dry.
- Dedicated pumps are preferable to portable pumps.
- If a portable pump is used, the pump shall be decontaminated between purging.
- If a portable pump is used, new or dedicated tubing must be used at each sampling location.
- If a petroleum-powered generator is used to run the sampling pump, the power source must be located downwind of the wellhead and any sampling apparatus.

3.2.2 Pump Purging Procedures

This procedure incorporates measurement of groundwater field-measured parameters. If these parameters are not necessary, the Project Work Plan will note the deviation.

To conduct groundwater sampling at wells without in-place pumps:

1. Measure and record the fluid depth and total well depth. Calculate the volume of water in the well and volume of water to remove.
2. The pump intake must be in an appropriate location with respect to well screen, saturated portion of well, targeted contamination zone, or formation. If the Project Work Plan does not specify pump intake depth, the pump intake should be positioned at the midpoint of the well screen length or midpoint of the saturated portion of the well if the well screen is not fully submerged. If details about the well are not available, the pump intake should be placed about 5 feet (1.5 meters) above the bottom of the well or based on professional judgement.

3. Place any plastic sheeting, if necessary, on the ground to avoid equipment contact with the ground.
4. Don a new pair of disposable nitrile or surgical gloves.
5. Connect the tubing to pump.
6. Slowly lower the pump and tubing to the pump intake depth. In some situations, safety cables, hooks, or safety ties may be required. Ensure the equipment is decontaminated and is non-reactive.
7. Attach power supply to pump.
8. Begin pumping at a slow rate and then gradually increase the rate.
9. Discharge the water into a bucket, pail, or container. It is recommended the volume of bucket or container be known to estimate the volume of water removed during purging.
10. Routinely measure and record the depth to water and groundwater field-measured parameters generally including temperature, pH, conductivity, DO, ORP, and turbidity during the purging cycle. Note and record any physical observations, such as color, odor, visual turbidity, effervescence, or presence of particulates.
11. Continue purging groundwater until the calculated well volume is removed.
    a. The pump generally should not be moved but can be lowered if the water level drops below the pump intake.
    b. The pump rate can be decreased for sample collection in order to allow filling of sampling containers (this is often necessary to fill VOC sampling vials).
    c. As in all groundwater sampling, make sure the flow-through cell, if used, is bypassed during sample collection.
12. Collect and record a final groundwater measurement after the well volumes have been removed.
13. If the well is purged dry, attempt to remove three well volumes prior to sampling. Groundwater field-measured parameters and final depth to groundwater should be recorded to the best extent practicable.
14. If three well volumes cannot be removed, purge the well dry and allow the well to recover until at least one of the following is met:
    a. A minimum of 2 hours has elapsed since purging.
    b. There is sufficient water volume present to obtain the sample.
    c. The water in the well has recovered to 80 percent of the initial pre-well volume.
15. The well will be re-purged if more than 24 hours has elapsed since the well went dry and sampling begins.
16. Place the representative groundwater directly into the sample bottles or sample container.
17. Follow the Project Work Plan for sampling and in accordance with SOP-05 Sample Management and Shipping and SOP-46 Water Sampling for Chemical Analysis.
18. Discard purge water and disposable equipment or supplies in accordance with the project work plan or SOP-07 Investigation-Derived Waste.

4 Records

Field notes will be kept in a bound field logbook or approved field documentation following the format specified in SOP-04 Field Documentation. A Groundwater Sample Sheet is contained as **Attachment A**. Documentation of the sampling event should include (at a minimum):

- Well identification and location
- Type of equipment and supplies
- Well construction details including well screen length
- Air monitoring readings, if required
- Water level and total depth measurements
- Groundwater Sampling Form details
  - Physical water observation
  - Containment and volume of water removed
  - Name of the sample collector/s
  - Pump intake depth
  - Pumping rates, drawdown, indicator parameters values, calculated or measured total volume pumped, and clock time of each set of measurements.
  - Times (start, finish, sample time)
  - Laboratory information (sample ID, preservative, quality assurance/quality control [QA/QC])
  - Purge water disposal location and date of disposal
- Field observations
- Weather conditions
- Any problems encountered
- Equipment rental company pre-calibration sheet.

