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Lawrence Livermore National Laboratory

Lawrence Livermore National Security, LLC, Livermore, California 94551

LLNL-AR-454953

Explanation of Significant Difference for Ground Water Nitrate Treatment at the Building 829-Source Treatment Facility Lawrence Livermore National Laboratory Site 300

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December 2010

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1. Introduction

The Final Site-Wide Record of Decision (ROD) (U.S. Department of Energy [U.S. DOE], 2008) was signed in July 2008, documenting the final cleanup plan for the Lawrence Livermore National Laboratory (LLNL) Site 300 in Tracy, California (Figure 1). Any significant changes to that plan must be publicly noticed through an Explanation of Significant Difference (ESD). As required under Section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendment and Reauthorization Act of 1986 (SARA), and pursuant to 40 Code of Federal Regulations (CFR) Section 300.435 (c)(2)(i) (Fed. Reg. Vol. 55, No. 46 [March 8, 1990]), an ESD is required because a significant, but not fundamental change is proposed to the final remedy for the High Explosives (HE) Process Area Operable Unit (OU) described in the Final Site-Wide ROD.

This ESD documents a change in treatment technology for nitrate in extracted ground water at the Building 829-Source (SRC) ground water treatment facility (Figure 2), located in the HE Process Area OU. This ESD explains the decision to use *ex situ* ion-exchange treatment media to remove nitrate from ground water extracted from well W-829-06; rather than the existing *ex situ* biotreatment unit.

The U.S. DOE is the lead agency for the CERCLA cleanup at LLNL Site 300 with regulatory oversight by the U.S. Environmental Protection Agency (U.S. EPA), the California Department of Toxic Substances Control (DTSC), and the Regional Water Quality Control Board (RWQCB)-Central Valley Region. The lead regulatory agency for this ESD is the U.S. EPA. The RWQCB and the California DTSC have reviewed and commented on this ESD. Regulatory comments and DOE/LLNL responses are presented in Section 6.

This ESD includes a description of the site history and contamination, a brief summary of the remedy selected in the Final Site-Wide ROD, a description of the change, and a description of why DOE/LLNL are making this change to the selected remedy. This ESD was prepared according to EPA guidance (U.S. EPA, 1999).

2. Site History and Description of Contamination

Prior to the purchase of the land that is now LLNL Site 300 in 1955, the area was used for livestock grazing and ranching. Facility construction began in 1955 and most of the HE processing facilities were constructed by the early 1960s. Technical operations, which began in the late 1950s, involve the chemical formulation, mechanical pressing, and machining of HE compounds into shaped detonation devices. These devices are used in explosive experiments conducted in the East-West Firing Area, located in the northern part of Site 300. Solid HE waste remaining after machining operations was disposed of by incineration at the HE Open Burn Facility located near Building 829 in the northern part of the HE Process Area OU. In 1997, the Final Closure Plan for the HE Open Burn Facility at Building 829 was submitted to the regulatory agencies (Lamarre et al., 1997). As specified in the Final Closure Plan, the Burn

Facility was dismantled, capped, and three deep ground water wells were installed in the regional $Tnbs_1$ aquifer for post-closure monitoring.

While no anthropogenic chemicals have been detected in the post-closure monitor wells for the Burn Facility, ground water sample data and passive soil vapor surveys confirmed the Hazardous Waste Accumulation Area or Drying Shed, located near the former Burn Facility, as the source of volatile organic compounds (VOCs) in this area. While TCE concentrations have declined from a historical maximum of 1,000 micrograms per liter (μg/L) (August 1993), the recent TCE maximum concentration of 22 μg/L (May 2010) still exceeds the 5 μg/L TCE ground water cleanup standard. Perchlorate concentrations in ground water have declined from a historical maximum of 29 μg/L (December 2000) to 7.9 μg/L in May 2010; slightly above the 6 μg/L cleanup standard. While nitrate ground water concentrations have declined from a historical maximum of 240 milligrams per liter (mg/L) (December 2000), the recent maximum concentration of 80 mg/L (May 2010) still exceeds the 45 mg/L cleanup standard.

These ground water contaminants of concern (COCs) are present in the $Tnsc_{1b}$ hydrostratigraphic unit (HSU). Ground water in this HSU is perched and is limited in lateral extent. Concentrations of VOCs, perchlorate, and nitrate in $Tnsc_{1b}$ HSU ground water are shown in Figure 3. Anthropogenic chemicals have not been detected in the regional $Tnbs_1$ aquifer, located about 300 ft below the $Tnsc_{1b}$ HSU.

No COCs were identified in surface soil or subsurface soil in the Building 829 source area. There is no surface water present in this area. No unacceptable risks to human health (onsite workers) or ecological receptors have been identified in the Building 829 area.

Additional characterization information is described in the Site 300 Site-Wide Remedial Investigation Report (Webster-Scholten et al., 1994), the Site-Wide Feasibility Study (Ferry et al., 1999), the Interim Site-Wide ROD (U.S. DOE, 2002), the Final Site-Wide ROD (U.S. DOE, 2008), and the Remedial Design Report for the HE Process Area OU (Madrid et al., 2002).

