

Appendix E
Well Installation, Maintenance, and Decommissioning

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Terms

AEA	<i>Atomic Energy Act of 1954</i>
bgs	below ground surface
CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i>
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
ID	identification
OU	operable unit
PRZ	periodically rewetted zone
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
Tri-Party Agreement	<i>Hanford Federal Facility Agreement and Consent Order</i> (Ecology et al., 1989)

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E Well Installation, Maintenance, and Decommissioning

This appendix describes well installation, maintenance, and decommissioning activities for the Hanford Site in 2015. Numerous water wells were drilled or hand dug by early settlers for drinking water supplies, beginning in the early half of the 20th Century. Several thousand wells have been drilled since the early 1940s to support the Site's nuclear weapons production program. Since the 1990s, many additional wells have been drilled to support the Site's environmental cleanup mission.

All well types are tracked on the Hanford Site through the Well Maintenance Application database, which is available to users of the Hanford Local Area Network. Much of this information (e.g., borehole geophysical logging reports and data sheets) is also available to the public through the U.S. Department of Energy (DOE) Environmental Dashboard Application. Other data can be accessed via borehole summary reports that are generated for each drilling campaign.

Recognized well types onsite include aquifer tubes, borings, groundwater wells, hosted piezometers, independent piezometers, piezometer hosts, soil tubes, lysimeters, and vadose wells (Table E-1). All wells (cased and uncased), borings, aquifer tubes, soil tubes, piezometers, and other subsurface excavations are required to receive a unique Hanford well identification (ID) number. A total of 12,271 unique well ID numbers had been assigned on the Hanford Site. The Washington State Department of Ecology (Ecology) also assigns a well ID number to each of these well types.

Table E-1. Hanford Site Well Types

Well Category	Description
Aquifer tube	A groundwater monitoring site installed along the river shoreline. Generally consists of a small-diameter tube (less than 1 in.) and screen installed using push technology near the water table.
Boring	A borehole or direct push that was decommissioned immediately after drilling. Decommissioning generally would have been performed before the drill rig was removed from the site.
Groundwater well	A well constructed with the open interval extending below the water table. This is the general case and should not be used if the site could be otherwise classified as an aquifer tube, piezometer, or piezometer host.
Hosted piezometer	Groundwater monitoring well constructed inside of a host well. In most cases, hosted piezometers are one and one-half inch in diameter with the open interval extending below the water table.
Independent piezometer	Small-diameter, independent, groundwater monitoring well not constructed inside of a host well. In most cases, the independent piezometers are one and 0.5 in. in diameter.
Lysimeter	Generally, an in situ open bottom cylindrical core where the top is coincident with the ground surface, and with walls that prevent horizontal movement of moisture. A lysimeter is used to measure moisture or contaminant changes through time over a specific depth interval.
Piezometer host	A well with one or more piezometers constructed inside of it.
Soil tube	Vadose zone monitoring site. A small-diameter tube (less than 2 in. in diameter) and possibly a screen are left in place after the drilling is completed for sampling.
Vadose well	A vadose zone monitoring site where casing (greater than 2 in. in diameter) is left in place after drilling activities are completed. May have a screen, open bottom, or may be closed.

Figure E-1 presents the categorization of unique well ID numbers taken from the Well Maintenance Application database and their approximate geographic designations. During 2015, 4,159 unique well ID numbers were documented to be in use, representing 3,063 wells, 122 piezometers within host wells, 79 lysimeters within host lysimeters, 509 aquifer tubes, and 386 soil tubes. Thus, of the 12,271 unique well IDs, 5,996 wells are candidates for decommissioning or have been decommissioned.

