Report

Lynnfield Center Water District

Glen Drive Wells
Water Treatment Facilities Plan

December 2018

CDM Smith

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December 19, 2018

Ms. Constance Leccese, Chairperson
Lynnfield Center Water District
83 Phillips Road
Lynnfield, MA 01940-1763

Subject: Task Order 2
Glen Drive Wells Treatment Facilities Plan
Report Deliverable

Dear Ms. Leccese:

In accordance with Task Order 2, dated June 13, 2018, CDM Smith is pleased to present you with the Glen Drive Wells Water Treatment Facilities Plan report. This report includes a description of the District's water supply system, existing conditions at the Glen Drive facility, current and past water quality data, facilities modifications and new water treatment requirements, an environmental assessment and permitting review, and an opinion of probable construction cost. This report also includes two options for the new greensand filter building layout and a figure showing the proposed site layout for the new building and sludge lagoons.

Although the Task Order scope of work identified a technical memorandum as the final deliverable, CDM Smith generated this report in its place. The report format allowed for more effective and thorough documentation of the facilities planning process.

As part of the facilities planning process, CDM Smith also assisted the District with a Project Evaluation Form (PEF) to apply for funding through the Massachusetts Drinking Water State Revolving Fund (DWSRF) program. The PEF was submitted to MassDEP in August 2018; if the Greensand filter plant is placed on the State's Intended Use Plan, the District will have the opportunity to apply for a 2 percent interest loan with a 20-year payback period for the construction of the greensand filter plant. The State's Intended Use Plan is anticipated to be made available in January 2019.

On August 23, 2018, CDM Smith met with the District to review a draft building layout for the new greensand filter plant at Glen Drive, and the draft PEF application. The District reviewed the draft building layout and provided comments. CDM Smith met with the District again on September 27, 2018 to conduct a site visit of the existing greensand filter plant at Philips Road and the existing pump station building at Glen Drive; CDM Smith also review an updated draft of the building layout with the District during this site visit. Through October and November 2019

CDM Smith exchanged emails and phone calls with the District to review various components of the new greensand filter plant such as options to fuel an on-site emergency generator, recommendations for installing a new bathroom in the existing pump station building, and chemical storage and dosing practices.

Through the duration of this Task Order, regularly scheduled Board Meetings occurred. Board Meetings are always open to District customers. Beginning in August 2018 and continuing through December 2018, District customers attended the Board meetings. The Board relocated their meetings from the District's office on Phillips Road to the Lynnfield Middle School on Main Street to accommodate the crowd. The District made the meeting Agendas and Minutes available on their website and obtained the services of CDM Smith to assist in presenting material regarding the new greensand filter plant at Glen Drive to those in attendance. The District then uploaded presentation material to their website for all customers to view.

A Special District meeting was held on December 10, 2018 to vote on a warrant article to design and construct the greensand filter as presented in this report. The greensand filter warrant article was not voted on, and therefore, the design and construction of the greensand filter plant is not scheduled to move forward at this time.

This report is considered final, however, if the District is in a position to move forward with design and construction of the greensand filter plant at Glen Drive, CDM Smith would be pleased to meet with the District to revisit the report content and review final design options and recommendations with the District.

If you have any questions on this information, please call me at 617-452-6561.

Very truly yours,

Angela Moulton, PE
Project Engineer
CDM Smith Inc.

Cc: Nicholas Couris, LCWD
John Doherty and Meredith Sullivan, CDM Smith

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Section 1
Introduction

1.1 Purpose of Project

The purpose of this project is to characterize the current condition of the Lynnfield Center Water District's (District's) Glen Drive source, to consider existing pumping and treatment components for the source, and to develop a facilities plan for new water treatment improvements. This information will be used for the anticipated design of greensand filtration for the Glen Drive wellfield.

The supply sources contain iron and manganese, which can affect aesthetics including taste and color. Customers in the District's service area have concerns including the taste, color and staining of laundry and plumbing fixtures. Water from the Glen Drive wells in particular have manganese concentrations above the Massachusetts secondary maximum contaminant level (SMCL). Note that this wellfield has been online since 1997, and while manganese levels were originally low and therefore not a concern, concentrations at this location have increased over time.

Consumer complaints regarding water quality have been recorded and filed at the District's office on Phillips Road. Generally, customer complaints focus on discolored water along with staining of fixtures and laundry.

In the recent months (May-October 2018), Glen Drive wellfield's manganese levels have ranged between 0.06 and 0.213 milligrams per liter (mg/L) in the individual wells at the existing Glen Drive wellfield, generally with a combined value of between 0.1 and 0.15 mg/L.

MassDEP issued a complaint letter to the District on September 26, 2018, requesting the District submit a written report on the probable cause and resolution of these water quality complaints. A copy of this letter and the District's response letter, dated October 31, 2018, are included in **Appendix A**.

While manganese concentrations at the Glen Drive wellfield have been below health advisories (0.3 mg/L as the recommended water concentration limit for lifetime exposures to manganese), Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (MassDEP) include manganese as a secondary contaminant because of aesthetic concerns at levels greater than 0.05 mg/L. Though the District continues to maintain the ability to provide water that meets all federal and state regulations, the District is also committed to addressing these secondary contaminant issues, including aesthetic concerns.

1.2 Overall Water Supply Source System

Lynnfield Center Water District's water supply includes four groundwater source locations:

- Station 1 – Phillips Road Tubular Wellfield

- Station 2 – Main Street Well
- Station 3 – Phillips Road Bedrock and Gravel-Packed Wells
- Station 4 – Glen Drive Wells

The four sources draw water from two watersheds: The Ipswich River Basin (Stations 2 and 4) and the North Coastal Basin (Stations 1 and 3). The registration volume for the Ipswich River Basin is 0.29 million gallons per day (mgd) and the registration volume for the North Coastal Basin is 0.32 mgd. Each basin is allowed to exceed the registration volume by 0.10 mgd, which brings the total registered volume to 0.81 mgd. Note that since 2017, the Phillips Road tubular wellfield has been offline and reserved for emergency use only.

The District's distribution system consists of 48 miles of water mains ranging in size from 2- to 16-inch diameter. In addition, the distribution system includes two storage tanks, one at Knoll Road and one at Wing Road.

See attached map of the District's system as **Appendix B**.

1.2.1 Station 1: Phillips Road Tubular Wellfield

Station 1 is a vacuum priming system wellfield consisting of approximately 60 2-inch wells connected to a common manifold located at 83 Phillips Road. Treatment processes at Station 1 include post hypochlorination using sodium hypochlorite for disinfection, pH adjustment using potassium hydroxide for corrosion control, and sodium fluoride for fluoridation. Station 1 houses two 30 horsepower (HP) horizontal split case pumps with a maximum capacity of 340 gallons per minute (gpm). The pumps turn on and off based on elevations in the Knoll Road Tank through the supervisory control data acquisition (SCADA) system. The approved daily pumping volume for this station is 0.49 mgd, however, the District typically pumps less than the approved daily volume. In April 2017, the tubular wellfield at Station 1 experienced elevated levels of nitrate, and through coordination with MassDEP, was taken offline.

1.2.2 Station 2: Main Street Well

Station 2 is a single gravel packed well located off upper Main Street near the Sagamore Golf course. The station includes a vertical turbine pump and a 30 HP motor with a variable frequency drive (VFD). The pump at Station 2 has a maximum capacity of 375 gpm at 235 feet total discharge head; the flow at this station fluctuates based on the season, and the average flow is 135 gpm in the winter and 200 gpm in the summer. The pump turns on and off based on elevations in the Knoll Road tank through the SCADA system. Treatment processes at Station 2 include post hypochlorination using sodium hypochlorite for disinfection, pH adjustment using potassium hydroxide for corrosion control, and sodium fluoride for fluoridation. The approved daily pumping volume for this station is 0.5 mgd.

1.2.3 Station 3: Phillips Road Bedrock and Gravel-Packed Wells

Station 3 has four bedrock wells, and one gravel packed well. The gravel packed well was developed in the late 1970s and has a daily pumping volume of 0.13 million gallons. The four bedrock wells were constructed in 2013 and have an approved daily pumping volume of 0.53 million gallons. All pumps at station 3 turn on and off based on elevations in the Knoll Road tank

through the SCADA system. Treatment processes at Station 3 include caustic (potassium hydroxide) addition to raise alkalinity and pH for corrosion control, sodium hypochlorite injection into raw water as an oxidizer and filter effluent for primary disinfection and residual chlorine, greensand filtration for iron and manganese removal, and sodium fluoride for fluoridation.

Unlike the Glen Drive Station, the Philips Road bedrock wellfield showed elevated levels of manganese during the extended pumping tests which were conducted when the original wells were constructed. A greensand filter was constructed at the Phillips Road facility in the 1980's as part of the treatment process. This original greensand filter was subsequently replaced by 2 10-ft diameter greensand filters in 2013.

1.2.4 Station 4: Glen Drive Wells

Station 4 was constructed in 1997 and is located on an access road at the end of Glen Drive. The wellfield is comprised of 4 low pressure submersible pumps in deep bedrock wells which pump to a common 15,000 gallon clearwell. From the clearwell, water is then pumped into the distribution system by two 50 HP high lift pumps (in a duty/standby configuration) which are designed for a flow range between 500 and 600 gpm at 230 feet head. Treatment processes for Station 4 include post hypochlorination using sodium hypochlorite for disinfection, pH adjustment using potassium hydroxide for corrosion control, and sodium fluoride for fluoridation. Flow through the four wells is controlled through the SCADA system, and is based on elevations in the Knoll Road Tank.

1.3 Report Outline

The overall outline of the subsequent sections or this report is as follows:

- **Section 2** provides a description of the existing Glen Drive Wells and associated facilities.
- The quality of the Glen Drive well water is discussed in **Section 3.**
- The existing and future treatment processes for the Glen Drive wells are described in **Section 4**.
- **Section 5** discusses permitting implications associated with improvements at the Glen Drive Facility.
- The costs of the potential future improvements, and an outline of funding options considered are presented in **Section 6.**

Section 2

Glen Drive Existing Conditions

The Glen Drive wells are located on a gravel access road extending from the end of Glen Drive and were constructed in 1997. This station has a Water Management Act maximum daily approved volume of 0.83 million gallons per day (mgd). As this station is located in the Ipswich River Basin, flows must also account for the annual average maximum withdrawal as 0.42 million gallons per day (mgd), which includes the 0.32 mgd limit plus allowable 0.1 mgd threshold.

2.1 Existing Glen Drive Water Supply

The Glen Drive wellfield is comprised of four low pressure submersible pumps in deep bedrock wells which pump to a common 15,000 gallon clearwell. From the clearwell, water is then pumped into the distribution system by two 50 HP pumps (in a duty/standby configuration) which are designed for a flow range between 500 and 600 gpm at 230 feet head. Flow from the four wells is controlled through the SCADA system and is based on the elevations in the Knoll Road Tank. **Table 2-1** below identifies the Station 4 Glen Drive Wellfield Parameters. It is important to note that Well #4's pump was recently replaced, which has decreased the pumping capacity of this well.

Table 2-1: Station 4 – Glen Drive Wellfield Parameters.

Well	Well Depth (ft)	Design Flow (gpm)	Design Head (ft)	Approved Daily Pumping Volume (mgd)	Pump HP
Glen Drive Well #1	850	190	250	0.27	20
Glen Drive Well #2	660	100	190	0.15	10
Glen Drive Well #3	220	120	145	0.17	10
Glen Drive Well #4	300	165	215	0.24	15
Total	-	575	-	0.83	-

Treatment processes for Station 4 currently include post hypochlorination using sodium hypochlorite for disinfection and pH adjustment using potassium hydroxide for corrosion control. Treatment also includes sodium fluoride for fluoridation. These treatment processes, as well as the two 50 HP vertical turbine pumps and associated equipment, are housed in a 38-ft by 26-ft building adjacent to the existing clearwell. The building is a slab-on-grade, one-story, brick-on-block structure. There is currently no emergency power at this station. The location of the existing bedrock wells, clearwell and pumping facility can be seen in **Appendix C**.

2.1.1 Consumption Data

The District supplies approximately 8,500 customers throughout two thirds of the Town of Lynnfield, Massachusetts. The approved daily pumping volume for this station is 0.83 mgd, however, the District typically pumps less than the approved daily volume due to:

- Decreasing yield from the wells over time (current yields are lower than yields during the earlier years of operation)
- The need to meet the requirements of the Withdrawal Permit
- Recent water quality issues

Table 2-2 below shows pumping data for the four wells combined during 2017.

Table 2-2: 2017 Glen Drive Consumption Data

Total 2017 Consumption	90 Million Gallons
Average 2017 Daily Consumption	0.25 mgd
Median 2017 Daily Consumption	0.24 mgd
Maximum 2017 Daily Consumption	0.72 mgd
Average Summer Consumption (July-Sept.)	0.38 mgd
Average Spring Consumption (April-June)	0.24 mgd
Average Fall Consumption (October-December)	0.24 mgd
Average Winter Consumption (Jan-March)	0.12 mgd

As seen in **Table 2-2**, the average pumping rate for this wellfield is 0.25 mgd, however, there is a significant seasonal flux in these flows, with as little as 0.12 mgd of consumption in the winter months, with up to 0.72 mgd in the summer months.

Section 3
Water Quality

The Environmental Protection Agency (EPA) and MassDEP Secondary Maximum Contaminant Level (SMCL) for manganese is 0.05 mg/L. The EPA and MassDEP Health Advisory levels for manganese are 0.3 mg/L. In addition, EPA recommends limiting consumption of water with manganese levels over 1.0 mg/L.

According to MassDEP's Drinking Water Supply Guidelines, "If the manganese concentrations in raw water exceed 0.3 mg/L but are less than or equal to 1.0 mg/L, an assessment by MassDEP Office of Research and Standards will be necessary to determine if removal [of manganese] shall be required. If manganese concentrations in raw water exceed 1.0 mg/L, removal is required. If iron, manganese, or a combination thereof exceeds 1.0 mg/L, removal [of iron and / or manganese] is required."

It should be noted that MassDEP has a broad regulatory discretion over matters related to public health and drinking water and has the authority to use the SMCL or Health Advisory as a basis for action on a case-by-case basis should it feel necessary. In the appended Fact Sheet (**Appendix D**), MassDEP states to the public the following:

- "The recommended water concentration limit for lifetime exposures to manganese is 0.3 mg/L. People may also want to limit consumption of waters containing greater than 1.0 mg manganese/L."
- When manganese in drinking water is elevated, you may use "A pitcher filter or a home water filter unit that is capable of removing dissolved metals."