3. Remedy Selected in the Final Site-Wide ROD

The cleanup remedy for VOCs, nitrate, and perchlorate in the Building 829 area was selected in the Interim Site-Wide ROD and finalized in the Final Site-Wide ROD. The selected remedy for these ground water COCs in the Building 829 area consists of:

- Ground water monitoring to evaluate the effectiveness of the remedial action, and to determine when cleanup standards are met.
- Extracting and treating ground water to reduce VOCs, nitrate, and perchlorate concentrations in ground water to cleanup standards.

The Building 829-Source (B829-SRC) Treatment Facility is located on the southern central portion of Site 300, and is part of the HE Process Area OU (Figure 2). The B829-SRC ground water extraction and treatment facility began operating in 2005 to remediate VOCs, nitrate, and perchlorate in ground water (Figure 3). Solar power is used to extract ground water from well W-829-06 at a flow rate of approximately 5 to 10 gallons per day (gpd). The current ground water treatment system configuration consists of two ion-exchange columns connected in-series

for perchlorate removal, followed by three aqueous-phase granular activated carbon (GAC) canisters connected in-series for VOC removal, and finally, a biotreatment unit (BTU) to remove nitrate (Figure 4). The treated effluent is monitored to ensure ground water COC concentrations have been reduced to meet the VOC, perchlorate, and nitrate effluent limitations of 0.5 μg/L, 4 μg/L, and 45 mg/L, respectively. The treated effluent is then reinjected into upgradient well W-829-08.

4. Description of the Significant Difference and the Basis for the Difference

The significant difference between the remedy for the Building 829 area presented in the Final Site-Wide ROD and the modified remedy is described below.

4.1. Description

This ESD describes a change in treatment technology for nitrate in ground water at the B829-SRC facility, where ground water extracted from well W-829-06 will be treated using ion-exchange treatment technology to remove nitrate. This is a change from current nitrate biotreatment technology at the B829-SRC facility as described in the ROD.

4.2. Basis

Operational data for the B829-SRC ground water extraction and treatment system indicate that the long-term yield from the extraction well W-829-06 is very low (5 to 10 gpd) and continuous pumping is not possible. Because of the low yield, the extraction well is pumped on a cyclic basis, 2 or 3 times per day. Experience operating and maintaining BTUs at B829-SRC and other Site 300 facilities (e.g., B854-PRX and B830-DISS) indicate that the long-term yield from the $Tnsc_{1b}$ HSU does not meet the minimal flow necessary to create efficient steady-state conditions required for bacterial denitrification in the B829-SRC BTU. The low flow conditions and cyclic pumping resulted in biofouling and clogging of the BTU and incomplete utilization of the acetate added to the BTU to promote degradation. The acetate that is not fully used by the bacteria was discharged into the injection well, increasing the risk of biofouling of the well. Additionally, during cold weather periods the bacteria become dormant and are not effective at metabolizing nitrate. Under these operational conditions, the use of biotreatment at B829-SRC to remove nitrate from ground water is not practical.

Table 1 and Figure 5 present nitrate analytical data for water samples collected at sample ports at the influent to and effluent from the ion-exchange resin columns at the B829-SRC treatment facility. These data demonstrate that the ion-exchange resin effectively reduces nitrate concentrations to significantly below the 45 mg/L nitrate effluent limitation. Because the BTU is located after the ion-exchange resin columns, the decrease in nitrate concentration to near or below the 0.5 to 1 mg/L practical quantitation limit is solely the result of nitrate treatment by the ion-exchange resin. Therefore, the BTU is not necessary to meet discharge limits for nitrate.

Table 1. Nitrate concentrations in the influent to and effluent from the ion-exchange columns at the B829-SRC treatment facility.

Sample date[a]	Nitrate (as NO_3) concentration in B829-SRC (ion-exchange) influent[b] (mg/L)	Nitrate (as NO_3) concentration in effluent from ion-exchange resin[b,c,d] (mg/L)
4/25/06	94	<0.5
5/04/06	Not required	<0.5
6/07/06	Not required	<1
7/12/06	54	<1
7/18/07	93	2.6
7/26/07	Not required	3.4
8/2/07	Not required	<1
9/12/07	Not required	<1
10/4/07	85	<1
11/5/07	Not required	<0.5
12/4/07	Not required	<0.5
2/13/08	82	1.3
3/4/08	Not required	<0.5
5/28/08	Not required	<1
6/10/08	81	<0.5
7/8/08	85	<0.5
8/20/08	Not required	<1
5/17/10	78	<1

Notes:

[a] **Operational details are discussed in the semi-annual and annual Compliance Monitoring Reports.**

[b] **Quarterly monitoring of influent and monthly monitoring of effluent is required by the Compliance Monitoring Report and RWQCB Substantive Requirements when facility is operating.**

[c] **Nitrate effluent limitation of 45 mg/L specified in the Final Site-Wide ROD.**

[d] **As shown in Figure 4, the effluent sample from the ion-exchange resin is collected at sample port 829-SRC-BTU-I before the water stream enters the BTU.**

This ESD documents the removal of the BTU and the use of the existing ion-exchange technology already in place at the B829-SRC treatment facility to continue to remove nitrate from extracted ground water because:

1. The ion-exchange columns are effectively removing the nitrate to meet effluent discharge limits, rendering the BTU unnecessary,
2. The BTU is impractical under the operational conditions at B829-SRC.
3. Elimination of the BTU is expected to increase the overall operational efficiency of the B829-SRC treatment facility, and decrease operation and long-term maintenance (O&M) efforts.