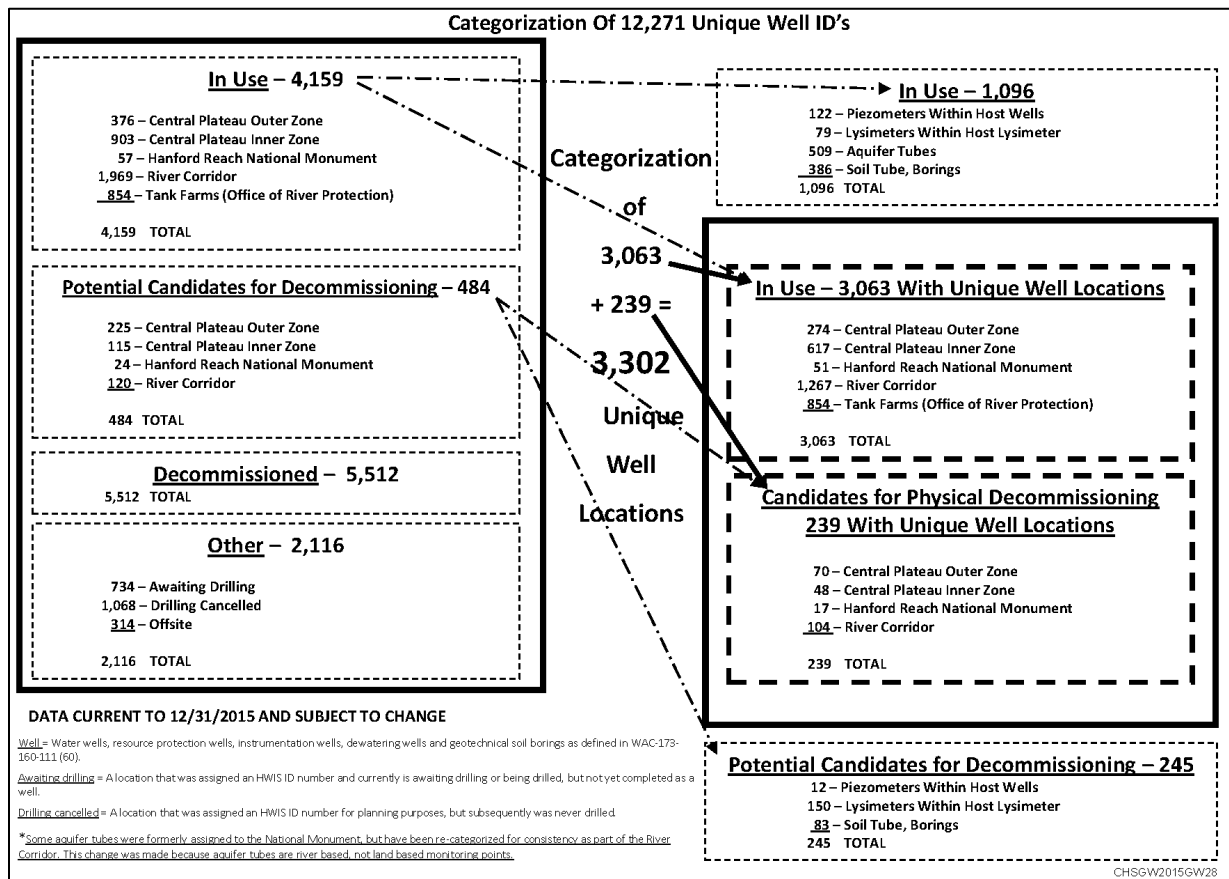


Figure E-1. Categorization of Unique Well ID Numbers

E1 Monitoring Well and Aquifer Tube Installation

DOE works with the appropriate regulatory agencies to define the need for new wells at the Hanford Site. Each year, DOE proposes new wells to meet the requirements of the [RCRA](#) (*Resource Conservation and Recovery Act of 1976*) detection and assessment groundwater monitoring requirements; characterization, remediation, and monitoring for the [CERCLA](#) (*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*); and long-term monitoring of regional groundwater plumes in accordance with DOE orders based on [AEA](#) (*Atomic Energy Act of 1954*) requirements. These efforts may include new or ongoing RCRA assessment of groundwater contamination, replacement of monitoring wells that go dry because of the declining regional water table, replacement of wells that need to be decommissioned, improvement of spatial coverage for different monitoring networks and plume monitoring, and characterization of subsurface contamination.