3.1 Potential Future Health Standards for Manganese

Under the provisions of the Safe Drinking Water Act, EPA periodically prepares a "Contaminant Candidate List" (CCL), indicating which contaminants are potential candidates for future regulatory efforts. Manganese appeared on the first list, known as CCL1, but EPA determined in 2003 not to pursue a health-related standard for manganese.

In the appended Fact Sheet, MassDEP also recommends that the general public take precautionary efforts to limit consumption of drinking water with high levels of manganese in order to help decrease exposure and decrease the possibility of adverse neurological effects.

3.2 Glen Drive Water Quality

3.2.1 Iron and Manganese

The 'Final report on the Well Construction, Pump Testing and Zone II and III Delineation for the Glen Drive Wellfield Site' report by D.L. Maher Co., dated January 1996, states:

"In general, the water quality at Glen Drive is excellent. However, provisions should be considered to provide simple aeration radon removal within the proposed clear-well. The

manganese is slightly elevated in BRPW-1 (0.06 mg/L) and BRPW-4 (0.08 mg/L). Since iron is very low, sequestration will probably not be required."

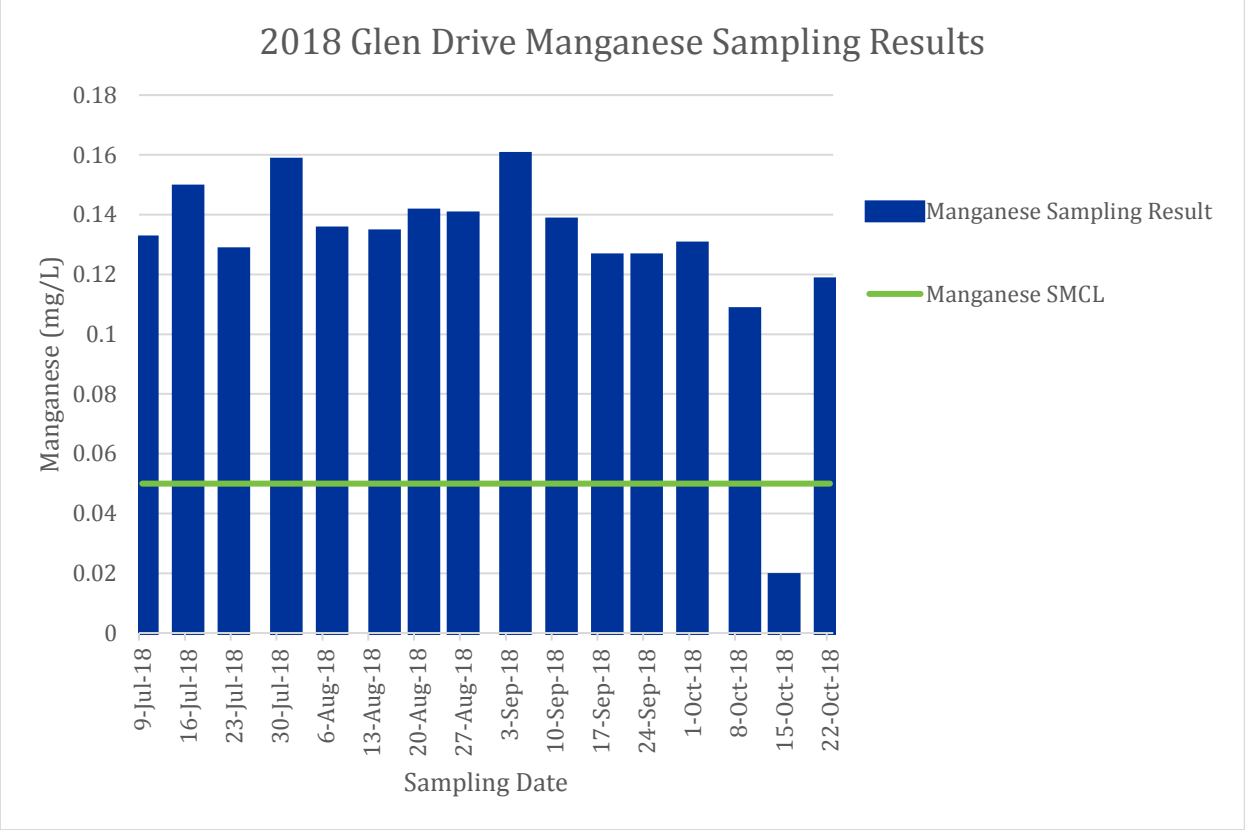
The District conducts regular water quality testing in the distribution system to meet state regulations concerning monitoring for coliform bacteria, chlorine residual, trihalomethanes (TTHMs), haloacetic acids (HAAs), volatile organic contaminants (VOCs) and synthetic organic contaminants (SOCs). **In addition to this regular sampling schedule, the District has recently been sampling for iron and manganese, due to the increase in customer complaints regarding discolored water.**

In recent months (May – October 2018), the District's sampling results have shown increased manganese levels at the Glen Drive wellfield. **Table 3-1** shows the 2018 iron and manganese sampling results at Glen Drive. It is important to note that these samples (**Table 3-1**) are taken for the combined wells at Glen Drive and not for individual wells.

Table 3-1: 2018 Glen Drive Combined Iron and Manganese Sampling Results

Sampling Date	Iron (mg/L)	Manganese (mg/L)
9-Jul-18	0.035	0.128
16-Jul-18	0.030	0.145
23-Jul-18	0.037	0.124
31-Jul-18	0.054	0.154
7-Aug-18	0.068	0.131
15-Aug-18	0.026	0.130
21-Aug-18	0.027	0.137
27-Aug-18	0.026	0.136
4-Sep-18	0.077	0.156
11-Sep-18	0.041	0.134
18-Sep-18	0.064	0.122
24-Sep-18	0.027	0.122
1-Oct-18	0.036	0.126
9-Oct-18	0.024	0.104
15-Oct-18	0.015	0.015
22-Oct-18	0.048	0.114

The SMCL for Iron is 0.3 mg/L, which is significantly higher than all sampling results from the Glen Drive wellfield to date. Manganese concentrations at this location, however, have been consistently higher than the SMCL of 0.05 mg/L. **Graph 3-1** shows how the 2018 manganese sampling results compare to the manganese SMCL.



Graph 3-1 – 2018 Glen Drive Manganese Sampling Results

Additional sampling was conducted throughout the District's distribution system for both iron and manganese. These compiled results can be found in **Appendix E**. The majority of the blended sample results throughout the system, excluding those taken directly at the Glen Drive station, show manganese results below the 0.05 mg/L SMCL, with a few exceptions.

In May 2018, iron and manganese sampling was conducted for each of the 4 individual wells within the Glen Drive wellfield. The results of this sampling can be seen in Table 3-2 below.

Table 3-2: LCWD 2018 Iron and Manganese Sampling Results

Location	Date	Iron, (mg/L)	Manganese (mg/L)
Station 4 Well #1	5/1/2018	0.213	0.213
Station 4 Well #2	5/1/2018	0.162	0.105
Station 4 Well #3	5/1/2018	0.195	0.069
Station 4 Well #4	5/23/2018	0.188	0.062

These results show significantly higher levels of manganese in wells 1 and 2 than in wells 3 and 4, however, all results are above the Secondary Maximum Contaminant Level of 0.05 mg/L.

In 2018, the District has documented a number of residential services that have experienced multiple discolored water issues. While only a relatively small portion of the District's overall service area has experienced discoloration issues, the neighborhoods with the largest number of

complaints are closest to the Glen Drive sources and/or are near dead-ends in the system. Additional sampling results throughout the distribution system are included in **Appendix E**.

Samples were taken on July 23, 2018 to determine the dissolved and particulate portions of the total manganese in the Glen Drive Wellfield water. Two samples were taken of the combined water at this site; One sample was filtered, and one was not. The result of this sampling is shown below in **Table 3-3**.

Table 3-3: Particulate vs. Dissolved Manganese Sampling Results

Sample Type	Manganese Result (mg/L)
Station #4 Glen Drive Combined (total Manganese)	0.133
Station #4 Glen Drive Combined – Filtered (Dissolved Manganese)	0.063

As shown in the table above, the results of these samples indicate that approximately half of the total manganese in the water at this station is dissolved, while just over half of the manganese is particulate. In-line home filters are often effective in removing particulate manganese in drinking water, however, they are generally not effective in mitigating water quality issues associated with dissolved manganese. A greensand filtration system has the ability to remove both dissolved and particulate forms of manganese in the source water.

3.2.2 Radon

The original Glen Drive facility was designed with the potential for radon removal in the future, if regulatory agencies were to add radon to the drinking water quality standards and if the radon levels increased. The existing clearwell at Glen Drive was included as part of the design for ease of adding an air stripping tower for radon removal. The District recently collected radon samples at Glen Drive. The results of this sampling conducted on October 10, 2018 ranged from 1,000 to 1,040 pCi/L, which is below the Office of Research and Standards Guideline (OSRG) of 10,000 pCi/L. Therefore, no provisions for radon removal have been included in this report.

3.3 Pilot Testing

The next step in moving forward with designing a new treatment facility is to conduct pilot testing as required by MassDEP per their Drinking Water Policy No. 90-04. MassDEP states that:

"Pilot testing is performed:

a. To ensure that the proposed treatment process will continuously produce water that meets State and Federal drinking water standards. Additionally, the treatment should address secondary standard quality concerns such as taste and order or other consumer complaints so as to provide a drinking water widely accepted by the public.

b. To determine the specific operational and performance characteristics of the selected processes throughout the anticipated range of raw water quality, hydraulic loading rates, chemical feeds, and operating conditions.

c. To ensure that the proposed treatment process will continuously produce water that meets State and Federal drinking water standards.

d. To enable full scale design to be implemented with the approved pilot scale model.

e. To assist the water supplier in estimating overall capital and operation costs.

f. To compare the benefits of the most cost-effective process with benefits of other processes.

g. Piloting is intended to test the treatment processes identified in the Pilot Test Proposal. The Department will determine whether any changes in actual construction from the treatment process(es) piloted will require additional piloting."

Pilot testing will be conducted to further refine details required for final design of the treatment process. This includes a comparison of the filter media options of GreensandPlus and pyrolusite media, allowable loading rates, preoxidant efficiency and dosages, maximum run times, and backwash water characterization necessary for permitting and design of backwash disposal. **Once MassDEP reviews and approves the Pilot Test Report, the District can complete final design.**

Section 4

Facility Modifications and New Water Treatment Requirements

Glen Drive currently supplies 40% of the District's water supply. This site includes four bedrock wells, a clearwell, and a pumping station with minimal chemical treatment. Due to the increased levels of manganese in the water from the Glen Drive wells, the addition of a new treatment facility to house two greensand filters is being proposed at the Glen Drive site for manganese removal.

Unlike the Glen Drive wellfield, the Phillips Road bedrock and gravel-packed wells showed manganese levels above the drinking water secondary maximum contaminant level (SMCL) during the extended pumping tests which were conducted when the wells were constructed. Due to the SMCL exceedance, a greensand filter was constructed at the Phillips Road facility as part of the treatment process when the wells went online in the 1980's. This original greensand filter was subsequently replaced by two 10-ft diameter greensand filters in 2013. The District has been successful in removing iron and manganese from this source through this greensand filter treatment facility.

4.1 Current Practice

Currently, the Glen Drive wellfield water treatment processes include post hypochlorination using sodium hypochlorite for disinfection and pH adjustment using potassium hydroxide for corrosion control. Treatment also includes sodium fluoride for fluoridation. The Safety Data Sheets for the chemicals currently used at Glen Drive can be found in **Appendix F**. There is no emergency power at the existing building. **Figure 4-1** shows the treatment process that is currently used at Glen Drive.

4.2 Manganese Removal Process Refinement

Following the increased number of complaints regarding discolored water that the District has received in recent months, MassDEP has been involved in the District's long term and short term actions to remove manganese from the water. CDM Smith, on behalf of the District, has contacted MassDEP periodically to update the regulators on the status of ongoing programs, such as iron and manganese sampling, Board Meetings, and unidirectional flushing that occurred in the spring and fall 2018 to help remove manganese buildup within the distribution system.

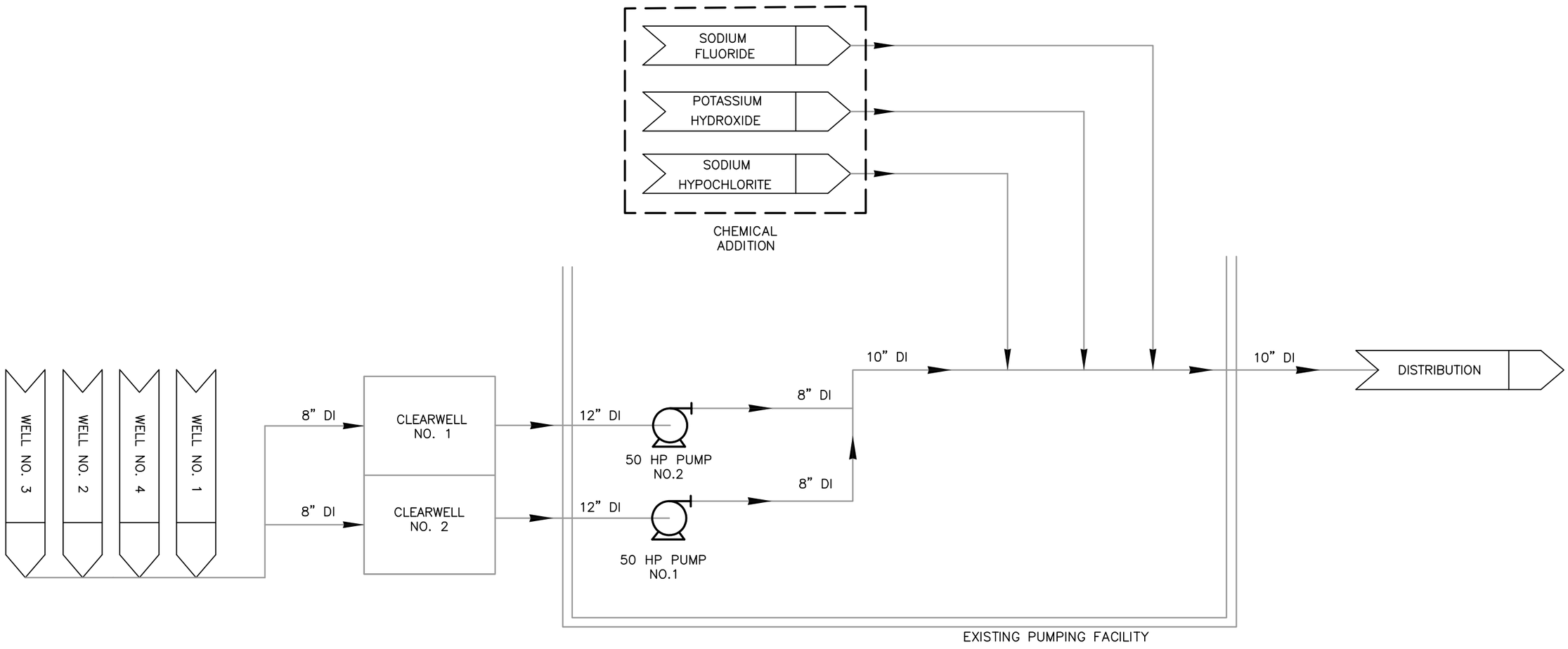
As an interim solution, the District considered the use of chemical treatment to sequester manganese, however, this approach was ruled out. Sequestering agents for iron and manganese are either polyphosphates or silicates, with silicate being more effective for iron and not very effective for manganese. Sequestration keeps dissolved iron and manganese remaining in solution, lowering cold water aesthetic issues. Sequestration does not lower or remove manganese. It should be noted that polyphosphates are different than orthophosphates, which are used to control lead by formation of a lead-phosphate scale (or "film") on the pipe wall. From

initial consideration, sequestering manganese is most successful when manganese concentrations are below 0.1 mg/L (iron must be below 0.6 mg/L). Due to chemical breakdown upon heating, sequestering does not help homeowners' warm/hot water aesthetics. In addition, sequestering loses its effectiveness as water ages. CDM Smith and the District both agree that sequestering will not solve the homeowners' aesthetic concerns, as in addition to their concerns with bath water and other warm water uses, the geographical area of many complaints is near dead ends where water age is higher than other areas of the distribution system.