The proposed B829-SRC treatment facility configuration is shown in Figure 6. The ion-exchange resin used for perchlorate removal is an anion-exchange resin that also effectively removes nitrate. The resin has a higher affinity for binding perchlorate, so nitrate will be released as the perchlorate is loaded. There are two ion-exchange columns in series, and routine monitoring for both nitrate and perchlorate will be performed between columns to ensure change-out of columns is performed to meet effluent limitations for perchlorate and nitrate. When breakthrough of nitrate or perchlorate occurs after the first ion-exchange column, the first column will be removed, the second column will be moved to the first position, and a new column would be placed in the second position. The ion-exchange technology has been demonstrated to be effective, and requires relatively little maintenance. No changes to the size or number of ion-exchange columns are needed to remove nitrate and perchlorate to meet effluent limits.

A description of changes to the selected remedy for the B829-SRC treatment facility is presented in Table 2.

Table 2. Description of changes to B829-SRC treatment facility.

Item	Existing B829-SRC	Modified B829-SRC	Change from Final Site-Wide ROD
Ground water extraction well	**W-829-06**	**W-829-06**	**No**
Flow rate	**5-10 gpd**	**5-10 gpd**	**No**
VOC Treatment	**3 in-series GAC units**	**3 in-series GAC units**	**No**
Perchlorate Treatment	**2 in-series ion-exchange units**	**2 in-series ion-exchange units**	**No**
Nitrate Treatment	**Biotreatment unit**	**2 in-series ion-exchange units**	**Yes**
Effluent Limitations	**VOCs: 0.5 µg/L** **Perchlorate: 4 µg/L** **Nitrate: 45 mg/L**	**VOCs: 0.5 µg/L** **Perchlorate: 4 µg/L** **Nitrate: 45 mg/L**	**No**
Discharge method/ location	**Treated effluent injected into well W-829-08**	**Treated effluent injected into well W-829-08**	**No**
Facility effluent monitoring	**Treatment facility effluent is monitored after the BTU.**	**Treatment facility effluent will be monitored after the GAC units.**	**No; not specified in ROD**

There would be a relatively low investment in capital costs (approximately $8,000) that consists primarily of labor costs to remove the BTU and install a short length of pipeline from the GAC units to the injection well. The change from using the BTU to the existing ion-exchange resin for the removal of nitrate in ground water is anticipated to reduce long-term annual operation and maintenance costs by approximately $21,000.

The change in the nitrate treatment technology for the B829-SRC facility proposed in this ESD will not alter the protectiveness or outcome of the remedy (i.e., expected time to achieve cleanup objectives.)

However, DOE would like to retain the ability to utilize bioremediation technology for nitrate treatment, if conditions at Building 829 change in the future where bioremediation/treatment becomes feasible and appropriate. In this event, DOE would consult with the regulatory agencies.

5. Support Agency Comments

To be added after regulatory comments are received and addressed.

6. Public Participation

Pursuant to 40 CFR Section 300.435(c)(2)(i) and U.S. EPA (1999), a public comment period is not required for an ESD. However, a notice of availability and brief description of the ESD were published in the *Tri-Valley Herald* and the *Tracy Press*.

This ESD has been placed in the LLNL information repositories for interested members of the public to review. One repository is located at the Tracy Public Library – 20 East Eaton Avenue, Tracy, California. Library hours are Monday and Wednesday, 11:00 a.m. to 7:00 p.m.; Tuesday and Thursday, 10:00 a.m. to 6:00 p.m.; Saturday, 10:00 a.m. to 4:00 p.m.; and Sunday, 1:00 to 5:00 p.m. The second repository is at the LLNL Discovery Center on Greenville Road near Eastgate Drive in Livermore, California. Discovery Center hours are Tuesday through Friday, 1:00 to 4:00 p.m., and Saturday, 10:00 a.m. to 2:00 p.m.

The ESD was also placed in the LLNL Site 300 Administrative Record, which contains all documents that form the basis for the LLNL Site 300 cleanup plan. The Administrative Record can be accessed through the LLNL Discovery Center. The ESD is also available on-line at http://www-erd.llnl.gov/library/index.html.

7. Affirmation of the Statutory Determinations

Considering the new information and the changes that will be made to the remedy, the U.S. Environmental Protection Agency believes that the remedy remains protective of human health and the environment, complies with Federal and State requirements identified in the Final Site-Wide ROD as applicable or relevant or appropriate to this remedial action, and is cost effective. In addition, the revised remedy provides a permanent and effective solution for the removal of nitrate from ground water in the Building 829 area to the maximum extent practical for this site.