New monitoring well proposals for RCRA, CERCLA, and AEA are reviewed, prioritized, and approved annually in accordance with [Tri-Party Agreement](#) (Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order*) Milestone M-024. All new wells are constructed as either resource

protection wells or water supply wells in accordance with [WAC 173-160](#), “Minimum Standards for Construction and Maintenance of Wells.” Well requirements are integrated, prioritized, and documented through the budget development process, discussions between DOE and the regulatory agencies, and specific monitoring and characterization requirements.

During 2015, 76 wells were installed (Table E-2) and five aquifer tubes were installed at the Hanford Site. The locations of the new wells are shown in Figure E-2. The 76 wells installed were completed (accepted) in 2015. In some cases, drilling began in 2014. The aquifer tubes were installed in 100-NR as replacements for tubes that could no longer be sampled.

Table E-2. Wells Installed in 2015

Groundwater Interest Area	Well Name	Well ID	Well Purpose	Construction Depth (ft bgs)	Drilled Depth (ft bgs)	Acceptance Date
100-HR-D	699-97-61	C8794	Monitoring/potential extraction	95.3	100.9	6/15/2015
100-HR-D	699-93-48C	C8929	Injection	64.8	67.0	7/7/2015
100-HR-D	199-D5-159	C9377	Extraction	104.0	106.5	3/25/2015
100-HR-D total = 3						
100-HR-H	199-H4-92	C8792	Extraction	56.0	58.8	5/21/2015
100-HR-H	699-97-60	C8793	Monitoring/potential extraction	87.1	89.0	6/15/2015
100-HR-H	199-H6-7	C8947	Injection	46.0	54.7	4/16/2015
100-HR-H	199-H5-16	C8948	Extraction	64.9	68.5	4/16/2015
100-HR-H	199-H4-93	C8949	Extraction	56.9	58.0	5/21/2015
100-HR-H	699-95-45B	C8950	Injection	43.2	46.3	5/21/2015
100-HR-H	199-H6-8	C8951	Injection	72.4	74.6	5/21/2015
100-HR-H	699-97-47B	C9485	Extraction	37.9	38.4	7/7/2015
100-HR-H	199-H1-46	C9486	Extraction	45.4	50.4	7/7/2015
100-HR-H total = 9						
100-KR	199-K-203	C8290	Monitoring	160.0	161.8	3/23/2015
100-KR	199-K-204	C8291	Monitoring	160.2	163.0	3/23/2015
100-KR	199-K-207	C8294	Monitoring	153.8	155.5	3/23/2015
100-KR	199-K-208	C8295	Extraction	132.2	133.9	3/23/2015
100-KR	199-K-209	C8296	Monitoring	153.1	154.6	3/23/2015
100-KR	199-K-221	C8796	Monitoring	100.8	101.7	9/29/2015
100-KR	199-K-222	C8797	Monitoring	114.8	116.8	9/29/2015

Table E-2. Wells Installed in 2015

Groundwater Interest Area	Well Name	Well ID	Well Purpose	Construction Depth (ft bgs)	Drilled Depth (ft bgs)	Acceptance Date
100-KR total = 7						
100-NR	C9590	C9590	Replaced N116mArray-8.5A	7.0	7.0	11/20/15*
100-NR	C9589	C9589	Replaced N116mArray-12A	8.0	8.0	11/19/15*
100-NR	C9587	C9587	Replaced N116mArray-13A	7.0	7.0	11/19/15*
100-NR	C9588	C9588	Replaced N116mArray-14A	8.3	8.3	11/19/15*
100-NR	C9586	C9586	Replaced C6136	7.0	7.0	11/18/15*
100-NR total = 5						
200-BP	299-E26-15	C8913	Monitoring	206.4	206.9	6/17/2015
200-BP	299-E33-360	C8923	Monitoring (replaced 299-E33-18)	272.2	272.8	2/2/2015
200-BP	299-E33-361	C8924	Monitoring	276.6	277.9	2/2/2015
200-BP	299-E28-31	C9447	Monitoring	362.0	362.0	6/15/2015
200-BP	299-E28-32	C9448	Monitoring	371.8	372.4	7/29/2015
200-BP total = 5						
200-PO	299-E25-237	C8922	Monitoring (replaced 299-E25-236)	329.0	374.8	2/2/2015
200-PO	699-26-33A	C9404	Monitoring (replaced 699-26-33)	166.7	168.7	9/14/2015
200-PO	699-25-34F	C9405	Monitoring (replaced 699-25-34A)	161.21	163	9/14/2015
200-PO	699-24-34D	C9406	Monitoring (replaced 699-24-34A)	164.2	167.5	9/14/2015
200-PO	699-24-34E	C9407	Monitoring (replaced 699-24-34B)	167.6	169.5	9/14/2015
200-PO total = 5						
200-UP	299-W22-93	C8202	Monitoring (replaced 299-W22-44)	284.7	288.1	5/21/2015
200-UP	299-W19-111	C8718	Extraction	419.8	448.5	9/24/2015
200-UP	299-W11-97	C8719	Extraction	520.2	536.9	9/17/2015
200-UP	699-38-64	C8921	Injection	548.9	549.5	7/1/2015