Attachment A EHS Support Groundwater Sampling Form

SOP-46 Water Sampling for Chemical Analysis

Purpose

The purpose of this SOP is to provide general procedures for preparing water samples for chemical analysis during field investigations. This SOP focuses on the requirements for accurate sample collection and preservation of water samples for representative quality analysis. For this SOP, water sampling refers to those samples whose main constituent is water, such as samples collected from surface water, groundwater, and wastewater. In addition, this SOP assumes bottle sets received from the laboratory will contain the required preservative (i.e., the bottles are pre-preserved by the laboratory and a preservative will not be required in the field).

Note that local and/or state regulations may be different and will need to be verified.

Relevant EHS Support SOPs

- SOP-04 Field Documentation
- SOP-05 Sample Management and Shipping
- SOP-07 Investigation-Derived Waste
- SOP-08 Field Equipment Operation and Calibration
- SOP-09 Field Equipment Decontamination
- SOP-43 Low-Flow Groundwater Sampling
- SOP-44 Volume Purge Method for Groundwater Sampling
- SOP-61 Surface Water Sampling

Attachments

- Attachment A Sampling Considerations When Analyzing for PFAS

Required Materials

- Field logbook and field documentation
- Site maps, site layouts, site plans
- Health and Safety Plan
- Appropriate personal protective equipment
- Black waterproof and/or indelible ink pens
- Chain-of-custody form, sample labels, custody seals
- Safety Data Sheets (from the laboratory, for each preservative type)
- Filters, if applicable
- Laboratory-supplied bottle set, with preservatives as needed

- Other approved sample storage containers, if applicable
- Equipment required, if applicable, to monitor the water sample parameters

1 Water Sampling for Chemical Analysis

Water samples are collected and analyzed to evaluate the chemical quality of the water. The chemical characteristics of the water aid in understanding the groundwater or surface water system of interest or are used as a monitoring control for wastewater treatment facilities or meeting criteria to discharge treated water.

Grab samples and composite samples are the two types of samples that can be collected during a sampling event. Grab samples are discrete samples collected at a specific location and time. Composite samples (or homogenized samples) are samples composited from two or more locations at the time of sampling. Composite samples usually represent an average concentration for a period of time. Samples collected for volatile organic compound (VOC) analysis are generally not composited or homogenized unless specified.

Accurate sample collection and preservation are crucial in acquiring representative data. The Project Work Plan or Quality Assurance Project Plan (QAPP) should be reviewed to understand the project needs and sample requirements. The Project Work Plan or QAPP should provide a clear understanding of the sample locations, sample identification, analytical testing, number and type of quality control samples, or other project-related needs (objective, equipment, laboratory supplier, purging method-if required, etc.).

2 General Water Sampling Considerations

Although the procedures used to fill sample bottles may seem to be a minor consideration, filling them improperly can jeopardize the careful work of properly purging a well to produce minimally disturbed, representative samples. Improper sampling techniques can cause changes in sample composition due to agitation and exposure to air, which can result in the loss of contaminants by volatilization or degassing. The following are general considerations when preparing to collect water samples:

- The specific order of sample collection, processing, and preservation for specific analytes should be adhered to consistently throughout the project. The recommended sequence for sample collection and processing is often based on logistics for maintaining sample integrity and the analytes' sensitivity to change. The sequence can be modified, depending on the types of samples to be collected and the data objectives.
- VOC samples (and other organic-sensitive analytes) are typically collected first if samples are being collected for multiple analytes. The more sensitive the analytical parameters being collected (e.g., VOCs and redox-sensitive metals), the more cautious the filling procedures should be. A suggested sample order, if not specified in the Project Work Plan or QAPP, may include:
    - VOCs
    - Semi-volatile organic compounds
    - Herbicides/pesticides/polychlorinated biphenyls
    - Total petroleum hydrocarbons
    - Metals, cyanide, or radionuclides
    - Other water quality parameters (e.g., microbiological, anion/cation, ammonia, sulfides/sulfates, nitrates/nitrites)
    - Nutrients (e.g., phosphorous)
    - Filtered samples (e.g., dissolved metals, ultra-trace metals)
    - Additional sample order considerations might include a sulfate sample collected before samples preserved with sulfuric acid (e.g., nitrogen series, phenolics)
- If questions exist pertaining to sampling or laboratory concerns, check with the laboratory(s) or laboratory project manager to ensure the sample containers, required sample volume, preservation, and holding times are understood before starting the project. Several analytes in a sample suite may be grouped in one bottle (or more) based on the preservation method and analytical testing method.
- Laboratory quality assurance and quality control procedures should be reviewed before field sampling to ensure the Project Work Plan, QAPP, and chain-of-custody procedures are followed. Sample management and shipping procedures can be reviewed in SOP-05. A laboratory example of holding times is included as an attachment to SOP-05.
- Ensure field equipment is properly decontaminated in accordance with the guidelines provided in SOP-09 and is calibrated with the guidelines provided in SOP-08 or the instrument's manual.
- During purging and/or sample collection, the flow should be a smooth, solid stream of water with no air or gas bubbles in the tubing or flow cell. Gradually adjust the pumping rate to eliminate bubbles if present.
- Prepare sample containers. Keep sample containers capped until it is time to fill them to avoid possible container contamination.

- If water samples are collected via bailer, the recommendation is to use a bottom emptying device to slow/control the release of the water sample into the laboratory bottles.
- Any equipment (e.g., flow-through cell, multi-parameter quality meter) used to monitor water quality parameters will be disconnected to allow the sample to be collected directly from the discharge tubing.
- Groundwater samples from a purged well will be collected in a continual process following the purge cycle.
- For groundwater samples collected by using low-flow sampling techniques, the pumping/discharge rate should:
    - Be high enough to fill sample bottles efficiently and with minimal exposure to atmospheric conditions, but low enough to minimize sample alteration or aeration.
    - Allow for a smooth and uniform flow, preferably about 250 millimeters per minute.
    - Remain unchanged from the purging cycle to the sampling cycle.

3 Water Sample Procedures

Water samples are generally collected as follows:

- Collect the sample directly from a sample port, faucet, or spigot at the sample point location.
- Collect the sample directly or indirectly at a surface water location (SOP-61) at the sample point location or via an intermediate container or drop-down tube.
- Collect the sample directly or indirectly from a well that has been purged of groundwater (SOP-43 and SOP-44) using down-hole tubing or via an intermediate container (i.e., bailer).

Do not use bottles containing preservative to directly collect the water sample from a surface water body, pond, or lagoon. Instead, employ an intermediate container for sample collection and transfer the sample to the bottle containing the preservative.

Ensure sample tubing has been disconnected from any in-line equipment (e.g., flow-through cell) before filling the sample jars.

Assuming all pre-sample activities (e.g., purging, stabilization of water quality parameters, bottle labeling) are done, complete the following steps:

1. For water samples from a port, faucet, or spigot, disinfect the port, faucet, or spigot with an alcohol swab or approved cleaning detergent. Open the sampling port and allow the water to flow (about 250 milliliters per minute) for 2 to 3 minutes. Collect the discharged water in a bucket.
2. If sampling for VOCs, fill the volatile organic analyte (VOA) vials first.
    a. Slowly fill each 40-mL VOA vial with water. Do not let it overflow as preservative will be lost.
    b. Fill the VOA vial with water so a meniscus is formed at the top of the container.
    c. Place the cap with the Teflon septum on the vial top and secure.
    d. Turn the VOA vial upside down and check for the presence of air bubbles. Tap the bottom of the VOA vials to dislodge any bubbles that may have formed around the cap or sides.
    e. If no bubbles are present, the sample is considered to have "No Headspace" and the sampling for that vial is complete. Move on to the next VOA vial or sample container.
    f. If bubbles are present, remove the cap and fill the VOA vial with additional sample water to fill the vial and form a meniscus. Replace the cap and reconfirm there are no bubbles in the vial. If air bubbles are still present after three attempts, discard the sample jar and obtain a new VOA vial for sample collection.
    g. If the purge water has observable entrained gas bubbles in the effluent, or if the sample effervesces or fizzes during the collection of the water sampling into the hydrochloric acid (HCl) pre-preserved VOA, the collected sample and/or vial will be discarded. Instead, use a new VOA vial containing no preservative, or rinse the VOA vial with the representative purge water to completely remove the HCl preservative, to collect the sample. The sample will be contained in the VOA vial with the "No Headspace" procedures (steps d through f) and the chain-of-custody form will note the sample is unpreserved. Inform the laboratory of the unpreserved sample and holding time change.