_____ _____

Angeles Herrera Date
Acting Assistant Director, Federal Facilities and Site Cleanup Branch
Superfund Division
U. S. Environmental Protection Agency, Region IX

_____ _____

Claire Holtzapple Date
Site 300 Remedial Project Manager
Environmental Stewardship Division
National Nuclear Security Administration
Livermore Site Office

8. References

Ferry, L., R. Ferry, W. Isherwood, R. Woodward, T. Carlsen, Z. Demir, R. Qadir, and M. Dresen (1999), *Final Site-Wide Feasibility Study for Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-132609).

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9. Acronyms and Abbreviations

B829-SRC	Building 829-Source
BTU	Biotreatment unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COCs	Contaminants of Concern
DOE	Department of Energy
DTSC	(California) Department of Toxic Substances Control
EPA	Environmental Protection Agency
ESD	Explanation of Significant Difference
GAC	Granular activated carbon
gpd	Gallons per day
GWTS	Ground water treatment system
HE	High Explosives
LLNL	Lawrence Livermore National Laboratory
mg/L	Milligrams per liter
O&M	Operation and maintenance
OU	Operable Unit
ROD	Record of Decision
RWQCB	(California) Regional Water Quality Control Board
SARA	Superfund Amendment Reauthorization Act
$Tnbs_1$	Tertiary Neroly Lower Blue Sandstone
$Tnsc_{1b}$	Tertiary Neroly Lower Siltstone/Claystone Unit 1b
VOCs	Volatile organic compounds
U.S.	United States
μg/L	Micrograms per liter

FIGURES

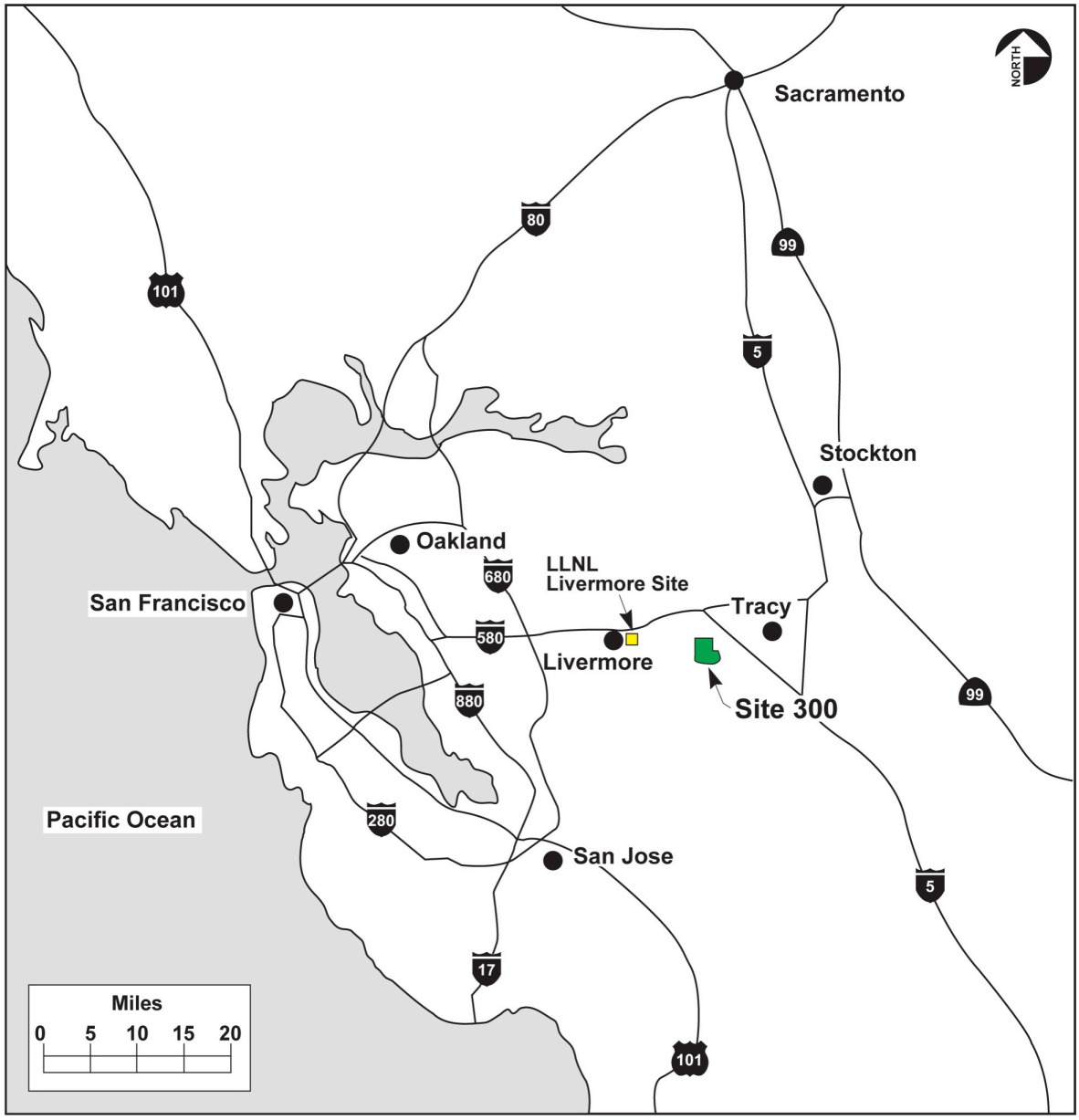

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Figure 1. Location of LLNL Site 300.