Also negatively affecting sequestering agents is high alkalinity and hardness. Recent Glen Drive samples show about 100 mg/L alkalinity and 180 mg/L hardness (hard). The sequestering agent (polyphosphate) will also sequester other elements in the water, namely calcium and lead. There is significant research that shows that lead levels can increase following polyphosphate addition because the lead is kept in solution rather than precipitating as an insoluble scale on the pipe wall.

Though several manganese and iron removal techniques and systems are available today, greensand filtration is the most commonly utilized technology in New England, with many successful facilities in this region, including within Lynnfield Center itself. Based on the District's experience with this technology, it is recommended that greensand filtration be the selected technology for manganese removal at the Glen Drive facility.

The costs to develop a water filtration plant for the combined treatment of the Glen Drive wells utilizing greensand filtration are discussed in **Section 6**. While the available information from the vendor, and the District's experience, indicate that greensand filtration is a very promising process for the District's case, a future pilot treatment evaluation will be conducted to confirm preoxidant efficacy and dosages, as well as filter loading rates and duration of operation between backwash cycles. The purpose here is to develop a representative total project cost for developing a water filtration plant for the District's Glen Drive wells. It is anticipated that this pilot testing will include greensand and one additional filtration media. The duration of flow per cycle through the filters as well as sodium hypochlorite usage and percentage of filtered water used will vary depending on the manganese level coming into the filters and will be refined during pilot testing. Further information on Pilot Testing is provided in **Section 3.3** of this report.



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EXISTING GLEN DRIVE PROCESS FLOW DIAGRAM
FIGURE 4–1

DECEMBER 2018

4.3 New Greensand Filtration System Building

As stated in **Section 2**, the Glen Drive wellfield is approved for 575 gpm (0.83 mgd). The existing facility includes a 15,000 gallon clearwell and a 38-ft. by 26-ft. building, which houses two 50 horsepower pumps and the existing chemical feeds at the station designed for the 575 gpm flow. The new facility would be adjacent to the existing building. This new facility would house the greensand filtration system and associated equipment.

CDM Smith has considered several approaches in this preliminary design of the new building, as greensand filter facilities can range considerably in size. While two options are being presented herein, the selected option will be further detailed and modified during final design with input from the District. Both options are designed for two 12-ft diameter greensand filtration vessels and associated chemical feeds and equipment, and both would be located within a new building adjacent to the existing pumping station building on the access road at the end of Glen Drive, as seen in **Figures 4-2** and **Figure 4-3**.

4.3.1 Conceptual Layout - Option 1

The first option presented, seen in **Figure 4-2**, includes a new water treatment building with a footprint of approximately 60-ft by 45-ft. This conceptual layout includes a designated room for chemical feed systems and chemical storage within the new building. The interior height of this building is estimated to have an 18-ft clearance to allow for safely accessing the filter vessels. This building will be brick-on-block with a peaked-roof.

Modifications to the existing building and piping would include relocating the influent piping from the pumps to the new treatment building and relocating all chemical feed systems and storage to the new facility.

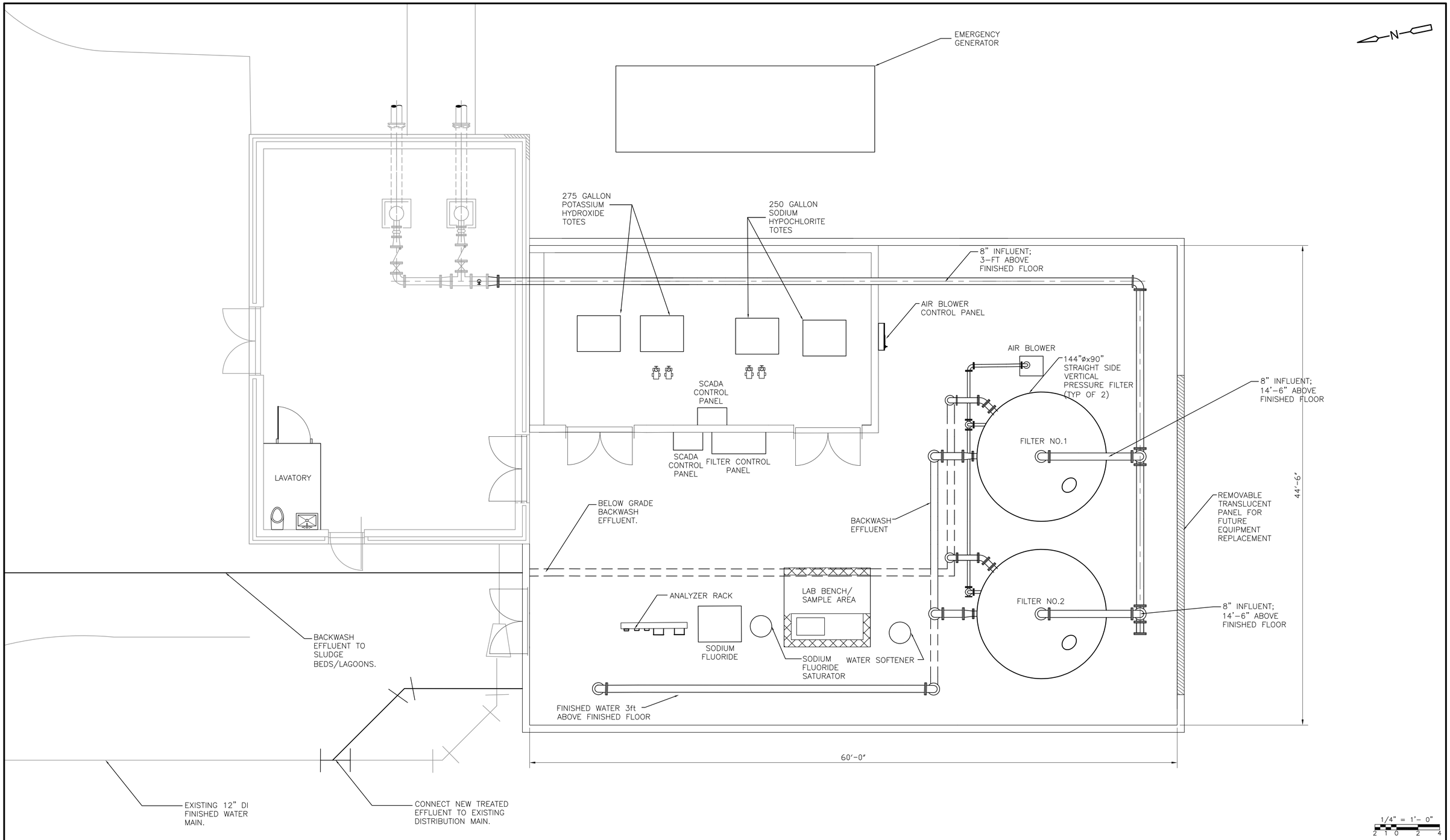
By code, chemical storage areas require appreciable ventilation rates. Enclosing chemicals within a segregated room offers the advantage of introducing higher ventilation rates to a smaller room volume, thereby reducing energy costs.

4.3.2 Conceptual Layout - Option 2

The second option presented, seen in **Figure 4-3**, includes a new water treatment building, adjacent to the existing building, with a footprint of approximately 40-ft by 40-ft. This conceptual layout does not include a designated room for chemical feed and chemical storage but will have space within the existing pumping station building for chemical feed systems and tote storage. The interior height of this building is estimated to have an 18-ft clearance to allow for safely accessing the filter vessels. This building will be brick-on-block with a peaked-roof.

Modifications to the existing building and piping would include relocation of the chemical feed systems and chemical storage to the new facility, as well as modifications to the piping within the existing building.

The remaining components are applicable to both of the proposed conceptual layouts.



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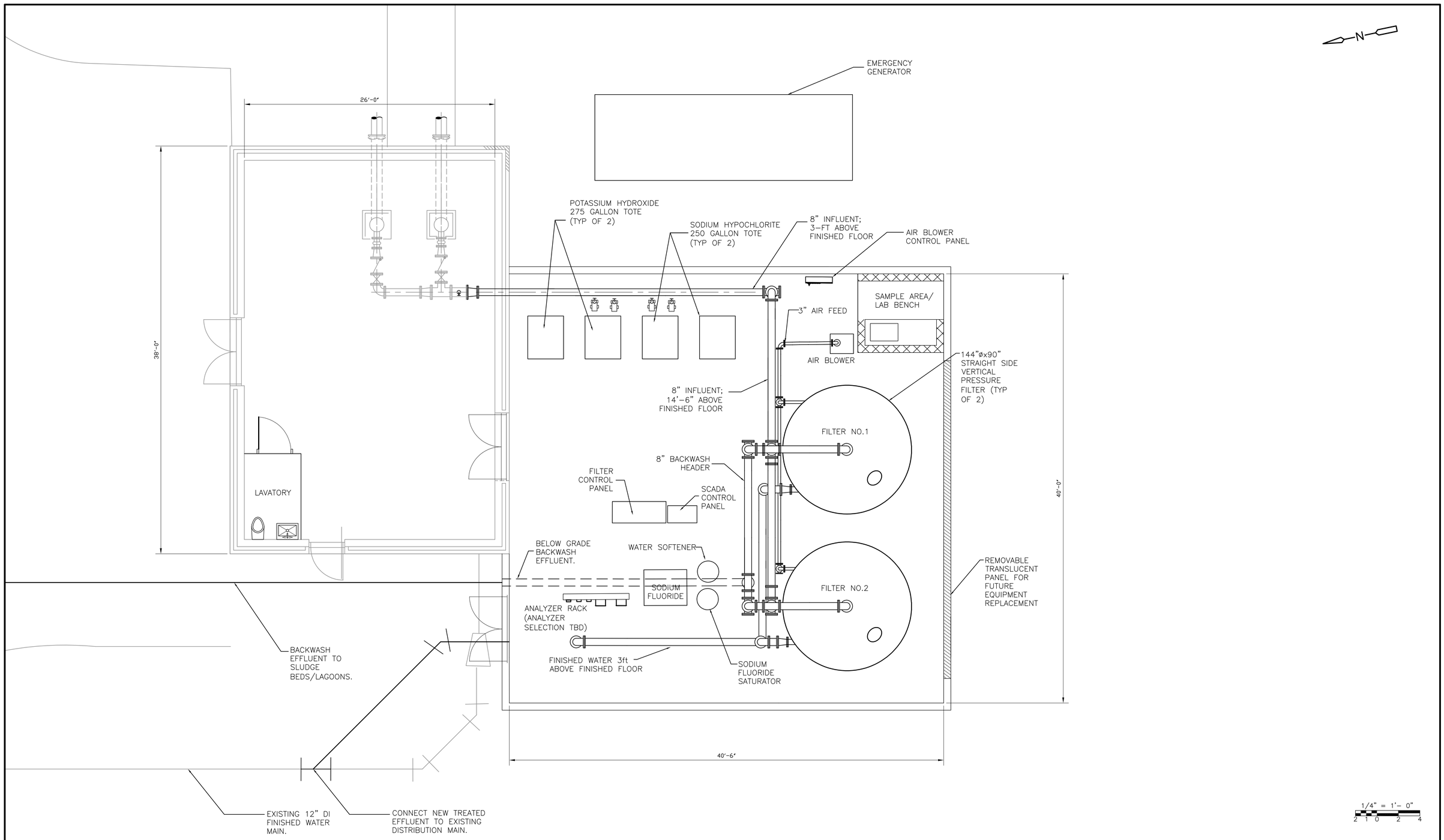
CONCEPTUAL LAYOUT 1

FIGURE 4-2

DECEMBER 2018



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CONCEPTUAL LAYOUT 2

FIGURE 4-3

DECEMBER 2018

4.3.3 Greensand Filter Vessels

The greensand filtration system will consist of two vertical filter vessels, each a 12-ft diameter and 12-ft 8-inch tall (90-inch straight side). **Figure 4-4** shows a preliminary proposed process flow diagram for addition of the greensand filtration. **Appendix G** contains the Greensand Filter proposal and the vendor's planning level cost estimate.