Table E-2. Wells Installed in 2015

Groundwater Interest Area	Well Name	Well ID	Well Purpose	Construction Depth (ft bgs)	Drilled Depth (ft bgs)	Acceptance Date
200-UP	299-W18-260	C8925	Monitoring replaced (299-W18-30)	272.8	326.3	2/2/2015
200-UP	299-W19-113	C8927	Extraction	366.0	370.0	5/21/2015
200-UP	299-W19-114	C8928	Extraction	360.8	391.0	2/5/2015
200-UP	299-W22-115	C9430	Monitoring (replaced 299-W22-45)	270.9	272.3	6/15/2015
200-UP	299-W22-116	C9431	Monitoring (replaced 299-W22-50)	275.0	275.3	5/21/2015
200-UP	299-W23-236	C9432	Monitoring (replaced 299-W23-15)	259.8	261.3	5/21/2015
200-UP	299-E20-1	C9482	Injection	395.0	403.0	8/13/2015
200-UP	299-E20-2	C9483	Injection	401.1	406.0	9/14/2015
200-UP	299-E11-1	C9484	Injection	412.7	419.0	9/24/2015
200-UP total = 13						
200-ZP	299-W18-41	C8920	Injection	444.8	486.9	3/31/2015
200-ZP	299-W5-2	C9439	Monitoring	428.1	447.1	12/16/2015
200-ZP total = 2						
300-FF	399-1-69	C8930	PRZ monitoring	38.4	40.0	8/12/2015
300-FF	399-1-70	C8931	Aquifer monitoring	48.9	48.9	8/12/2015
300-FF	399-1-71	C8932	PRZ monitoring	38.2	40.5	8/12/2015
300-FF	399-1-72	C8934	Aquifer monitoring	47.4	48.1	8/12/2015
300-FF	399-1-73	C8935	PRZ monitoring	35.9	40.5	8/12/2015
300-FF	399-1-67	C8936	Monitoring	37.0	40.7	2/2/2015
300-FF	399-1-74	C8937	Aquifer monitoring	47.8	50.07	8/12/2015
300-FF	399-1-68	C8938	Monitoring	37.0	41.3	2/2/2015
300-FF	399-1-75	C8939	PRZ monitoring	38.2	40.1	8/12/2015
300-FF	399-1-76	C8940	Aquifer monitoring	47.9	50.9	8/12/2015
300-FF	399-1-77	C8941	PRZ monitoring	38.0	40.2	8/12/2015
300-FF	399-1-78	C8942	Aquifer Monitoring	48.3	50.3	8/12/2015