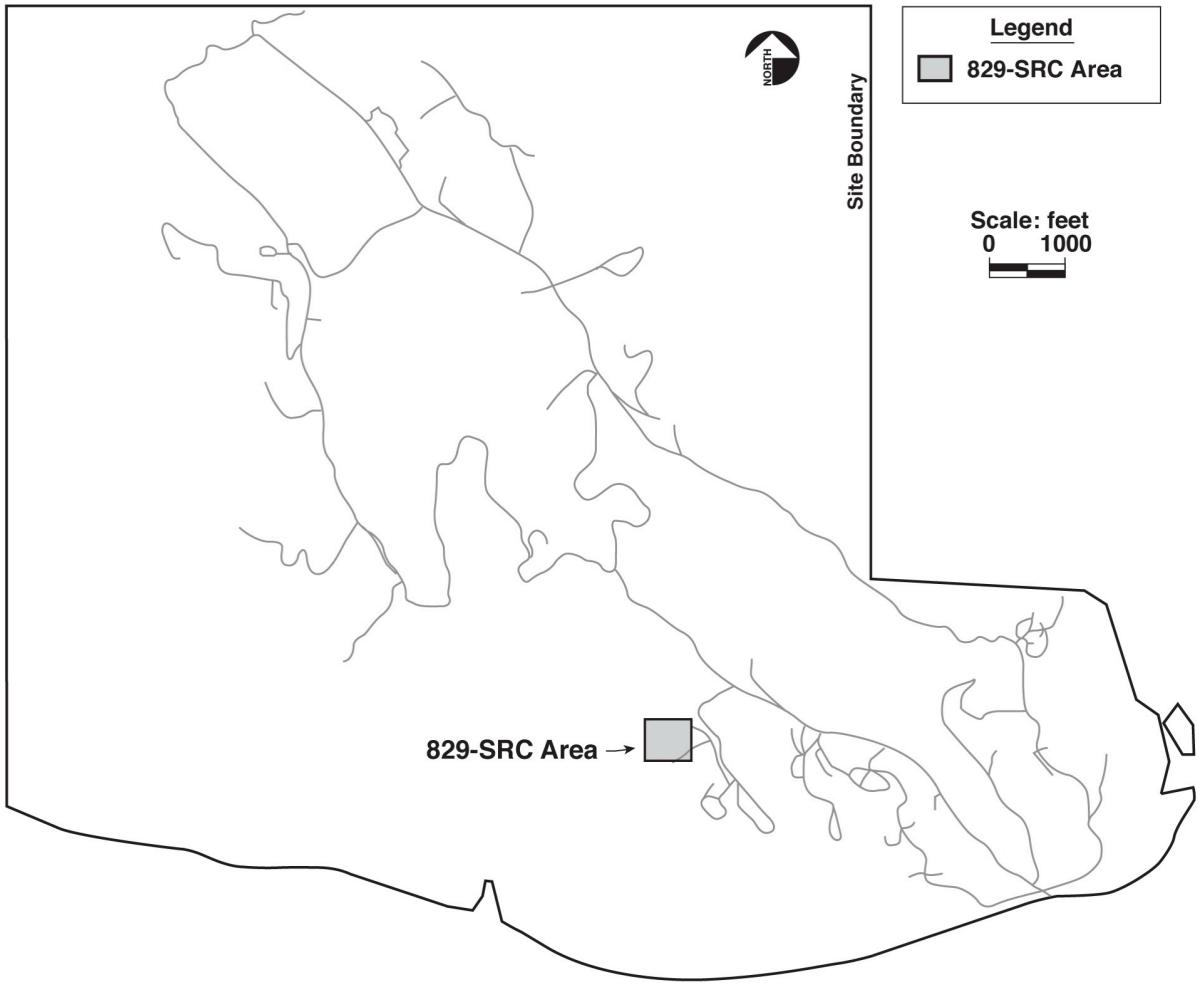

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Figure 2. Location of Building 829-SRC Area at LLNL Site 300.