4.3.4 Emergency Generator

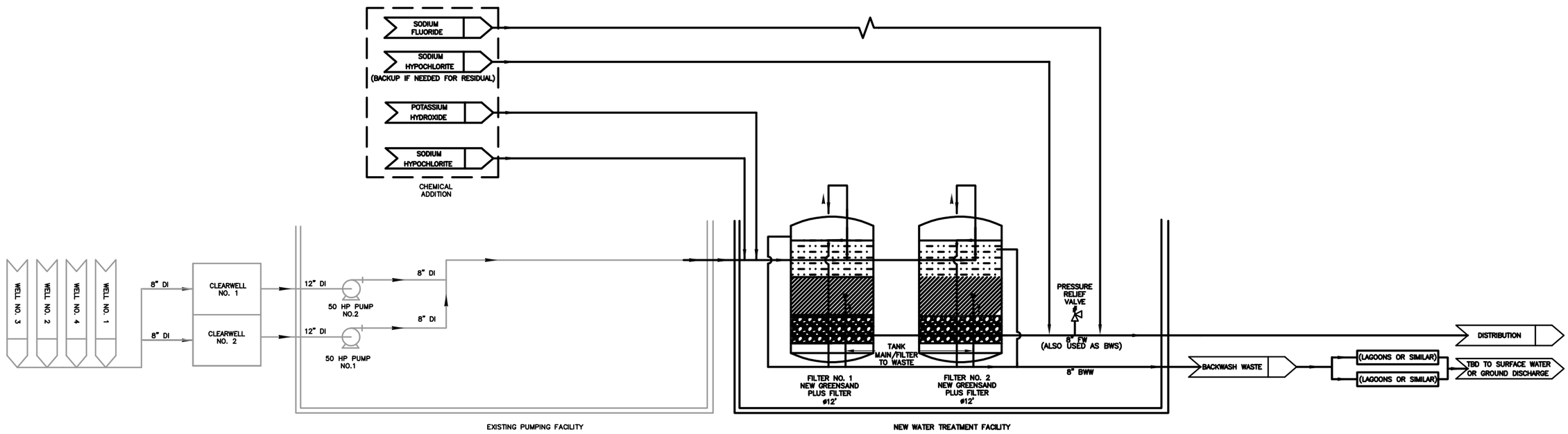
The existing facility does not have emergency power. Stand-by power is expected to be included in the design of the new building. The energy demand at the new building will at a minimum include the following:

- approximately 30-35 kVA load from the existing pump station building including:
  - one of the two existing 50-hp pumps,
  - the four existing submersible pumps (well 1 = 20 hp, well 2 & 3 = 10 hp each and well 4 = 15 hp)
  - four power centers at each of the four wells
  - two ¾ hp exhaust fans
- loading from the new building is assumed to be similar to the load from the greensand filter building at Phillips Road which includes 30 kw of electric heat, one 3 hp blower, one ½ hp water pump, one 1 hp air compressor, one ½ hp and 1 hp mixers, and up to 10 kVA of lighting panel load.

The total demand is assumed to be a minimum of 150 kW or potentially more. The District has expressed interest in a single generator that is weather proofed. Emergency power can be supplied by diesel fuel, propane, or natural gas.

MassDEP guidelines are unfavorable for diesel fueled generators and their associated fuel storage and fuel transfer within a 400-foot radius of a water supply. If a diesel generator could not be located further away from 400 feet from the existing wells or potential wells, then diesel is not a favorable choice. CDM Smith has reviewed the District's GIS and it appears that the new building is greater than 400 feet from the four existing wells. The District would need to evaluate if there is potential for new wells within 400 feet from the new building. If diesel fuel is selected during final design, the fuel storage tank would be double-walled and constructed above ground surrounded by an impermeable containment wall, with proper capacity, including leak detection devices in accordance with MassDEP guidelines.

Propane would be stored in an approved above ground tank anchored to a concrete platform which would be constructed to a depth just below the local frost line. Propane is only suitable for smaller sized generators. A preliminary review indicates there are limited options for generators to operate on propane fuel at more than approximately 100 kW, which would result in multiple generators. The Phillips Road greensand filter plant currently has two propane powered emergency generators that operate in series. The District has experienced circuiting issues and prefers a single generator.



NOTE: NEW FACILITIES SHOWN IN BOLD

CDM Smith

PROPOSED GLEN DRIVE PROCESS FLOW DIAGRAM

FIGURE 4–4

DECEMBER 2018

National Grid has a gas main on Glen Drive. The existing gas service would need to be extended approximately 1,100 feet on Glen Drive from just south of West Tapley Road down the access road and into the new building. The District would then rely on the National Grid to power the emergency generator. MassDEP guidelines state that natural gas is the preferred type of fuel if available.

To have a more conventional single standby generator, the fuel must be natural gas or diesel. MassDEP will consider diesel acceptable as long as the generator and fuel handling equipment are more than 400 feet from the wells and constructed in accordance with MassDEP guidelines.

4.3.5 Lavatory

CDM Smith is recommending a new bathroom be considered for installation in either the existing building or the new building. Since the Town of Lynnfield does not have a sewer system, installation of a bathroom will also require a septic system. The septic system cannot be constructed within the Zone I radius of the water supply wells. Zone I is defined as a 400 foot radius. The existing building, and proposed location for the new building are beyond the Zone I 400-foot radius.

There are specific septic system off sets listed under Title 5. These off sets include:

- Building: 10-foot distance for a septic tank, 20-foot distance for a leaching field;
- Wetlands: 10-foot distance for a septic tank, 20-foot distance for a leaching field; and
- Suction lines: 50-foot distance for a septic tank, 10-foot distance for a leaching field.

The design flow based on the Title 5 description for a warehouse is 15 GPD per person. A septic tank would need to be a two-compartment tank with a 1,500-gallon minimum. The leaching field size will be based on the soil type and percolation rate; assuming a Class II (Sandy Loams, Loams) soil with a percolation rate between 5-10 minutes per inch, the leaching field primary area would be approximately 25 square feet. A reserve of the same area would be required. The slowest acceptable percolation rate is 60 minutes per inch and would yield a size of 100 square feet for each the primary and reserve area. Therefore, the size of the leaching field may range from 50 square feet to 200 square feet.

Generally, 4-inch PVC pipe is used for the effluent pipe and leaching area trenches. A slope of 2% is preferred out of the building, 1% from the septic tank to the distribution box, and then typically 0.5% for the leaching field. Depending on the percolation rate, 4 to 5 feet of separation is needed from the bottom of the leaching field stone and the high groundwater level. The need for a sewer pump from the bathroom to the septic system will be evaluated during final design after the ground survey is complete.

4.3.6 Chemical Feed Systems

Currently, the supply source is treated by addition of sodium hypochlorite (for disinfection), potassium hydroxide (for corrosion control), and sodium fluoride (for dental health). These chemical feed systems are currently housed in the existing pumping station but are expected to be relocated to the new treatment building. Modifications will be made to existing piping to allow for sodium hypochlorite to be added to the supply source prior to filtration, to be used as the

required oxidant ahead of the greensand filter vessels. An additional sodium hypochlorite feed will be added after the greensand filter vessels for disinfection purposes prior to entering the distribution system, if needed. The use of sodium hypochlorite as an oxidant will be confirmed during pilot testing.

The draft building layout currently accounts for an analyzer rack, showing space for 5 analyzers. During final design CDM Smith will work with the District to recommend and finalize the list of chemical analyzers. Some analyzers discharge a waste flow and others rely on probes within the pipeline and therefore do not have a waste stream.

4.3.7 Yard Piping

Figure 4-2 shows the approximate locations of the needed yard piping for the following connections and utilities:

- Pipe modifications to existing interior piping. New piping will be installed from the existing pumping station building to the new filter building. New piping will also be installed from the new building to connect to the existing distribution system at the site.
- Yard piping will be added for backwash discharge to the settling lagoons.

4.3.8 Lagoons/Sludge Basins

Since there is no sewer service within the District, backwash waste will need to be directed to a settling basin, similar to Phillips Road. This facility plan has accounted for a similar design, including two 50,000 gallon sludge drying beds (lagoons). The approximate location of the sludge drying beds can be seen in **Figure 4-5**. The bottom of the lagoons is expected to be constructed of bituminous concrete with layers of gravel and sand along the entire bottom. Underdrain flow will be collected in perforated underdrain pipes running along the bottom. The perforated pipes will discharge into a collector box, where they are to be combined in a reinforced concrete pipe. The final discharge location will be selected in consultation with the EPA. Further detail regarding discharge permitting is provided in **Section 5** of this report.

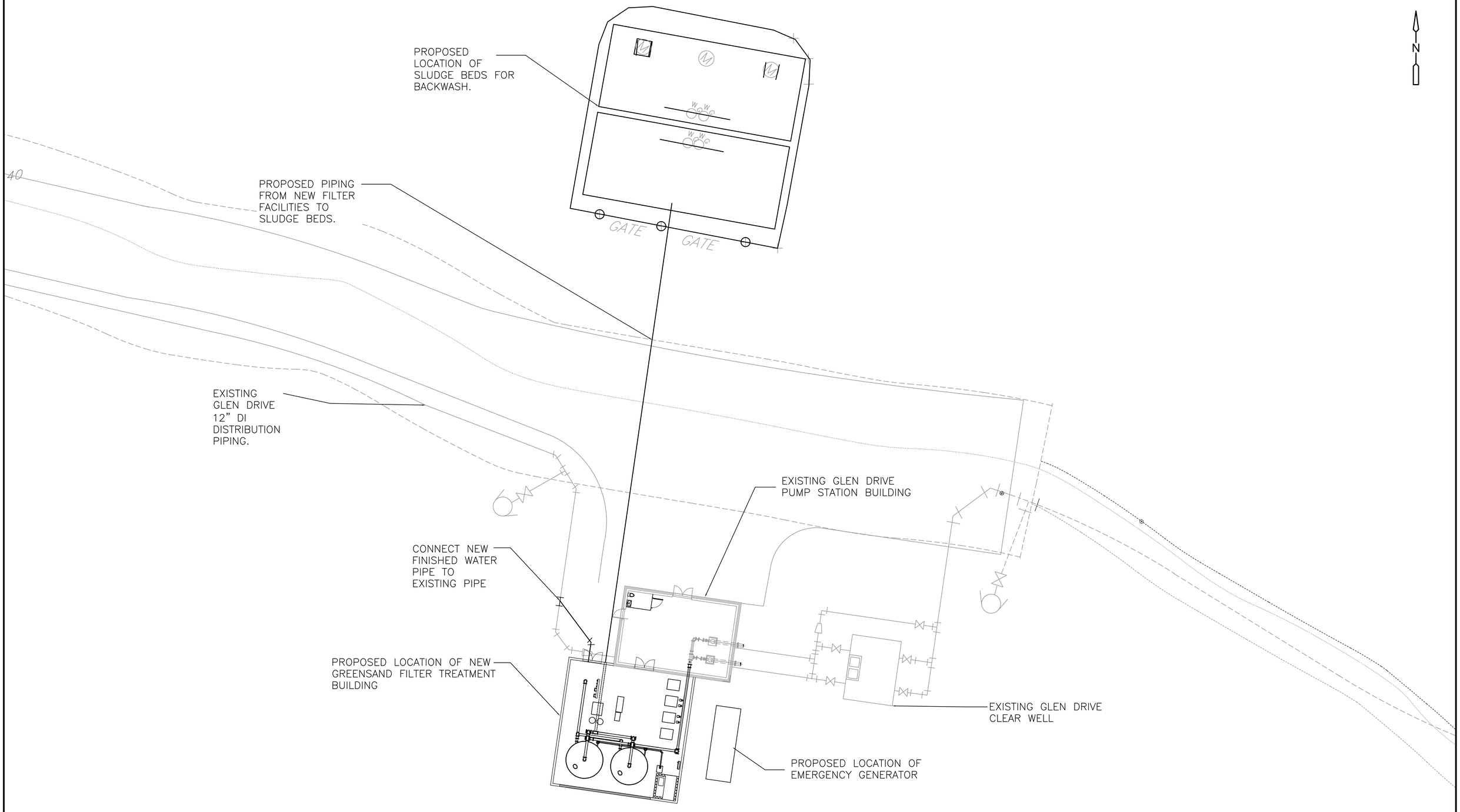
4.3.9 Site Work

Modifications will be made to the existing security fencing and security gate at the facility. New fencing will be installed to encompass all new and existing facilities, including the lagoons.

Provisions for clearing, grading, and landscaping will be determined during final design.

4.3.10 Automation and Instrumentation Recommendations

As part of the facility plan CDM Smith coordinated with the company that currently manages the District's SCADA system, Northeast System Controls, to confirm how the existing instrumentation and controls operates at Glen Drive. The conceptual design includes tying the controls associated with the new building into the existing building controls. The SCADA will then transmit data to computers located at the District's office on Phillips Road. New SCADA elements in the new building will be secure.



CDM Smith

PROPOSED SITE PLAN

FIGURE 4–5

DECEMBER 2018

4.3.11 Structural and Architectural Recommendations

The new building will have a concrete slab on grade foundation, similar to the existing building at Glen Drive. There will be an expansion joint between the two buildings to account for differential settlement. The new building will be taller than the existing building and will have a slanted roof. There interior of the building will have approximately 18 feet of clearance. This will allow for safe access to the top of the greensand filter vessels. Because the existing building was constructed with a flat roof, the final design will factor in rehabilitating the existing building's roof to account for snow drift from the new roof onto the existing roof. Modification of the existing building's roof could involve installation of a new slanted frame roof or reinforcing the existing joists.

4.4 Final Design Considerations

4.4.1 Main Street Station 2 Connection to Glen Drive Station 4

With a greensand filter already in place at Phillips Road (Station 3), and a greensand filter being proposed at Glen Drive, the Main Street Well (Station 2) would be the only station in the District remaining without means of iron and manganese removal, with the exception of Station 1 Phillips Road tubular wellfield, which is now only used for emergencies.

The Main Street well is a single gravel packed well located off upper Main Street near the Sagamore Golf Course. Although the well at Main Street is not currently showing elevated levels of iron and manganese, there are historic sample results that indicate the potential for increased levels. Between July 2014 and May 2018 there have been three instances where the manganese at Main Street was at or above the SMCL of 0.05 mg/L:

- 0.059 mg/L (7/15/2014);
- 0.049 mg/L (1/12/2015); and
- 0.067 mg/L (10/5/2015).

All other manganese results between July 2014 and May 2018 at Main Street have been at or below 0.02 mg/L.

Due to the Main Street well's proximity to Glen Drive, the new greensand filters at Glen Drive will be sized to handle the flow from both the Glen Drive wells and the Main Street well. While this facility plan does not include the details on conveyance from the Main Street well to the Glen Drive facility, the capacity of the greensand filter vessels will be designed around this potential future scenario.