Table E-2. Wells Installed in 2015

Groundwater Interest Area	Well Name	Well ID	Well Purpose	Construction Depth (ft bgs)	Drilled Depth (ft bgs)	Acceptance Date
300-FF	399-1-65	C9408	PRZ monitoring	48.6	49.7	8/12/2015
300-FF	399-1-66	C9409	Aquifer monitoring	47.1	50.1	8/12/2015
300-FF	399-1-79	C9450	PRZ monitoring	38.2	40.2	8/12/2015
300-FF	399-1-80	C9451	Aquifer monitoring	48.3	50.5	8/12/2015
300-FF	399-1-81	C9452	PRZ monitoring	38.3	40.7	8/12/2015
300-FF	399-1-82	C9453	Aquifer monitoring	48.3	50.5	8/12/2015
300-FF	399-1-83	C9454	PRZ monitoring	38.1	40.0	8/12/2015
300-FF	399-1-84	C9455	Aquifer monitoring	55.7	60.0	8/12/2015
300-FF	399-1-85	C9456	PRZ monitoring	38.2	40.0	8/12/2015
300-FF	399-1-86	C9457	Aquifer monitoring	48.0	50.5	8/12/2015
300-FF	399-1-87	C9458	Aquifer monitoring	38.0	41.0	8/12/2015
300-FF	399-1-89	C9460	Injection	48.9	50.5	8/12/2015
300-FF	399-1-90	C9461	Injection	49.0	50.3	8/12/2015
300-FF	399-1-91	C9462	Injection	48.5	50.0	8/12/2015
300-FF	399-1-92	C9463	Injection	48.8	50.0	8/12/2015
300-FF	399-1-93	C9464	Injection	48.5	50.0	8/12/2015
300-FF	399-1-94	C9465	Injection	48.8	50.0	8/12/2015
300-FF	399-1-95	C9466	Injection	49.4	50.3	8/12/2015
300-FF	399-1-96	C9467	Injection	48.4	50.0	8/12/2015
300-FF	399-1-97	C9468	Injection	48.4	50.0	8/12/2015
300-FF total = 32						
Grand Total = 81						

*Aquifer tube installation date (aquifer tubes do not undergo formal well acceptance process)