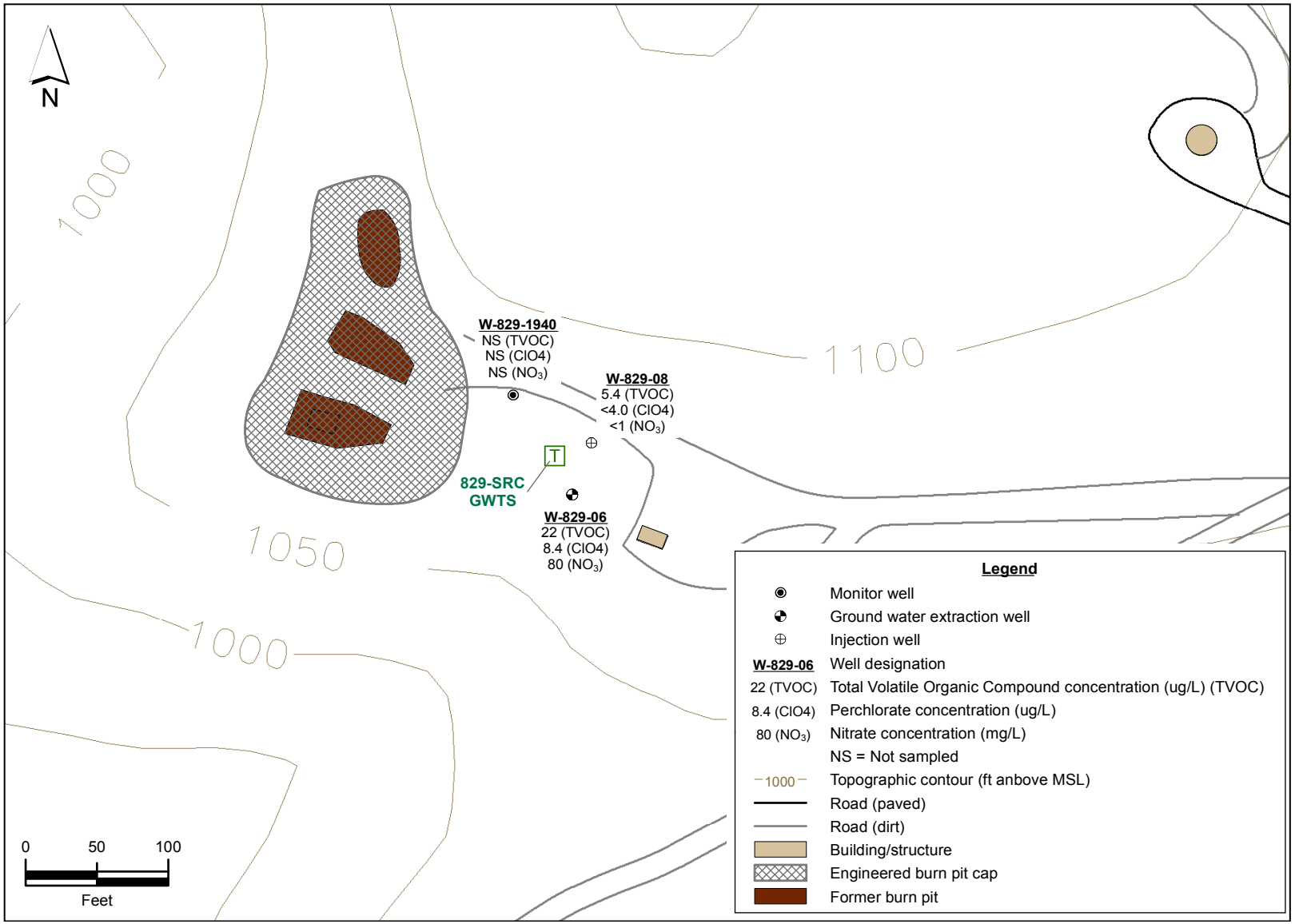

Figure 3. Site map showing the 829-SRC treatment facility, injection, extraction, and monitor wells, and total VOCs, perchlorate, and nitrate in the $Tnsc_{1b}$ HSU (First Semester 2010).