The District has voiced concern over elevated levels of nitrate at Main Street. The MCL for nitrate is 10 mg/L. As of September 2018, Main St. had nitrate results over 5 mg/L. Although this report does not consider provisions to treat nitrate in the water at Main Street, if the District were to connect Main Street to Glen Drive, nitrate could be treated and then blended with the water at Glen Drive. Additional water quality evaluations and possible pilot testing would be required.

Figure 4-6 shows that there is approximately 2,000 linear feet between the two stations. The potential routing of pipeline to convey water from Main Street to Glen Drive was not considered under this Facility Plan.

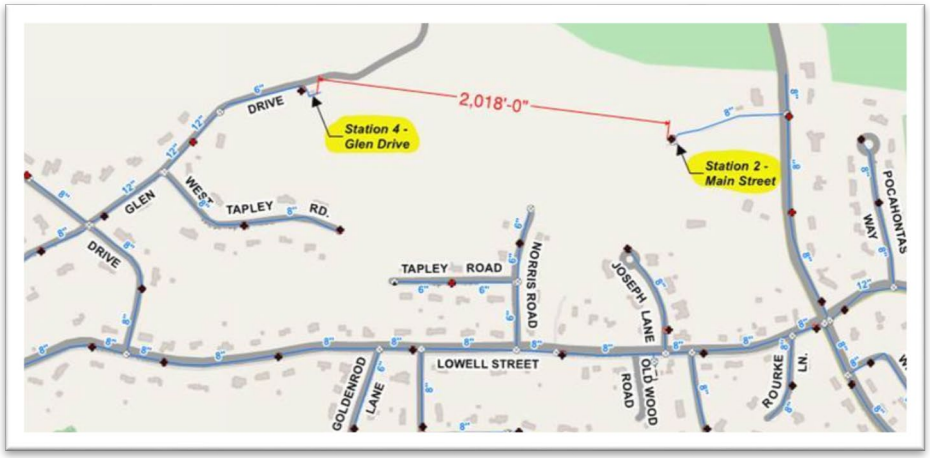


Figure 4-6 Connecting Main Street Well to Glen Drive Facility

4.4.2. Miscellaneous Additional Considerations for Final Design

In consultation with the District throughout the development of this facilities plan, there are several details that were not explicitly addressed in this report but will be addressed in final design. Below is a list of these items and considerations:

- Building doors with crash bars;
- Stone/drainage beneath the new filter vessels for condensation;
- Analyzer selection;
- Magmeters preferred over venturi meters;
- Site layout grading around the new building;
- Pilot testing; and
- Rehabilitation to the existing Building at Glen Drive, including:
  - HVAC;
  - Replacement of 50 horsepower vertical turbine pumps; and
  - Modifications to the existing flat roof.

Section 5
Environmental Assessment and Permitting

The Lynnfield Center Water District (LCWD) is experiencing high levels of manganese in their well water. A proposed greensand filter treatment facility to treat these increased levels of manganese would be located off Glen Drive on a 30-acre LCWD land (Parcel ID: 0012-000-0197).

Table 5-1 below summarizes the anticipated permits and approvals for the greensand filter facility:

Table 5-1 Summary of Permitting Requirements

Federal Approvals	NPDES Discharge Permit	√
	NPDES CGP	√
State Approvals	MEPA	
	Interbasin Transfer	
	MHC	√
	MWRA	
	MassDOT	
Local Approvals	Order of Conditions	TBD
	Street Opening/Trench	TBD

TBD – To Be Determined

It is anticipated that the District would be required to obtain the following permits/approvals prior to the bid opening of the construction contract:

- National Pollutant Discharge Elimination System (NPDES) Discharge General Permit (DGP) – U.S. EPA;
- Environmental Notification Form (ENF) followed by Environmental Impacts Report (EIR) – MEPA Unit of Massachusetts Executive Office of Environmental Affairs; and
- Project Notification Form (PNF) – Massachusetts Historical Commission.

Once the construction contract has been awarded, the selected contractor is required to obtain the following additional permits prior to starting construction:

- National Pollutant Discharge Elimination System (NPDES), Construction General Permit (CGP) – U.S. EPA

5.1 Environmental Assessment

CDM Smith performed an office environmental assessment of the proposed project site to determine the environmental constraints in the project area of the proposed new building at the Glen Drive facility.

CDM Smith reviewed the following information: MassDEP GIS (online OLIVER viewer), Federal Emergency Management Agency's (FEMA) Flood Insurance Rate (FIRM) maps, Massachusetts Natural Heritage & Endangered Species Program's (NHESP) Priority & Estimated Habitat Viewer, U.S. Fish & Wildlife Service's iPAC, Natural Resources Conservation Service's soils map. The assessment did not include field assessments such as wetland delineation.

5.1.1 Wetlands

Based on review of MassDEP wetland boundaries available from MassGIS, the proposed location of the new facilities is outside of wetland resource areas and the 100-foot buffer zone. However, this will need to be field verified during design. If wetland resource areas are present within 100 feet of the proposed facilities or site work, wetland resource areas will be field delineated for conformance with the Massachusetts Wetlands Protection Act (MGL c.131, s.40) (MWPA) and Regulations (310 CMR 10.00), the U.S. Army Corps of Engineers 1987 Wetlands Delineation Manual (Environmental Laboratory, 1987), and the U.S. Army Corps of Engineers 2011 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0). The wetland boundary will be determined based on the limit of wetland vegetation (limit of plant community dominated (50% or more cover) by species adapted to living in wetland conditions) as ascertained by visual inspection, as well as indicators of hydric soil and wetland hydrology.

5.1.2 State and Federal Protected Species

Review of the NHESP's Priority & Estimated Habitat Viewer shows that the proposed location for the greensand filter facility is not located within an Estimated Habitat for state wetland and wildlife or Priority Habitat for protected species.

The NHESP has an online link to maps of known locations of winter hibernacula and maternity roost trees for the federally endangered northern long-eared bat (*Myotis septentrionalis*). Projects that result in tree removal activities must comply with the Northern Long-eared Bat Final 4(d) Rule under the federal Endangered Species Act (ESA). The Final 4(d) Rule prohibits tree removal within 0.25-mile radius of known northern long-eared bat hibernacula and/or tree removal/destruction of known occupied maternity roost trees, or any other trees within a 150-foot radius from the known maternity trees during the pup season (June 1 through July 31). Review of the available maps on the NHESP's website shows that the proposed work is not located within 0.25-mile radius of known northern long-eared bat hibernacula nor within a 150-foot radius from the known maternity roost trees.

5.1.3 Tree Evaluation

After finalizing the proposed building layout, sludge lagoons and any other associated work, potential impacts to existing trees and proposed mitigation measures will be reviewed by an arborist.

5.2 Permitting Requirements

The following regulatory agencies were considered when reviewing the list of potentially applicable permits:

- Federal

- United States Environmental Protection Agency (EPA or USEPA)
- United States Army Corps of Engineers (ACOE)
- Federal Emergency Management Agency (FEMA)
- United States Fish and Wildlife Service (USF&W)

- State (Commonwealth of Massachusetts)
  - Massachusetts Executive Office of Environmental Affairs (MEPA)
  - Massachusetts Department of Transportation (MassDOT)
  - Massachusetts Department of Environmental Protection (MassDEP)
  - Massachusetts Historical Commission (MHC)
  - Massachusetts Water Resources Authority (MWRA)
  - Massachusetts Division of Fisheries and Wildlife (Mass Wildlife)
  - Massachusetts Natural Heritage & Endangered Species Program (NHESP)
  - Massachusetts Department of Public Safety (DPS)
- Local
  - Town of Lynnfield
    - Conservation Commission
    - Department of Public Works (DPW)
    - Fire Department
    - Zoning Board of Appeals

5.2.1 Federal Permitting

5.2.1.1 National Pollutant Discharge Elimination System (NPDES) – Construction General Permit (to be obtained by Contractor)

EPA regulates construction stormwater discharges from construction activities (such as clearing, grading, excavating, stockpiling, etc.) under the NPDES stormwater program. Documenting compliance with the NPDES Construction General Permit (CGP) is required for construction sites that disturb 1 acre or more of land, and the CGP requires stormwater controls during project construction. A Stormwater Pollution Prevention Plan (SWPPP) addressing stormwater runoff management during construction must be prepared describing erosion and sedimentation controls as well as the method of treatment and ultimate discharge of stormwater and/or uncontaminated groundwater to be used during construction. To document compliance with the CGP, an electronic Notice of Intent (eNOI) must be submitted to the EPA-Region 1 and the SWPPP

must be complete by the time the eNOI is submitted. A project-specific permit is not generally issued by EPA. The SWPPP is not reviewed by EPA but must be kept on site in case EPA requests a copy. The proposed site improvements will require dewatering during construction and will therefore need to comply with the NPDES CGP.

The Contractor typically documents compliance with the NPDES CGP, prepares the SWPPP, and files the eNOI with EPA at least 14 days prior to the start of construction. A Notice of Termination must be submitted when construction is completed.

There is no review time for a NPDES CGP permit. The eNOI must be submitted at least 14 days prior to start of construction.

5.2.1.2 National Pollutant Discharge Elimination System (NPDES) – Discharge Permit

EPA regulates point source discharges into water bodies of the United States. Because Lynnfield does not have a sewer system that can carry backwash waters away from the proposed greensand filters, sludge drying lagoons will be installed at Glen Drive, similar to the sludge drying beds at Phillips Road.

Preliminary communications with the EPA suggest the new treatment plant discharge will be covered under the NPDES 'General Permit', as opposed to an 'Individual Permit'. The proposed discharge will be considered a new discharge, not a new source. A new discharge can be covered under the GP MAG64 provided an antidegradation review is conducted. MassDEP conducts the antidegradation review in order to authorize the discharge, and the EPA will review the document prior to processing the Notice of Intent. The discharge will be categorized as an industrial wastewater. The NPDES permit will contain limits on what can be discharged, monitoring and reporting requirements, and other provisions to ensure the discharge does not harm the receiving water's quality.

5.2.2 State Permitting

5.2.2.1 Massachusetts Environmental Policy Act (MEPA)

The MEPA Unit of the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) requires environmental review if a project requires a State Agency Action and meets or exceeds a MEPA review threshold (outlined at 301 CMR 11.03). Agency actions include granting state permits or licenses, providing state financial assistance, or transferring state land. The MEPA Regulations (301 CMR 11.00) establish thresholds, procedures, and timeline for a two-tiered review process, which generally proceeds as follows: the project proponent submits an Environmental Notification Form (ENF) to the Secretary of Environmental Affairs (Secretary), a public comment period follows, during which time the Secretary receives comments from the public and regulatory agencies, and holds a site visit and consultation session. At the close of the comment period, the Secretary issues a certificate stating whether an Environmental Impact Report (EIR) is needed and what the EIR should include, if required.

The Project is not subject to the filing of an ENF since the flow through the proposed greensand filter does not exceed the review threshold under water for construction of a new drinking water treatment plant with a capacity of 1,000,000 or more gpd [301 CMR 11.03 (4)(b)(4)].

Based on review of the preliminary layout, it appears the project will not exceed any of the review thresholds listed for wastewater. The preliminary design discharges a maximum of 12,000 gpd of wastewater from the proposed filter backwash to proposed onsite lagoons for settling/treatment.

5.2.2.2 Massachusetts Historical Commission (MHC)

The Massachusetts Historical Commission (MHC) is the state agency which functions as the State Historic Preservation Office (SHPO) in Massachusetts and identifies, evaluates, and protects the state's significant cultural resources under Section 106 of the National Historic Preservation Act (NHPA). Compliance with Section 106 and/or M.G.L Chapter 9, Sections 26-27c, as amended by Chapter 254 if the Acts of 1988 (950 CMR 71.00) is also required as part of the USACE permitting review process. A Project Notification Form (PNF) is required to initiate MHC review. The PNF will include: a detailed narrative description of the proposed project; a description of the existing conditions and the nature of any past development of disturbances on the project site, if any; a list of all the federal and state funds, licenses, and permits required for the project; photographs of existing areas to be disturbed; and a USGS project location map and proposed site plan. Review by MHC typically takes 30 days from the time MHC receives the PNF.

5.2.2.3 Section 401 Water Quality Certification

Pursuant to Section 401 of the Clean Water Act, federal permits for projects in wetlands or waterways must be certified by the MassDEP to ensure state water quality standards are met. Section 401 Certification will be necessary for any work authorized by a USACE individual permit. Individual certification is required if, among other criteria, more than 5,000 square feet of wetlands or water bodies are filled, which is not expected to be the case for this project. An Order of Conditions from the Lynnfield Conservation Commission serves as the 401 WQC for alterations to less than 5,000 sf of wetlands or water bodies. Review time is approximately 6 months.

Not anticipated to be applicable to this project.

5.2.2.4 Chapter 91 Waterways License

Chapter 91, Massachusetts Public Waterfront Act of Massachusetts General Law and its Regulations 310 CMR 9.00, is administered by the MassDEP Waterways Regulation Program. The waterways licensing program was established in 1866 and dates back to the Colonial Ordinances of 1641-1647, which granted to the public rights in tidelands and great ponds. The oldest state waterways regulatory program in the country, Chapter 91 regulates activities on both coastal and inland waterways, including construction, dredging and filling in tidelands, great ponds and certain rivers and streams. Review time is approximately 6 months.

The applicability of this license for this project is pending final design.

5.2.3 Local Permitting

5.2.3.1 Town of Lynnfield Street Opening and Trench Permits

The contractor would be required to prepare and submit to the Lynnfield Department of Public Works (DPW) street opening and trench permits for work on local Lynnfield roads. Work within public ways in Lynnfield cannot proceed until the contractor submits, and the Lynnfield DPW approves, the street opening and trench permits. These permits include requirements for proper

road restoration, traffic and pedestrian safety, insurance, signage, barricades and familiarization with all laws and regulations applicable to the work. Review time is approximately 1 month.

Not applicable to this Glen Drive Facility.

5.2.3.2 MWPA and Massachusetts Stormwater Regulations

Under the Massachusetts Wetlands Protection Act, authorization is required from the municipal Conservation Commission for any work in and adjacent to protected wetland resource areas. An Order of Conditions (wetland permit) is required for any work within a protected wetland resource area, or when the Conservation Commission determines that an Order of Conditions will be required for work in the 100-foot Buffer Zone area. The local Conservation Commission also administers the Massachusetts Stormwater Regulations.