bgs = below ground surface

ID = identification

PRZ = periodically rewetted zone

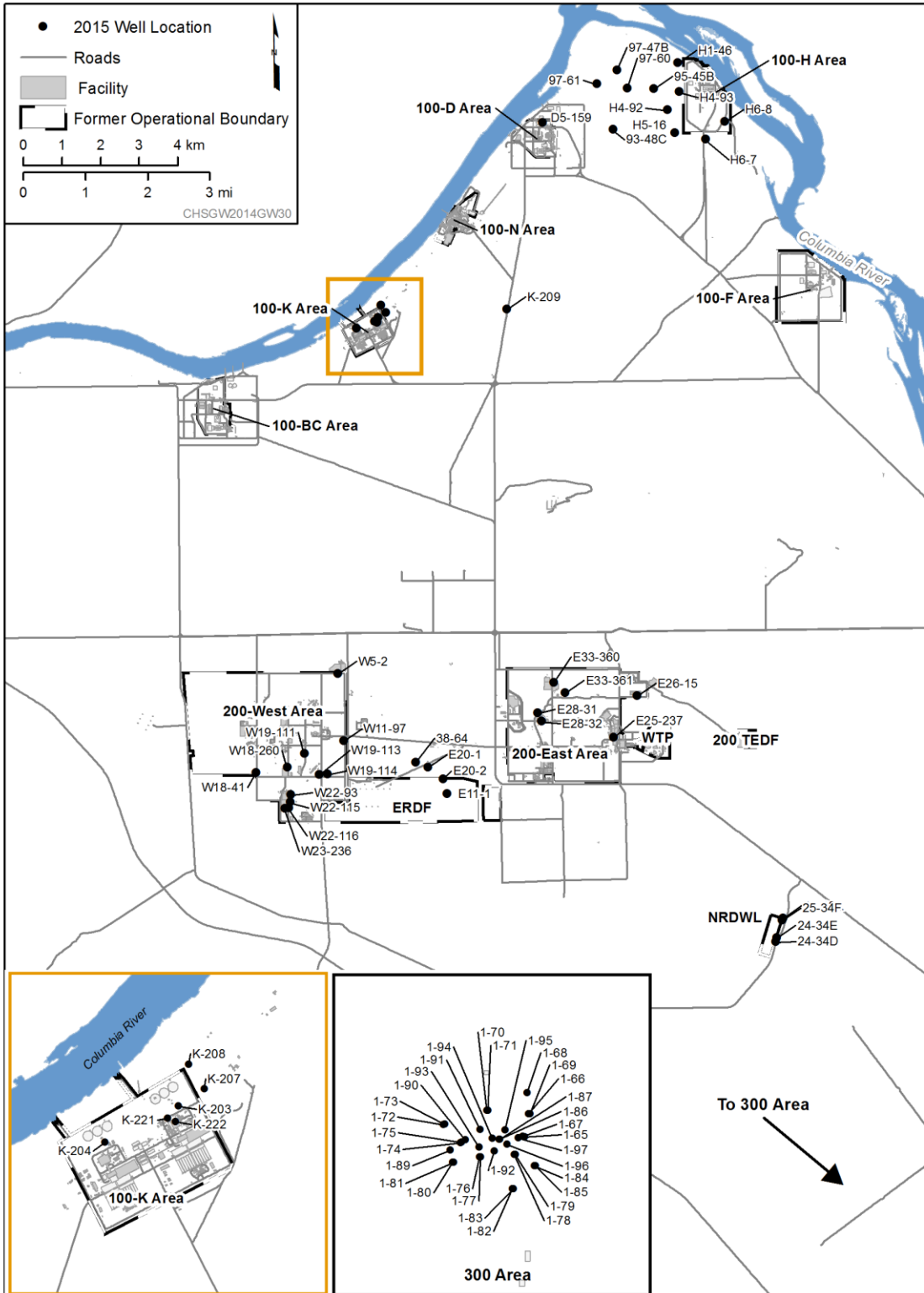


Figure E-2. Hanford Site Wells Installed in 2015

Water well reports for all newly constructed wells, as required by [WAC 173-160](#), were submitted to Ecology. Detailed well information such as geologic and geophysical descriptions, characterization activities (i.e., sediment and groundwater sampling, aquifer testing), and construction records for the new wells are stored in the Integrated Document Management System and consolidated in borehole summary reports. Much of this information is also accessible and available through the DOE Environmental Dashboard Application.

E2 Borings

During 2015, no soil borings were drilled for groundwater operable units (OUs). Borings differ from wells in that no permanent casing or screen is installed and the borehole is decommissioned immediately after characterization is complete.

E3 Maintenance

During 2015, well maintenance was conducted 360 times on the different well types. Surface modifications included repair or replacement of locking well caps, surface casing repairs, diagnosis and repair of electrical wiring, labeling, electrical bonding, and modifications to surface pump and riser pipe discharge components and fittings. Subsurface tasks typically included repair and replacement of sampling pumps, downhole camera surveys, pump and equipment retrieval, and replacement of discharge tubing. Well rehabilitation activities included surging, swabbing, screen brushing, chemical treatment, and over-pumping to improve well performance.

Documentation for well maintenance activities is entered into the Well Maintenance Application database and accessible through the DOE Environmental Dashboard Application.

E4 Decommissioning

As part of DOE asset management, wells, boreholes, or other subsurface installations are identified for decommissioning when they are no longer useful for achieving the Hanford Site environmental cleanup mission. Well decommissioning is driven by [DOE/RL-2005-70](#), *Hanford Site Well Decommissioning Plan*. Decommissioning is defined therein as the properly completed and documented sealing of water or resource protection wells in compliance with state groundwater protection laws ([WAC 173-160](#)). The plan lays out the basis, decision logic, and implementation process for prioritizing and decommissioning Hanford Site wells.

All candidate wells for decommissioning must be reviewed and approved by Hanford Site contractors, DOE, Ecology, the U.S. Environmental Protection Agency, and other potential well users (e.g., Pacific Northwest National Laboratory) prior to decommissioning. The initial phase of decommissioning includes a thorough records review and physical inspection of each well to confirm the well location and configuration (well attributes). Normally, a well becomes a candidate for decommissioning under one of the following conditions:

- The well is no longer used for water-level or contaminant monitoring, contaminant extraction, in situ remedial treatment of contaminated groundwater, permitted injection of treated effluent from a remedial action, water supply, research, or technology demonstration.
- The well has no specified future purpose.
- The well is unusable, abandoned, or permanently discontinued.
- The well is in such disrepair that its continued use is impractical.