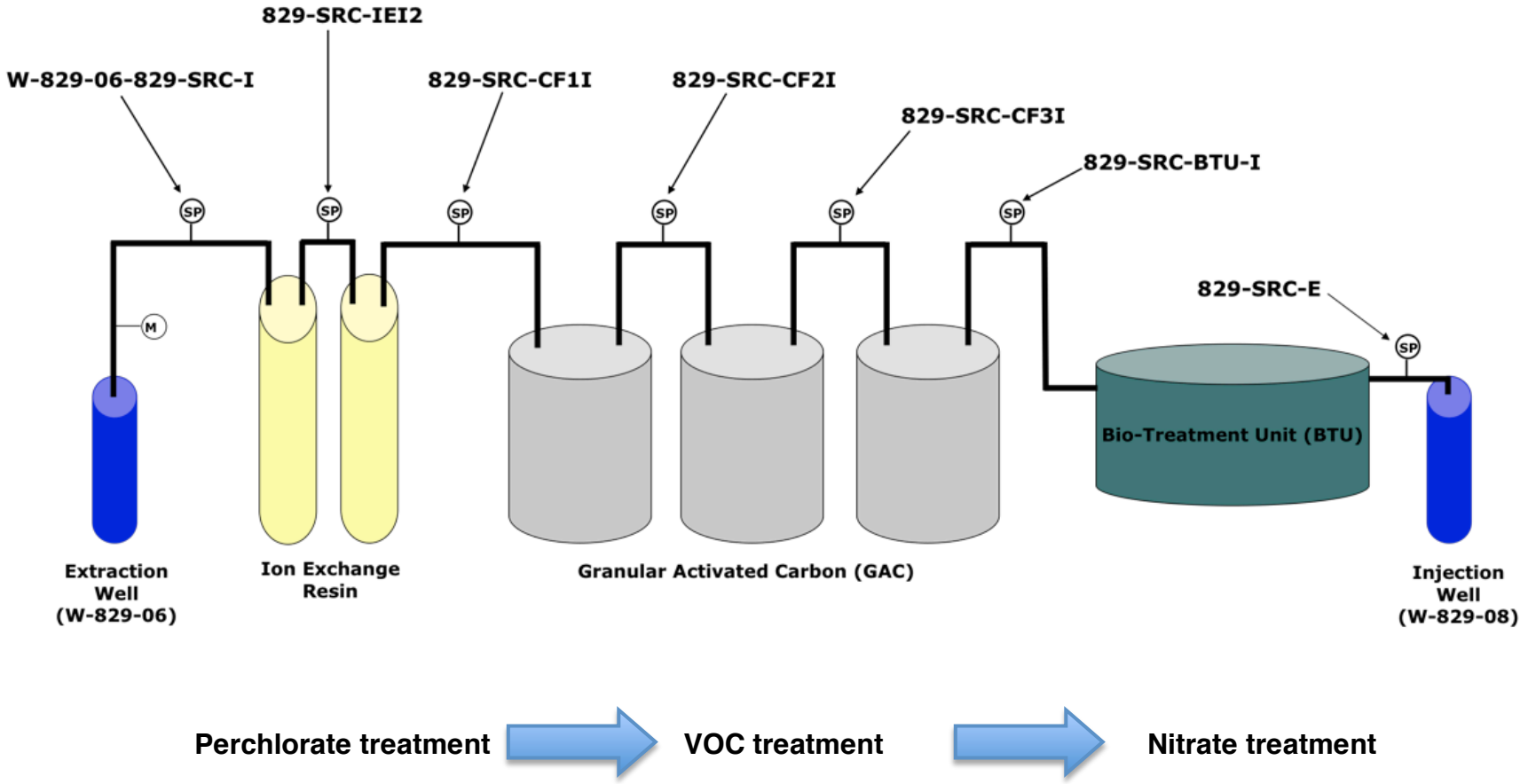

Figure 4. Existing B829-SRC treatment system configuration with nitrate biotreatment unit.