The Lynnfield Conservation Commission, in addition to administering the MA Wetlands Protection Act, has a local bylaw and regulations, much of which are based on the state wetlands law and regulations, with some exceptions. For example, the Lynnfield Wetlands Environmental Bylaw regulate isolated wetlands.

Additionally, the NOI form serves as a "joint application" to both the Conservation Commission and MassDEP per the Wetlands Protection Act, and the Natural Heritage and Endangered Species Program (for inland species) or the Department of Marine Fisheries [DMF] (for coastal species) per the Mass. Endangered Species Act [MESA]. Additional information will be required when completing the NOI for work that will occur within the Estimated Habitats of Wetland Wildlife and/or Priority Habitats or plants and/or upland species.

Review time for a filing with the local Conservation Commission is 2-3 months.

Based on MassDEP wetlands mapping, it does not appear that an Order of Conditions would be required for the proposed Glen Drive greensand filter building. However, the limit of state and federal jurisdictional wetland areas in the vicinity of all proposed construction work would need to be delineated during the design phase to confirm that no work would occur within 100 feet of a wetland resource area. If the Project will alter the 100-foot buffer zone associated with Bordering Vegetated Wetlands, then a filing with the Lynnfield Conservation Commission would be required.

5.2.3.3 Stormwater Management Permit

Lynnfield has a stormwater management bylaw (Chapter 4A) which requires a stormwater permit from the Lynnfield Conservation Commission for construction activities (including clearing, grading, and excavation) that results in land disturbance of an acre or more draining to the Town's municipal storm drainage system. A separate stormwater permit application is not required for projects that are subject to jurisdiction under the MWPA and demonstrate compliance with the Massachusetts Storm Water Management Policy as reflected in an Order of Conditions issued by the Lynnfield Conservation Commission. Review time is approximately 2 to 3 months.

Glen Drive Greensand Filter Project: Not applicable since stormwater runoff will not be discharged into the Town's municipal storm drainage system.

5.2.3.4 Special Permit

A Special Permit from the Zoning Board of Appeals (ZBA) would be required for special uses or activities within the Groundwater Protection District for new impervious area of more than 15% or 2,500 square feet of the lot size, whichever is greater. A system for groundwater recharge must be provided which does not degrade groundwater quality. Recharge shall be by stormwater infiltration basins or similar system equipped with grease traps and covered with natural vegetation. Dry wells can be used only where other methods are infeasible. Review time is approximately 2 to 3 months.

Glen Drive Greensand Filter Project: A Special Permit would be required from the ZBA if new impervious area is 2,500 square feet or greater.

Section 6

Project Costs and Funding Considerations

The increased levels of manganese within the Glen Drive Wellfield water has resulted in the need for installing treatment prior to distribution. This section presents the capital cost estimates for the project work included in **Section 4**. The work includes modifications to the existing pumping station building, the proposed filtration building, and backwash lagoons. Sources of funding assistance were considered for this project and are also discussed in this section.

6.1 Assumptions

Opinions of probable construction cost for the project were prepared based on estimated prices of current-day materials, equipment, and labor. The ENR Construction Cost Index for estimates is 11124 (August 2018).

CDM Smith included a 30% construction contingency at this planning stage. The amount is shown separately in the cost tables. A 30% contingency is shown for Engineering and Implementation, and a 15% allowance for Project Contingency is included, which is typical for planning, as shown on **Table 6-1**. There is also a 4% escalation used to inflate the construction cost to the midpoint of construction, which was considered to be August 2019.

6.2 Capital Costs

Table 6-1 identifies the potential construction items and associated mark-ups for an opinion of probable construction cost for the new water treatment building and associated items. The new building incorporates a greensand filtration system which is designed to remove manganese from the source. The proposed greensand filtration system includes a new building with two greensand filters and associated chemical systems to treat manganese. Information on the greensand filtration system and vendor quote for this system is included in **Appendix G**.

It should be noted that as of late 2018 international tariffs have introduced cost escalation and cost uncertainty in aluminum and steel materials in particular, as evident in recent municipal water treatment plant bids. Therefore, the District may see capital costs fluctuate in the future.

The recommended budget for the new water treatment building is $5.3 Million.

Table 6.1 - Opinion of Probable Construction Cost, New Water Treatment Building

Item	Cost
Construction Cost	
Site Work:	
Site Work for new WTP Facilities	$134,000
Sludge Drying Beds	$69,000
Piping	$82,000
Site Work Subtotal	**$285,000**
New WTP Building & Associated Systems:	
New Building	$652,000
Greensand Filters, Chemical Feed Equipment and Piping	$737,000
SCADA	$75,000
Emergency Generator	$290,000
New WTP Building & Associated Systems Subtotal	**$1,754,000**
Subtotal Construction Cost	**$2,039,000**
Contractor Fees (Overhead and Profit, etc.)	$577,000
Subtotal	**$2,616,000**
Construction Contingency (30%)	$785,000
Subtotal	**$3,401,000**
4% Inflation per Year to Midpoint of Construction (August 2019)	$278,000
Subtotal	**$3,679,000**
Engineering and Implementation (30%)	$1,104,000
Project Contingency (15%)	$552,000
Total Opinion of Probable Project Cost	**$5.3 Million**

Notes:
Totals may not add due to rounding.
Excludes legal fees, easements, rights-of-way.
Based on ENR Construction Cost Index of 11124
International tariffs may cause uncertainty in pricing for aluminum and steel materials

The costs presented above do not include the following:

1. Bathroom facility and associated septic system
2. Rehabilitated roof, HVAC, electric in existing pump station building
3. Replacement of vertical turbine pumps in existing building

6.3 Local Funding Assistance Programs

Due to the costs associated with the proposed treatment building, CDM Smith has outlined potential funding assistance programs that may be available to the District for this project.

6.3.1 MWRA Local Water System Assistance Program

The MWRA's Local Water System Assistance Program provides loans to member communities for system upgrades related to water quality issues. This program is only available to MWRA member communities, and therefore, LCWD is not eligible for this program.

6.3.2 MassDEP Drinking Water State Revolving Fund

MassDEP Drinking Water State Revolving Fund (DWSRF) is an annual program that "*provides low-cost financing to help community public water suppliers comply with federal and state drinking water requirements. The program aims to protect public health and strengthen compliance with drinking water requirements, while addressing the Commonwealth's drinking water needs, through affordability and proper watershed management priorities.*"

Below is the timeline associated with DWSRF funding for 2019 Construction Projects.

1. Project Evaluation Form (PEF) Application Submitted: August 24, 2018
2. Intended Use Plan Released: ~January 2019
3. Secure Local Borrowing Authorization Deadline: June 28, 2019
4. Loan (SRF) Application and Buildable Plans and Specs Due: ~October 15, 2019
5. Project Reviewed by MassDEP: ~2 Months
6. Initiate Construction within 6 months of receiving approval from Divisional Municipal Services (DMS)

CDM Smith has submitted a PEF application on behalf of the District for the 2019 Drinking Water State Revolving Fund. The DWSRF Intended Use Plan is expected to be released in January 2019.

Appendix A

MassDEP September 26, 2018 Complaint Letter and Response

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

September 26, 2018

RE: City/Town: Lynnfield
PWS Name: Lynnfield Center Water District
PWS-ID No.: 3164000
Program: Complaints
Action: Complaint Investigation

Lynnfield Center Water District
83 Phillips Road
Lynnfield, MA 01940
Attn: Ken Burnham, Superintendent

Dear Mr. Burnham:

The Massachusetts Department of Environmental Protection (MassDEP) has received complaints from several of your customers regarding the quality of their drinking water. A summary of the complaint information is attached for your information.

With this letter, MassDEP is requesting that your office provide a written report to this office on the probable cause and resolution of the complaint.

Please note that the signature on this cover letter indicates formal issuance of the attached document. If you have any questions regarding this letter, please contact William Zahoruiko at (978) 694-3232.

Very truly yours,

Thomas Mahin
Drinking Water Section Chief
Northeast Regional Office

William Zahoruiko
Drinking Water Program

cc: DWP/Boston Office (no attachment)

File Name: Y:\DWP Archive\NERO\ Lynnfield -3146000-Complaints-2018-09-26

The Massachusetts Department of Environmental Protection (MassDEP) has received complaints from your customers regarding the quality of their drinking water. The facts are as follows;

MassDEP has received several complaints from residents concerning the quality of the water from Lynnfield Center Water District (LCWD). The complaints addressed concerns with discolored water. One photo was included.

On September 13, 2018, MassDEP received a letter cosigned by seven residents which addressed discolored water. Several photos were included.

MassDEP has been in contact with LCWD concerning the abovementioned issues. LCWD has taken some steps to rectify the situation. LCWD has done flushing, complaint response (including sampling) and has retained the services of an engineer, CDM Smith.

On September 19, 2018, MassDEP personnel responded in person to LCWD in regards to these complaints. MassDEP personnel were presented with distribution sampling results, initial engineering assessment, and confirmation of new unidirectional flushing plans to be implemented soon. LCWD explained to MassDEP that discolored water has been isolated to one section of town which is supplied by the Glen Drive Treatment Station. LCWD has kept a Complaint Log to track the complaints and has responded to many of the discolored water calls. LCWD has invited customers to Water District meetings.

Massachusetts General Laws Chapter 111, section 160, states that MassDEP "...may make rules and regulations and issue orders as in its opinion may be necessary to ensure the delivery of a fit and pure water supply to all customers". In accordance with M.G.L chapter 111, section 160, MassDEP is requesting that your office investigate the complaint as detailed herein and submit a written report, detailing the results of its investigation, most probable causes, recommended corrective actions(s), and a timetable for the completion of these corrective action(s), to the Northeast Regional Office, by **October 31, 2018**.

75 State Street, Suite 701
Boston, Massachusetts 02109
tel: 617 452-6000
fax: 617 452-8000

October 31, 2018

Thomas Mahin
Drinking Water Section Chief
DEP – Northeast Region
205B Lowell Street
Wilmington, Massachusetts 01887

Subject: Lynnfield Center Water District
PWSID: 3164000
Complaint Investigation Response

Dear Mr. Mahin:

On behalf of the Lynnfield Center Water District (the District), this letter is in response to your letter dated September 26, 2018, requesting the District to submit a written report on the probable cause and resolution of water quality complaints. A copy of this letter can be found under *Appendix A.*

Background

The District receives its drinking water from four well sites, two in the North Coastal Basin and two in the Ipswich River Basin. The Glen Drive Wellfield and Main Street Well are in the Ipswich River Basin. The Phillips Road Tubular Wellfield and Phillips Road Bedrock and Gravel-Packed Wells are in the North Coastal Basin. A map of the District's distribution system can be found in *Appendix B.* Note that since 2017, the Phillips Road Tubular Wellfield has been offline and reserved for emergency use only. In addition to the four groundwater sources, the District operates two storage tanks, one at Knoll Road and one at Wing Road. The distribution system, which serves approximately 8,500 customers, consists of approximately 48 miles of water mains ranging in size from 2- to 16-inch diameter.

In spring 2018 the District began receiving phone calls regarding discolored water in the neighborhoods off Lowell St. between Main St. and Chestnut St. The District performed flushing, which reduced the discolored water for some time. Residents wanted to understand why they were seeing discolored water; in response, the District was invited to attend a Selectman's meeting on June 4, 2018 to educate the public on the discolored water.

This letter outlines the probable cause of the discolored water, and ongoing and long-term solutions.

Probable Cause

The Glen Drive well site (Station 4) contains four deep bedrock wells that were installed in the 1990's. When the original pump tests were conducted, the source water at Glen Drive was pristine with low levels of iron and manganese. There was no apparent need for a filtration system. Over the past 20 plus years, as the well water has been drawn, manganese has gradually started to increase. The District has been aware of this gradual increase in manganese and has managed discolored water in the system by flushing dead end hydrants on a regular basis.

The specific neighborhoods off Lowell St., between Main St. and Chestnut St. are located between the Glen Drive and Main Street well sites, and north of the Phillips Road well site. Glen Drive produces approximately 40 percent of the District's water, and similarly, Phillips Road also produces approximately 40 percent of the District's water. The neighborhoods receive water from both well sites, as well as water from the Main Street well site. It is likely that there are complex flow patterns in these neighborhoods, where the flow direction changes depending on which source of water the District is drawing from. A change in flow direction can cause sediment that is built up along the water main pipe walls to become dislodged.

The discolored water complaints occur more frequently during the springtime months when water usage first starts to increase seasonally.

Resolution – Ongoing Improvements

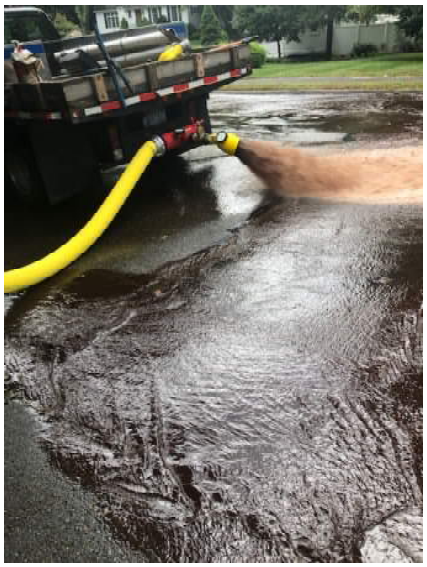
Ongoing improvements to respond to the discolored water complaints include directional flushing, increased frequency in water sampling, and a significant effort to increase public outreach.

Directional Flushing

Historically, the District has performed hydrant flushing at dead-end streets. When discolored water complaints increased in spring 2018, the District wanted to take a more proactive approach to flushing to address the manganese build up in the distribution system. In the spring 2018, the District performed directional flushing in the neighborhoods where they received discolored water complaints.

Following the spring flushing program, discolored water complaints decreased. Therefore, the District planned to repeat the directional flushing program in fall 2018. The District obtained assistance from CDM Smith to review their spring plan and make improvements where appropriate. The fall 2018 directional flushing program began at the Wing Road water storage tank and progressed systematically down Lowell Street and Chestnut Street. The Wing Road storage tank is viewed as a clean water source, which is critical to ensuring clean water is pulled through pipes during flushing. The flushing program involved closing gate valves in strategic locations to pull water from a clean source, starting with the Wing Road Tank, and towards the extremities of the

system. The District has made an effort to publicize the flushing program to their customers, so that residents know when their street will be flushed, and to not use the water during flushing. The District obtained permission from the Town to use traffic signs to indicate when flushing is occurring and has updated their website to list streets to be flushed.