    Note the following:

- A sample that is off gassing in a sealed container may cause a potential eruption hazard.
- The hold time of an unpreserved sample is 7 days instead of 14 days.

3. Fill the remaining sample containers for the other analytes, and seal the sample containers. Ensure a sufficient volume is available to fill the bottle set or the testing method criteria ("No Headspace" for other analytes) is achieved. Consult with the project manager, Project Work Plan, QAPP, or laboratory representative if potential concerns arise to assess possible corrective actions.
4. If water samples require filtration (further discussed in **Section 4**):
   a. Attach the in-line disposable filter to the sample tubing or hose. Using the water pressure from the pump, press the water through the filter. Allow (and discard) a minimum of 100 milliliters of water to pass through the filter cartridge before filling the appropriate sample containers with the sufficient container volume. Discard any filters that become clogged and attach a new filter as appropriate. Discard the filter between sample locations.
   b. Set up the filtration assembly, positive vacuum system, or syringe. Transfer the representative water into the appropriate holding chamber. Push or press the sample across the filter. The filtered sample will be placed directly into the appropriate sample jar or transferred from the filtered-water chamber and into the appropriate sample jar. Discard any filters that become clogged and attach a new filter as appropriate. Discard the filter between sample locations.
5. Complete the chain-of-custody form. Note the sample identification, time, date, analytical testing required, quality control samples, and any other notes that would be useful to a laboratory. (For instance, if a sheen is observed in the sample, make a note on the chain-of-custody form. This may assist the laboratory in preventing potential instrument issues.)
6. Place and package the samples in the appropriately-labeled sample containers and ship the containers to the subcontracted laboratory following the guidelines provided in SOP-04 and SOP-05.
7. Discard the purged water in accordance with the Project Work Plan and SOP-07.

3.1 Sampling and Analysis Protocol for PFAS

Samples collected using this protocol are intended to be analyzed for per- and polyfluoroalkyl substances (PFAS) also known as perfluorinated compounds (PFCs) by Modified (Low Level) Test Method 537. This section outlines the protocol for obtaining PFAS samples. See **Attachment A** for additional guidance.

The currently acceptable materials for sampling include stainless-steel, high-density polyethylene (HDPE), polyvinyl chloride (PVC), silicone, acetate, and polypropylene. Equipment blanks should be generated at least daily. Additional materials may be acceptable if preapproved. Requests to use alternate equipment should include clean equipment blanks. NOTE: Grundfos pumps and bladder pumps may contain PFC materials (e.g., Teflon™ washers for Grundfos pumps and locking rings on bladder pumps). The Teflon locking ring is not required for use with the QED bladder pump and should be removed. QED bladder pumps, low-density polyethylene (LDPE) bladders, and associated tubing have been tested for PFCs.[1]

Sampling equipment components and sample containers should not come in contact with aluminum foil, glass, or polytetrafluoroethylene (PTFE, Teflon) materials including sample bottle cap liners with a PTFE layer.

Standard two-step decontamination using detergent and a clean water rinse will be performed for equipment that does come in contact with PFC materials. Clothing that contains PTFE material (including GORE-TEX®) or that has been waterproofed with PFC materials must be avoided. Many food and drink packaging materials and “plumbers thread seal tape” contain PFCs.