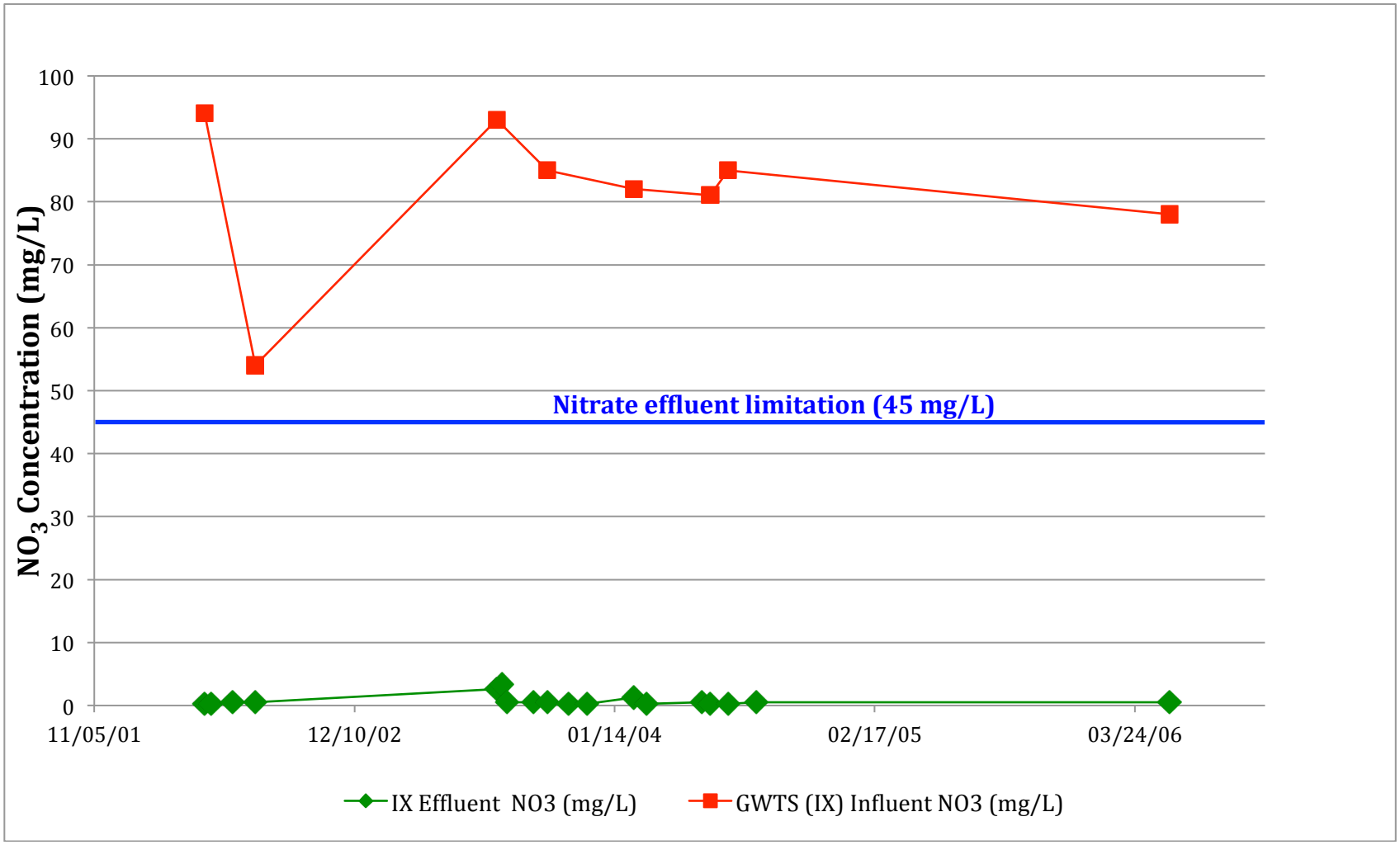

Figure 5. Nitrate (as NO_3) concentrations in the influent and effluent to the B829-SRC Ground Water Treatment System (GWTS) ion-exchange (IX) columns.

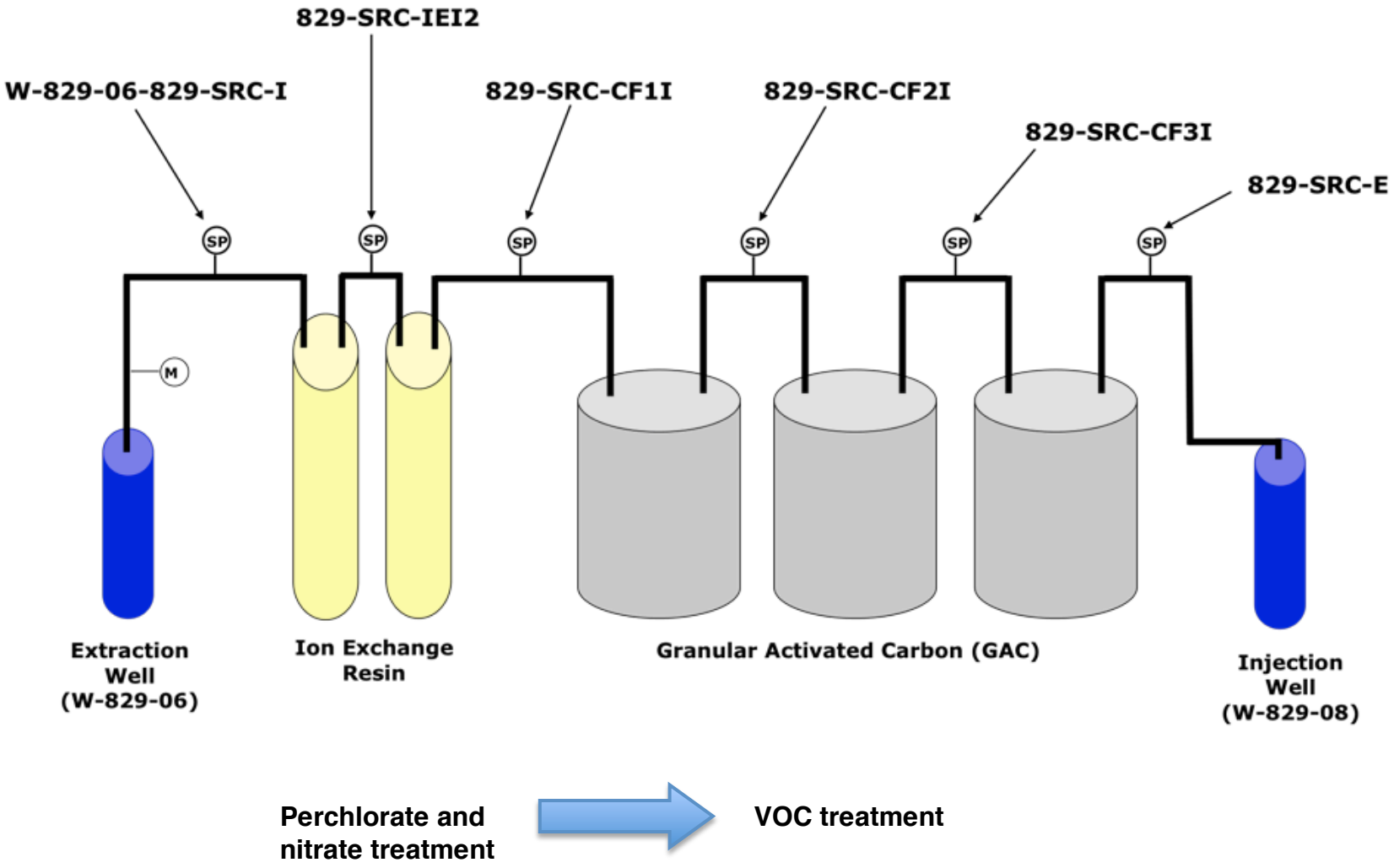

Figure 6. Modified B829-SRC treatment system configuration with nitrate ion-exchange columns.

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