Hydrant Flushing - Fall 2018

This fall 2018 flushing commenced on September 25, 2018 and was completed over 10 days. In comparison to the spring flushing program, there were improved results, including some decreases in flushing duration. The decreased flushing durations are attributed to iron and manganese in the water clearing up faster than in previous flushing efforts. This is also due to shorter pipe lengths flushed in each sequence.

Scouring velocity, which is considered to be 4 ft/sec, was achieved in nearly all flushing sequences during the fall 2018 flushing program. Detailed results of this program are provided as *Appendix C.* Additionally, 55 valves were operated throughout the flushing program. The District plans to conduct another round of flushing in November 2018, weather permitting.

A Selectman's meeting was held on June 4, 2018 to discuss the discolored water. CDM Smith prepared a presentation to explain the District's water system, where iron and manganese come from, and interim tasks to help alleviate the discolored water. Residents in attendance voiced their concerns and asked for an update meeting to be held in the fall.

Increased Water Sampling

The District has been collecting water samples and testing for iron and manganese in the distribution system on a weekly basis. A compilation of the additional samples collected between July and October 2018 are included in *Appendix D.* CDM Smith has been sharing the results with MassDEP.

Public Outreach

Starting in September, and going through October and November, the District has encouraged District customers to attend their regularly scheduled Board Meetings, which occur the second and fourth Monday of the month. These meetings are posted on the LCWD website and are advertised in the annual Water Quality report. Typically, residents have not attended the regularly scheduled Board Meetings. However, in late August 20 to 30 residents attended the Board Meeting and requested more information regarding discolored water and the District's plan to address discolored water. Since the August meeting, the meeting location has been moved to the Lynnfield

Middle School cafeteria to accommodate a larger crowd. CDM Smith has attended the Board Meetings and provided handouts and posters to aid the discussion. Below is a summary of the topics presented and discussed at each of the recent Board Meetings.

June 4, 2018 – This meeting provided residents with a detailed overview of their existing distribution system as well as information on short-term and long-term solutions to the discolored water issue. Approximately 30 residents attended this meeting. Residents also discussed watering ban restrictions and concerns over enough water quantity in the future. Residents' preferred approaches for communication improvements with the District were also discussed at this meeting.

September 10, 2018 – This meeting provided further detail on the options available to the District to address the discolored water and additional water quantity. Approximately 20 to 30 residents attended this meeting. Ongoing, short-term, and long-term alternatives were discussed, including the Glen Drive greensand filter plant and MWRA Connection possibilities. Alternatives included:

- Treatment improvements at Glen Drive to address water quality
- Supplemental MWRA water through Lynnfield Water District to address water quantity
- 100% MWRA water through a direct connection to MWRA at the Saugus townline to address water quality and quantity
- 100% MWRA water through Lynnfield Water District to address water quality and quantity

CDM Smith prepared a summary table focusing on how each alternative would affect water rates. High-level cost assumptions were made on capital improvements associated with MWRA water alternatives. During this meeting the Board explained to residents that the Board would like to issue a warrant to have residents vote on designing and constructing the new greensand filter plant at Glen Drive at a Special District Meeting to be held in October 2018. Residents felt as though they did not have enough information on the alternatives. Per the residents' request, the Board offered to reschedule the Special District Meeting, and to have CDM Smith present additional information on alternatives at the following Board Meeting. Residents in attendance also asked the Board to create a mailer to be sent to every customer to explain the alternatives, since attendance is generally low at the Board Meetings. The Board committed to preparing an informational mailer to be sent to every customer to educate them on the alternatives, and the warrant to vote on the greensand filter at Glen Drive and funds to study alternative water sources.

September 24, 2018 – Further discussion of short-term and long-term alternatives occurred at the September 24th meeting, with additional consideration of schedules for planning, design, bidding, construction, and costs for each of the long-term options being considered. Additionally, MWRA connection considerations were discussed, specifically regarding water quality issues resulting from differences in MWRA water vs. the District's groundwater, which would be mixed in a "Partially Served" scenario. Approximately 5 to 10 residents attended this meeting.

CDM Smith presented three poster boards to those in attendance. The poster boards compared LCWD water to MWRA's water, provided an estimated schedule for each alternative outlined in the September 10, 2018 meeting, and a graph to show estimated water rates associated with each alternative from 2018 through 2050.

October 9, 2018 – At this meeting two residents were in attendance. This meeting was more informal than the two held in September. A representative from CDM Smith attended the meeting and was available to answer questions along with the Superintendent and Board.

October 22, 2018 – Similar to the October 9 meeting, this meeting was intended to be informal. A representative from CDM Smith attended the meeting and was available to answer questions along with the Superintendent and Board. Approximately 20 residents were in attendance. Residents had several questions regarding the proposed greensand filter plant, MWRA alternatives, water quality and how each project would affect their rates. CDM Smith and the Superintendent reviewed the presentation material that was brought to the September 24 meeting. Although residents continued to push for more information, the Board felt it was important to move forward with the warrant article to vote on the greensand filter plant, as this is the most cost effective and timely solution to remove manganese from Glen Drive and to improve the water quality at a source that provides nearly 40 percent of the District's water. The Board made a motion to issue the warrant to vote on the new greensand filter plant at a Special District Meeting to be held on December 10, 2018.

Future Meetings – There will be two regular Board Meetings in November where representatives from CDM Smith will be available to answer questions alongside the Superintendent and members of the Board. The meetings are scheduled for November 7 and November 26. The Special District Meeting to vote on the warrant article to design and construct a new greensand filter plant at Glen Drive is scheduled for December 10, 2018.

Additional information including meeting agendas and presentations are included under *Appendix E*. Since September the District has engaged a Public Relations firm, John Guilfoil Public Relations,

that has created a Facebook and Twitter account for the District. The PR firm has also worked with the District to make improvements to their website and add information on manganese, the warrant article and hydrant flushing. The PR firm has also assisted the District in preparing and publishing articles in the local newspaper to help educate residents and encourage attendance at the Board Meetings. The District will also be posting the Board Meeting agendas and minutes on their website.

Per residents' request at the September 24 meeting, the Board worked with CDM Smith to prepare an informational mailer to explain the warrant article, where manganese comes from, and the cost and schedule associated with different alternatives. The warrant article proposes a two phased approach at addressing water quality and water quantity concerns. A "yes" vote includes design and construction of a new greensand filter plant at Glen Drive (Phase 1) and approves funding towards a hydraulic study to analyze obtaining supplemental water from surrounding communities (Phase 2). The exact language on the warrant article is included on the mailer. The mailer is scheduled to be sent out to residents the week of October 29 and is included as *Appendix F*.

Resolution – Long Term Improvements

The discolored water is due to increased levels of iron and manganese at the Glen Drive wellfield. Although flushing water mains helps to remove manganese built up in the pipelines, removing manganese from the source is the most effective way to improve the water quality. The District and CDM Smith have entered into a contract to prepare a facility plan for a new greensand filter plant at Glen Drive. The scope of work can be found in *Appendix G.* The greensand filter would remove manganese. On October 9, 2018 the District formally made a motion to issue a warrant to have residents vote on the design and construction of the greensand filter plant at Glen Drive. On December 10, 2018, customers will vote to move forward with the new plant, or not. If the customers do not vote on the new plant, the District will continue to perform directional flushing on a frequent basis to remove manganese from the distribution system.

In August 2018, the District submitted an application for financial assistance as part of MassDEP's Drinking Water State Revolving Fund (DWSRF). This application was submitted for the construction of the Glen Drive Treatment Facility Upgrades. The MassDEP DWSRF Intended Use Plan is anticipated to be published in late winter / early spring 2019.

The District has also considered the possibility of purchasing MWRA water. This connection could be for a supplemental solution, a 100% MWRA solution, or a "wheeling" solution, by obtaining MWRA water through a neighboring community's distribution system. The most logical approach would be to obtain water from the Lynnfield Water District. The alternatives require a hydraulic analysis of both the District's distribution system and the neighboring communities. A meeting to discuss moving forward with a hydraulic analysis with Lynnfield Water District has been scheduled.

Further consideration of water quality related to mixing MWRA water with the District's groundwater would be evaluated. On behalf of LCWD, CDM Smith has engaged in discussions with the MWRA, MassDEP and Department of Conservation and Recreation (DCR) to inquire on water rates, tie-in fees and the permitting approval. Obtaining any amount of MWRA water would require process under the Interbasin Transfer Act. This process can take up to two years, with the MWRA approval process following the approved MEPA application. Once MWRA approval is obtained, the District could begin the design and construction phase of executing any of the MWRA alternatives.

The District is working towards confirming the best course of action to alleviate the discolored water concerns. Due to the District's structure, a solution cannot proceed without resident approval. As presented above, the District is preparing a mailer to educate the public and encourage customers to come to the December 10th meeting to vote on the warrant article. This vote is intended to address both water quality concerns caused by high levels of manganese at the Glen Drive Wellfield, as well as the water quantity concerns.

If you have any questions, please contact me at 617-452-6561. Thank you for your consideration.

Sincerely,

Angela Moulton, P.E.
Project Manager
CDM Smith Inc.

Appendices:

A. MassDEP Letter (September 26, 2018)
B. LCWD Distribution System Figure
C. Directional Flushing Summary
D. Iron and Manganese results
E. Materials presented at public meetings
F. Informational Mailing to District Customers
G. Glen Drive Facility Plan Scope of Work

cc: William Zahoruiko, MassDEP
Kenneth Burnham, District Superintendent
Nicholas Couris, District Assistant Superintendent
John Doherty, CDM Smith

Appendix A

September 26, 2018 MassDEP Complaint Letter

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

Charles D. Baker
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September 26, 2018

RE: City/Town: Lynnfield
PWS Name: Lynnfield Center Water District
PWS-ID No.: 3164000
Program: Complaints
Action: Complaint Investigation

Lynnfield Center Water District
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Appendix B

Lynnfield Center Water District Distribution System Figure

TOWN OF LYNNFIELD
Massachusetts

LYNNFIELD CENTER WATER DISTRICT

Water System

April 2017

Water Network Features
- Hydrant
- Hydrant Valve
- System Valve
- Water Tank
- Distribution Pipe
- Hydrant Lateral
- Private Pipe
- Water District Boundary

Basemap
- Town Boundary
- Interstate
- U.S. Highway
- Local Road

N W E S

0 300 600 1,200 1,800
Feet

Sources: Town of Lynnfield, CDM Smith, and MassGIS
Coordinate System: NAD83 Mass. State Plane Mainland FIPS 2001 Feet

CDM Smith

F:\Projects\Project_data\LCWD\MXD\LCWD_Tanks_and_Wells.mxd billingsmc April-2017

Appendix C

Directional Flushing Summary

Lynnfield Center Water District
Fall 2018
Flushing Program Results

Sequence #	Date	Location of Flushed Hydrant	Flow (gpm)	Duration (min)	Velocity (fps)
1	9/25/2018	End of Joseph Lane	300	65	1.9
1A	9/25/2018	Joseph Lane	600	180	3.8
2	9/26/2018	Chestnut @ Lowell Street	600	60	3.8
3	9/26/2018	Hydrant @ end of North Hill	800	35	5.1
4	9/26/2018	Hydrant @ Glen Drive Station	750	75	4.8
5	9/26/2018	Hydrant @ end of West Tapley	1100	20	7.0
6	9/27/2018	Hydrant @ end of North Hill	750	30	4.8
7	9/27/2018	Hydrant @ end of Powderhill	550	20	3.5
8	9/27/2018	Hydrant @ end of Murphy Lane	750	30	4.8
9	9/28/2018	Hydrant @ end of Apple Hill	880	15	5.6
10	9/28/2018	Cidermill @ Orchard Lane	870	75	5.6
11	9/28/2018	Hydrant @ end of Apple Hill	870	20	5.6
12	9/28/2018	Hydrant @ end of Apple Hill	810	20	5.2
13	9/28/2018	Hydrant @ end of Apple Hill	800	30	5.1
14	10/2/2018	Chestnut @ Lowell Street	700	20	4.5
15	10/2/2018	Sevnoir Way	850	30	5.4
16	10/2/2018	480 Chestnut Street	880	25	5.6
17	10/2/2018	Alderny Way @ end	775	20	4.9
18	10/3/2018	Cooks Farm	700	40	4.5
19	10/3/2018	Cooks Farm @ Chestnut	675	5	4.3
20a	10/3/2018	6 Tophet Road	650	10	4.1
20b	10/3/2018	6 Tophet Road	1200	15	7.7
20c	10/3/2018	6 Tophet Road	450	15	2.9
21	10/3/2018	Cortland @ Tophet	830	30	5.3
22	10/3/2018	Tophet/Chestnut	600	5	3.8
23	10/4/2018	Haywood Farm	930	35	5.9
24	10/4/2018	Trog Hawley Hydrant	775	25	4.9
25	10/4/2018	741 Townsend	815	40	5.2
26	10/4/2018	Needham Street	800	20	5.1
27	10/4/2018	Hydrant @ end of Needham	830	15	5.3
28	10/9/2018	Bridle Path/Trog Hawley	715	30	4.6
29	10/9/2018	Chestnut Street	715	20	4.6
30	10/10/2018	Perkins Lane	715	15	4.6
31	10/10/2018	Windsor Street	575	30	3.7
32	10/10/2018	Candlewood Through Windsor	600	20	3.8
33	10/10/2018	Maiden Through Windsor	575	30	3.7
34	10/10/2018	Hart Through Windsor	575	25	3.7
35	10/11/2018	528 Heritage	575	15	3.7
36	10/11/2018	Wheeler	625	25	4.0
37	10/11/2018	Tappen Court	600	25	3.8
38	10/11/2018	Tappen Way	700	35	4.5
39	10/11/2018	Spearfield through Tappen Way	675	20	4.3
40	10/11/2018	Bryant	625	15	4.0
41	10/11/2018	End of Heritage	740	15	4.7