All clothing worn by sampling personnel must have been laundered multiple times.

The sampler must wear nitrile gloves while filling and sealing the sample bottles. Pre-cleaned sample bottles with closures, coolers, ice, sample labels, and a chain-of-custody form will be provided by the laboratory. Fill two pre-cleaned 500-milliliter HDPE or polypropylene bottles with the sample. Cap the bottles with an acceptable cap and liner closure system. Label the sample bottles. Complete the chain-of-custody form. Place the sample bottles in a cooler maintained at 4 ± 2 degrees Celsius.

Collect 1 equipment blank for every sample batch; do not exceed 20 samples. Collect 1 field duplicate for every sample batch; do not exceed 20 samples. Collect 1 matrix spike/matrix spike duplicate for every sample batch; do not exceed 20 samples. Request the appropriate data deliverables (Category A or B) and an electronic data deliverable.

[1] QED. 2017. The Most Reliable Portable Sampling Pump is PFC-Free. https://www.qedenv.com/media/1zpaw5bz/portable_groundwater_sampling_pump_datasheet.pdf. October.

4 Field Filtration Guidelines

Filtration is the physical process used to separate the particulate and aqueous fractions of a water sample. Samples are filtered for several purposes; for example, to remove microorganisms in order to help preserve ambient analyte concentrations, to remove suspended materials that interfere with specified analytical procedures, and to determine chemical speciation and fractionation of trace elements for geochemical studies.

Field filtration may be required for dissolved metals, alkalinity, hexavalent chromium, ultra-trace metals, total organic carbon, dissolved organic carbon, and speciated analytes such as ferrous iron, arsenic, and selenium. In some of these analytes, zero headspace is required in the bottle. Be sure to check with the Project Work Plan, QAPP, and laboratory for sample collection and containment requirements.

Accomplish in-line filtration by using disposable, high-capacity filter cartridges (barrel-type) or membrane filters in an in-line filter apparatus. A high-capacity, barrel-type filter is preferred due to the higher surface area associated with this configuration. If a membrane filter is used, a minimum diameter of 142 millimeters is suggested. The filter size and material should be appropriate for the expected quality of the water sample, the volume of water to be filtered, the analyte(s) to be measured, and the method of filtration. The filtration technique should minimize the sample exposure to air.

A generally accepted filter size is 0.45 microns; however, 0.2-micron filters can be used if bacteria or metal colloids must be removed. The most commonly used field filtration techniques are:

- In-line disposable filters (filtered during sample collection) (**Figure 1**)
- Hand-held and operated positive vacuum pump or syringe filters (filtered after sample collection) (**Figure 2**)

Figure 1 Examples of Field Filters: Barrel-Type Filter Cartridge and Membrane Filter

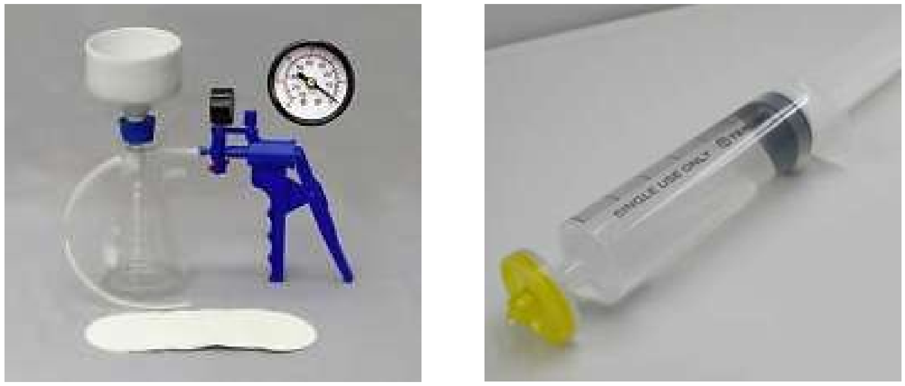

Figure 2 Examples of Hand-Help Positive Vacuum Pump and Syringe-Type Filter

5 Records

Keep field notes in a bound field logbook or other approved field documentation following the format specified in SOP-04. Record the following in the field notebooks and/or field documentation:

- Sample Identification
- Sample time and date
- Media collected
- Sample location
- Sample testing method
- Location and identification of quality control samples and types
- Chain-of-custody forms

Attachment A Sampling Considerations When Analyzing for PFAS

There are several potential sources of PFAS that could contribute to the cross-contamination of environmental samples during sample collection: Weatherproof clothing, pens, logbooks, cosmetics, personal hygiene products, insect repellents, even some sampling equipment could contain PFAS that could lead to false positive sampling results. Below are some special considerations when sampling for PFAS.

SAMPLING CONSIDERATIONS WHEN ANALYZING FOR PFAS	
Prohibited Materials	**Acceptable Materials**
Field Equipment	
Fluoropolymer tubing, valves and other parts in pumps (Teflon®)	High density polyethylene (HDPE) and silicon materials
Fluoropolymer bailers or pump bladders	Disposable Equipment / Dedicated Equiment (no PTFE parts)
Aluminum foil	Thin HDPE sheeting
Blue (chemical) ice*	Ice contained in plastic (polyethlene) bags (double bagged), secured to avoid meltwater from contacting sample containers, overnight shipping
Post-it notes, sharpies, waterproof fieldbook	Ball point pens, Loose paper on aluminum clipboard, non weatherproof fieldbook, pre-printed labels
Glass containers (due to potential loss of analytle through adsorption)	Polypropylene or HDPE sample bottles fitted with an unlined (no PTFE), polypropylene or HDPE screw cap
Decon 90	Alconox
Decontamination water from the site	Water used for the decontamination of sampling equipment will be laboratory certified "PFAS-free" water
Field Clothing and Personal Protective Equipment (PPE)	
New clothing or water resistant, waterproof, or stain-treated clothing, clothing containing Gore-Tex	Well-laundered clothing, defined as clothing that has been washed 6 times or more after purchase, made of synthetic or natural fibers.
Clothing laundered using fabric softener	No fabric softener
Boots containg Gore-Tex	Boots made with polyurethane and polyvinyl chloride
Cosmetics, moisturizers, hand cream or other related products as part of personal cleaning/showering routine on the morning of sampling	Sunscreens - Alba Organics Natural Sunscreen, Yes to Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss my face, Baby sunscreens that are "free" or "natural"
	Inspect Repellents: Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Inspect repellent, Herbal Armor, BabyGanics
Handling or prepackaged food products	Do not have at sampling location, wash hands well after handing wear powderless nitrile gloves

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

April 2023

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NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Data Assessment and Application to Site Cleanup Page 3	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	3/28/2023
Water Sample Results Page 3	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below.	NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These guidance values also include criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt).Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.	3/28/2023
Soil Sample Results Page 3	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values:	NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:	3/28/2023
Protection of Groundwater Page 3	PFOA (ppb) 1.1 PFOS (ppb) 3.7	PFOA (ppb) 0.8 PFOS (ppb) 1.0	3/28/2023

Citation and Page Number	Current Text	Corrected Text	Date
Footnote 2 Page 3	The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	3/28/2023
Testing for Imported Soil Page 4	If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.	If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.	3/28/2023
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Soil Sample Results, page 10	"The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase."	"Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. " [Interim SCO Table] "PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. "	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs. If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable. PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021
Water Sample Results Page 9	"In addition, further assessment of water may be warranted if either of the following screening levels are met: a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L"	Deleted	6/15/2021

Citation and Page Number	Current Text	Corrected Text	Date
Routine Analysis, Page XX	Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP)… criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids).	Deleted	5/31/2022
Analysis and Reporting, Page XX	As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.	Deleted	5/31/2022
Routine Analysis, Page XX	LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media.	EPA Method 1633 is the procedure to use for environmental samples.	
Soil Sample Results, Page XX	Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6	
Appendix A	"Include in the text… LC-MS/MS for PFAS using methodologies based on EPA Method 537.1"	"Include in the text ….EPA Method 1633"	
Appendix A	"Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101"	Deleted	
Appendix B	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	