- The well is an environmental, safety, or public health hazard (e.g., it does not meet [WAC 173-160](#) requirements for well completion; however, there are special provisions for continued use of a well that is not compliant with [WAC 173-160](#)).
- The well interferes with environmental remediation, excavation, and/or construction activities.

In 2015, 38 borings and wells (Table E-3) were physically decommissioned. Decommissioning is performed in accordance with [WAC 173-160-460](#), “What Is the Decommissioning Process for Resource Protection Wells?”, applicable well decommissioning variances, and conditions defined in *the Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* ([Hanford Federal Facility RCRA Permit](#)).

Table E-3. Wells Decommissioned in 2015

Groundwater Interest Area	Well ID	Out of Service Date
1100-EM	A9948	8/17/2015
1100-EM	A9949	8/17/2015
1100-EM	A9950	8/17/2015
1100-EM	A9951	8/17/2015
1100-EM	A9952	8/17/2015
1100-EM	A9953	8/17/2015
1100-EM	A9954	8/17/2015
1100-EM	A9955	8/17/2015
1100-EM	A9956	8/11/2015
1100-EM	A9957	8/11/2015
1100-EM	A9958	8/11/2015
1100-EM	A9959	8/11/2015
1100-EM	A9960	8/11/2015
1100-EM	A9961	8/11/2015
1100-EM	A9962	8/11/2015
1100-EM	A9963	8/11/2015
1100-EM	A9964	8/11/2015
1100-EM	A9965	8/11/2015
1100-EM	A9966	8/11/2015
1100-EM	C8695	9/2/2015
1100-EM	C9530	9/2/2015
1100-EM	C9531	9/2/2015
1100-EM	C9532	9/2/2015
1100-EM	C9534	9/2/2015

Table E-3. Wells Decommissioned in 2015

Groundwater Interest Area	Well ID	Out of Service Date
1100-EM	C9535	9/2/2015
1100-EM	C9538	9/2/2015
1100-EM	C9540	9/2/2015
1100-EM	C9569	9/2/2015
1100-EM	C9570	9/2/2015
1100-EM	C9571	9/2/2015
1100-EM	C9572	9/2/2015
1100-EM	C9573	9/2/2015
1100-EM	C9574	9/2/2015
1100-EM	C9575	9/2/2015
1100-EM	C9576	9/2/2015
1100-EM	C9577	9/2/2015
1100-EM	C9578	9/2/2015
1100-EM	C9579	9/2/2015
1100-EM Total =38		
Grand Total = 38		

ID = identification

Decommissioning typically involves backfilling a well with impermeable material in both the annular space and the casing to prevent vertical movement of water and/or contaminants into the vadose zone and groundwater. For wells that are constructed in accordance with [WAC 173-160](#) requirements (compliant), decommissioning is performed by filling the well screen and the casing with an impermeable material (e.g., bentonite or cement grout). For older, noncompliant wells, the casing is either removed and the borehole is filled with seal material, or the casing is perforated and pressure grouted to create an external annular seal and then internally grouted to the surface. As far as possible, all casing is removed from the ground. A brass survey marker identifying the former well is typically set in cement grout at the ground surface over the decommissioned location. Decommissioning activities result in the permanent removal of a well, borehole, or piezometer from service and from the Hanford Site active well inventory.

A completed water well report form is required to be transmitted by the contractor or in-house driller to Ecology when a well is decommissioned. The report provides the details on final construction of the well and the steps taken to decommission the well.

Administratively decommissioned wells may be wells that can no longer be located and are determined to no longer exist. More generally, administratively decommissioned wells have been physically decommissioned but still require documentation describing the decommissioning in the well database.

Each year, a very limited number of previously unknown wells are usually discovered during the conduct of field activities. Once discovered, these wells are assigned a unique well ID number, assigned

an appropriate well status, and information is input into the DOE Environmental Dashboard Application. Eighteen soil borings from 1100-EM were identified and decommissioned in 2015, and one soil tube drilled for the remedial investigation for the Horn Rapids Landfill in the 1100-EM-1 OU was decommissioned.

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E5 References

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