Citation and Page Number	Current Text	Corrected Text	Date
Appendix C	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix D	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix G		Updated to include all forty PFAS analytes in EPA Method 533	
Appendix H		Deleted	
Appendix I	Appendix I	Appendix H	
Appendix H	"These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report."	"These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER)."	
Appendix H	"The holding time is 14 days…"	"The holding time is 28 days…"	
Appendix H, Initial Calibration	"The initial calibration should contain a minimum of five standards for linear fit…"	"The initial calibration should contain a minimum of six standards for linear fit…"	
Appendix H, Initial Calibration	Linear fit calibration curves should have an R^2 value greater than 0.990.	Deleted	
Appendix H, Initial Calibration Verification	Initial Calibration Verification Section	Deleted	
Appendix H	secondary Ion Monitoring Section	Deleted	
Appendix H	Branched and Linear Isomers Section	Deleted	

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments, or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected. Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third-party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix G) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

EPA Method 1633 is the procedure to use for environmental samples. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist. Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These human health criteria should also be applied to surface water that is used as a water supply. This guidance also includes criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt). Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:

Guidance Values for Anticipated Site Use	PFOA (ppb)	PFOS (ppb)
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	0.8	1.0

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These

[2] The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
  - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an "Analytical Methods/Quality Assurance Summary Table" specifying:
  - Matrix type
  - Number or frequency of samples to be collected per matrix
  - Number of field and trip blanks per matrix
  - Analytical parameters to be measured per matrix
  - Analytical methods to be used per matrix with minimum reporting limits
  - Number and type of matrix spike and matrix spike duplicate samples to be collected
  - Number and type of duplicate samples to be collected
  - Sample preservation to be used per analytical method and sample matrix
  - Sample container volume and type to be used per analytical method and sample matrix
  - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by EPA Method 1633
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
  - Reporting Limits should be less than or equal to:
    - Aqueous – 2 ng/L (ppt)
    - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
-
- Include detailed sampling procedures
  - Precautions to be taken
  - Pump and equipment types
  - Decontamination procedures
  - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the current SOP developed by the Division of Fish and Wildlife (DFW) entitled "General Fish Handling Procedures for Contaminant Analysis" (Ver. 8). This SOP should be followed when collecting fish for contaminant analysis. Note, however, that the Bureau of Ecosystem Health will not be supplying bags or tags. All supplies are the responsibility of the collector

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

1. Project and Site Name.

2. DEC Region.

3. All personnel (and affiliation) involved in the collection.

4. Method of collection (gill net, hook and line, etc.)

5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

3. Date collected.

4. Sample location (waterway and nearest prominent identifiable landmark).

5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate "Age" column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish's tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **<u>The Bureau of Ecosystem Health will supply the bags.</u>** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **The Bureau of Ecosystem Health will supply the larger bags.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:
   - No materials containing Teflon.
   - No Post-it notes.
   - No ice packs; only water ice or dry ice.
   - Any gloves worn must be powder free nitrile.
   - No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
   - No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
   - Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
   - Wash hands after handling any food containers or packages as these may contain PFCs. Keep pre-wrapped food containers and wrappers isolated from fish handling.
   - Wear clothing washed at least six times since purchase.
   - Wear clothing washed without fabric softener.
   - Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with "fluor" in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

Project and Site Name ________________________________ DEC Region ____________

Collections made by (include all crew) ________________________________

Sampling Method: ☐Electrofishing ☐Gill netting ☐Trap netting ☐Trawling ☐Seining ☐Angling ☐Other ____________

Preservation Method: ☐Freezing ☐Other ____________ Notes (SWFDB survey number): ____________

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, ______________________________, of ____ collected the
(Print Name) (Print Business Address)

following on ___________________, 20____ from ____
(Date) (Water Body)

in the vicinity of ____
(Landmark, Village, Road, etc.)

Town of _______________________________________, in _________________________________ County.

Item(s) ____

____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on ___________________________________, 20______.

____ ___________________________
Signature Date

I, _________________________________, received the above mentioned sample(s) on the date specified and assigned identification number(s) ____ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

_______________________________________ ___________________
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonic acids	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluoropentanesulfonic acid	PFPeS	2706-91-4
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorononanesulfonic acid	PFNS	68259-12-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
	Perfluorododecanesulfonic acid	PFDoS	79780-39-5
Perfluoroalkyl carboxylic acids	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUnA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	376-06-7
Per- and Polyfluoroether carboxylic acids	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
	4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
	Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
	Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
	Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Fluorotelomer sulfonic acids	4:2 Fluorotelomer sulfonic acid	4:2-FTS	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2-FTS	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2-FTS	39108-34-4
Fluorotelomer carboxylic acids	3:3 Fluorotelomer carboxylic acid	3:3 FTCA	356-02-5
	5:3 Fluorotelomer carboxylic acid	5:3 FTCA	914637-49-3
	7:3 Fluorotelomer carboxylic acid	7:3 FTCA	812-70-4
Perfluorooctane sulfonamides	Perfluorooctane sulfonamide	PFOSA	754-91-6
	N-methylperfluorooctane sulfonamide	NMeFOSA	31506-32-8
	N-ethylperfluorooctane sulfonamide	NEtFOSA	4151-50-2
Perfluorooctane sulfonamidoacetic acids	N-methylperfluorooctane sulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethylperfluorooctane sulfonamidoacetic acid	N-EtFOSAA	2991-50-6
Perfluorooctane sulfonamide ethanols	N-methylperfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
	N-ethylperfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2

Group	Chemical Name	Abbreviation	CAS Number
Ether sulfonic acids	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	9Cl-PF3ONS	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	11Cl-PF3OUdS	763051-92-9
	Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7

Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER). Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 28 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of six standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

APPENDIX I - REQUEST TO IMPORT/REUSE FILL MATERIAL FORM

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Request to Import/Reuse Fill or Soil

This form is based on the information required by DER-10, Section 5.4(e) and 6NYCRR Part 360.13. Use of this form is not a substitute for reading the applicable regulations and Technical Guidance document.

SECTION 1 – SITE BACKGROUND

The allowable site use is: Choose an item

Have Ecological Resources been identified? Choose an item

Is this soil originating from the site? Choose an item

How many cubic yards of soil will be imported/reused? Choose an item

If greater than 1000 cubic yards will be imported, enter volume to be imported:

SECTION 2 – MATERIAL OTHER THAN SOIL

Is the material to be imported gravel, rock or stone? Choose an item

Does it contain less than 10%, by weight, material that passes a size 100 sieve? Choose an item

Is this virgin material from a permitted mine or quarry? Choose an item

Is this material recycled concrete or brick from a DEC registered processing facility? Choose an item

SECTION 3 - SAMPLING

Provide a brief description of the number and type of samples collected in the space below:

Example Text: 5 discrete samples were collected and analyzed for VOCs. 2 composite samples were collected and analyzed for SVOCs, Inorganics & PCBs/Pesticides.

If the material meets requirements of DER-10 section 5.4(e)5 (other material), no chemical testing needed.

SECTION 3 CONT'D - SAMPLING

Provide a brief written summary of the sampling results or attach evaluation tables (compare to DER-10, Appendix 5):

Example Text: Arsenic was detected up to 17 ppm in 1 (of 5) samples; the allowable level is 16 ppm.

If Ecological Resources have been identified use the "If Ecological Resources are Present" column in Appendix 5.

SECTION 4 – SOURCE OF FILL

Name of person providing fill and relationship to the source:

Location where fill was obtained:

Identification of any state or local approvals as a fill source:

If no approvals are available, provide a brief history of the use of the property that is the fill source:

Provide a list of supporting documentation included with this request:

The information provided on this form is accurate and complete.

____________________________________ ________________

Signature Date

____

Print Name

____

Firm