Appendix D

Iron and Manganese Results

Lynnfield Center Water District
Iron and Manganese Monitoring

Sample Site	July 2, 2018	July 9, 2018	July 16, 2018	July 23, 2018	July 31, 2018	August 7, 2018	August 15, 2018	August 21, 2018	August 27, 2018	September 4, 2018	September 11, 2018	September 18, 2018	September 24, 2018	October 1, 2018	October 9, 2018	October 15, 2018	October 22, 2018
1 - Huckleberry Hill School																	
Iron, MG/L	0.011	0.011	0.005	0.028	0.006	0.032	0.023	0.018	0.051	0.015	0.021	0.011	0.014	0.009	0.026	0.018	0.017
Manganese, MG/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.005	0.006
2 - Lynnfield High School																	
Iron, MG/L	0.008	0.012	0.006	0.006	ND	0.008	0.009	0.006	0.006	0.009	0.012	0.01	0.007	0.013	0.014	0.013	0.007
Manganese, MG/L	ND	ND	ND	0.005	ND	0.006	ND	ND	0.005	0.008	0.017	0.012	0.005	0.009	0.012	0.004	ND
3 - Lynnfield Fire Station																	
Iron, MG/L	0.009	0.062	0.017	0.012	0.025	0.013	0.017	0.022	0.018	0.03	0.025	0.03	0.021	0.034	0.008	0.016	0.014
Manganese, MG/L	ND	ND	0.007	ND	ND	ND	0.007	ND	ND	ND	ND	ND	ND	0.009	0.008	0.005	ND
4 - Elk's Club																	
Iron, MG/L	0.004	0.009	0.006	0.004	0.004	0.005	ND	ND	0.046	0.031	0.032	0.027	0.021	0.01	0.012	0.013	0.013
Manganese, MG/L	ND	ND	ND	ND	0.005	0.005	ND	ND	0.012	ND	0.005	ND	ND	ND	ND	ND	ND
5 - Lutheran Church																	
Iron, MG/L	0.021	0.03	0.037	0.014	0.02	0.012	0.02	0.025	0.02	0.026	0.018	0.016	0.04	0.026	0.036	0.022	0.017
Managnese, MG/L	0.052	0.061	0.1	0.044	0.06	0.048	0.058	0.076	0.067	0.1	0.085	0.043	0.034	0.046	0.124	0.062	0.049
6 - Glen Drive Pumping Station																	
Iron, MG/L		0.035	0.03	0.037	0.054	0.068	0.026	0.027	0.026	0.077	0.041	0.064	0.027	0.036	0.024	0.015	0.048
Manganese, MG/L		0.128	0.145	0.124	0.154	0.131	0.13	0.137	0.136	0.156	0.134	0.122	0.122	0.126	0.104	0.015	0.114
7 - Private Residence Lowell Street																	
Iron, MG/L	0.012	0.033	0.005	0.007	0.01	0.012	0.01	0.02	0.018	0.017	0.01	0.008	0.03	0.037	0.049	0.046	
Manganese, MG/L	0.026	0.1	0.01	0.028	0.028	0.021	0.014	0.03	0.031	0.037	0.019	0.012	0.028	0.056	0.134	0.051	

All results are reported in MG/L
ND = None Detected
Maximum Contaminent Level (EPA Limit) for Iron = 0.3 MG/L
Maximum Contaminent Level (EPA Limit) for Manganese = 0.05 MG/L

Appendix E

Materials Presented at Public Meetings

Lynnfield Center Water District

Selectmen's Meeting: Update on Water

June 4, 2018

What's Going on with the Water?

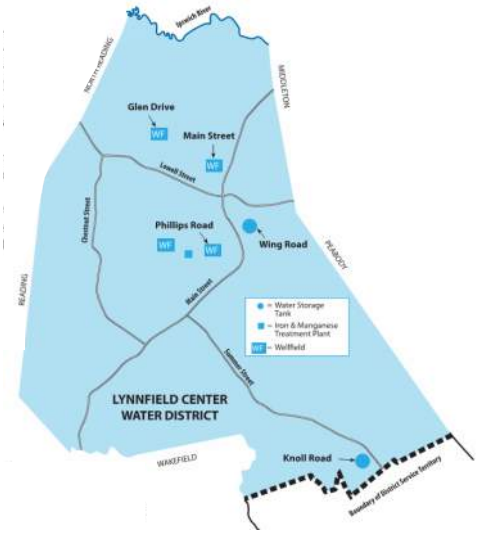
- Have you noticed sediment in your water?
- Is the water safe to drink?

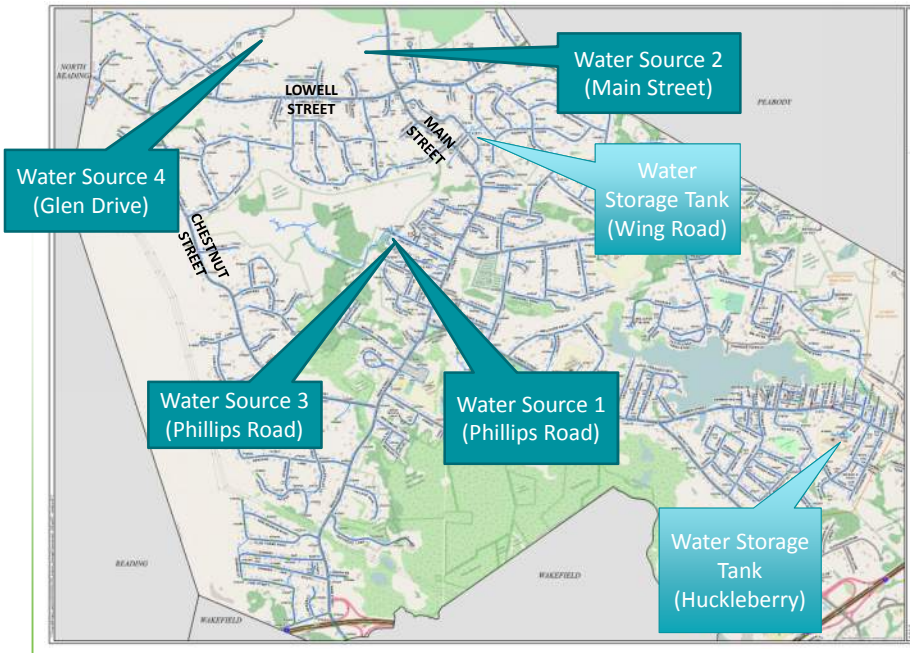
Agenda

- Overview of District's water system
- What the District is doing to Improve Water Quality (short term and long term)
- We want to hear from you

Overview of District's Water System

- Sources: four groundwater well sites
- Treatment: treatment plant and at pump stations
- Storage: two water storage tanks
- Distribution: 48 miles of water main





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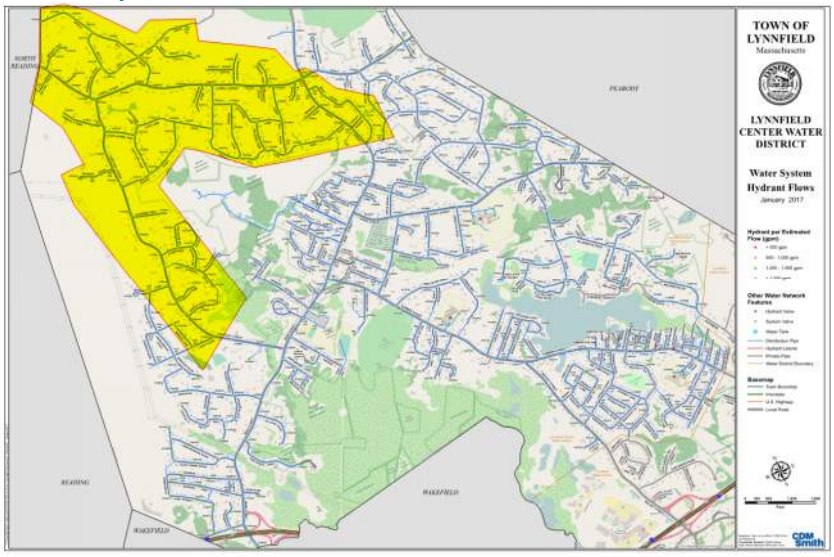
Overview of District's Water System

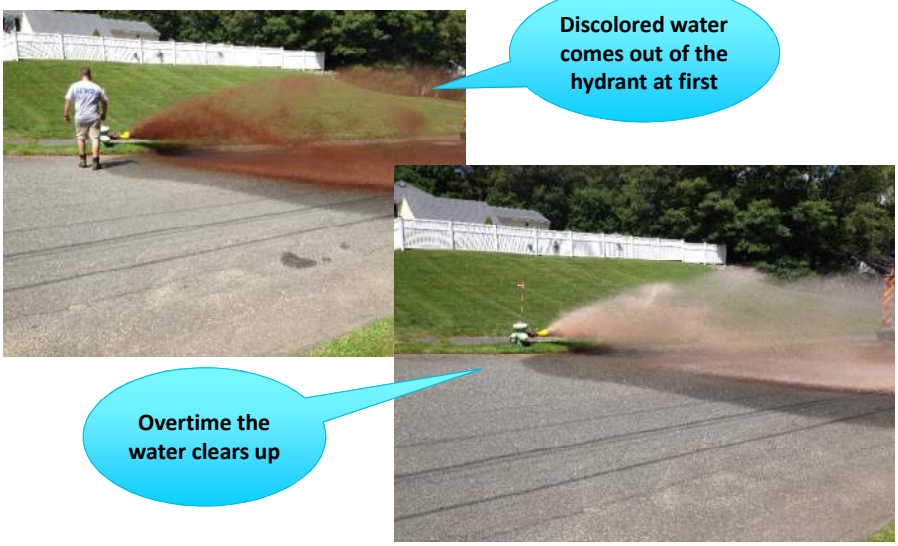
- The District uses different water sources at different times of the year
- Residents use water differently throughout the year

6

What is the District Doing to Improve Water Quality



What is the District Doing to Improve Water Quality



What is the District Doing to Improve Water Quality

- Long term solutions
  - Additional treatment
  - Source selection
  - Alternative sources of water

Mechanical piping at the Phillips Road Water Treatment Plant

We Want to Hear From You

- District and Town communication improvements
- What is the best way to inform residents of flushing:
  - Traffic message boards
  - Reverse 911 system
  - Other?
- You are our eyes and ears!

LYNNFIELD ADVOCATE

LYNNFIELD VILLAGER
Family-owned publication serving Lynnfield since 1973

CDM Smith

Public Comment Period

FYI:
- **2017 Water Quality Report**
- **Water Use Restrictions**

Please state your name and address;
To offer everyone a chance to speak,
please limit comments to 2 – 3 minutes.

Lynnfield Center Water District

Board Meeting – September 10, 2018

Ongoing, Short-Term and Long-Term Actions related to Discolored Water

1. **Ongoing**
   - Logging dates and addresses of discolored water
   - Increased frequency of manganese sampling at source and distribution sites
   - Discussions with customers
   - Source optimization
   - Distribution system optimization/valve operations

2. **Short-Term**
   - Rebates for individual residential filters
   - Glen Drive Treatment – submitted funding application to DEP
   - Glen Drive Treatment – continued facilities planning for greensand filters
   - Distribution flushing

3. **Long-Term**
   - Glen Drive Treatment Design and Construction
   - MWRA options via Lynnfield Water District or other locations

Water Quality Characteristics and Communities Partially Served by MWRA

1. **Public notification and education required for chloramines**
    - Dialysis cannot use chloramine treated water – notice to hospitals and other treatment centers and individuals
    - Tropical fish tanks cannot use chloramine treated water without first treating for removal – chloramines do not quickly dissipate like chlorine
2. **MWRA Connection Considerations**
    - Water characteristics including pH, disinfection, alkalinity, temperature and other considerations
    - MWRA's water quality is to passivate lead and arrest chlorinated byproduct formation.
    - Communities with partial MWRA source (chloramine and hypochlorite mix) – generally are successful with appropriate planning
    - See MWRA website list of served and partially served communities. Bedford is now 100% MWRA, initial mixing had some history of nitrification concerns. Marlborough serves its community by about ½ MWRA and ½ their own sources. Needham, Cambridge, Wakefield turn MWRA on and off seasonally and/or daily/weekly schedules.

Lynnfield Center Water District
Board Meeting - Monday September 10, 2018
Long Term Water Quality Improvement Alternatives

Preliminary Costs and Schedule for Discussion Purposes

	Alternative	Estimated Infrastructure Improvement Probable Cost *(column A)*	Estimated One Time MWRA Tie in Fee *(column B)*	Estimated Average Household Annual Water Usage Cost *(column C)*	LCWD Annual Service Connection Fee *(column D)*	Estimated Average Household Annual Rate Payer Cost Including Infrastructure Improvements and MWRA Tie in Fee *(columns A + B + C + D)*	Estimated Schedule
1	Existing Condition	$0	$0	$80	$60	$140	Not Applicable
2	Treatment Improvements at Glen Drive	$4,600,000	$0	$80	$60	$280	2020 Online
3A	MWRA Option A: Supplemental MWRA Water Connection to South Lynnfield; 20% MWRA Water	$500,000	$700,000	$120	$60	$220	3+ years
3B	MWRA Option B: Direct Connection to MWRA Water at Saugus Town Line; 100% MWRA Water	$13,500,000	$3,000,000	$280	$60	$830	4+ years
3C	MWRA Option C: Direct Connection to MWRA Water at South Lynnfield; 100% MWRA Water	$2,000,000	$3,000,000	$280	$60	$490	4+years

Notes:

1 -The average household annual water usage cost is based on 77,000 gallons of water used per household per year; some households use less water and others use more water.

2 - Options 2 & 3 assume infrastructure improvements are funded through a General Obligation bond, which has in interest rate of approximately 5% and is paid back over 20 years; The District may be eligible for funding through the State Revolving Fund (SRF) loan program, which is a 2% loan paid back over 20 years.

3 - Average annual rate payer cost reflects the Districts & MWRA's 2018 water rates, the water rates for both entities are subject to change. MWRA typically increases their annual water rate by 3.9% per year. The District may restructure their rate block structure.

4- Option 3C requires a hydraulic evaluation to determine South Lynnfield's capability to supply 100% of the District with water; the hydraulic evaluation could result in additional infrastructure improvements not reflected in the costs shown.

5- For simplification and discussion purposes, the cost for infrastructure improvements and the one time MWRA tie in fee were evenly divided between the number of water service connections reported in the District in 2017.

Lynnfield Center Water District

Board Meeting – September 24, 2018

Continued Update and Discussion

Ongoing and Short-Term Efforts

1. Glen Drive Treatment – continued facilities planning for greensand filters
2. Distribution flushing – start this week

Long-Term Options – Various Considerations

3. MWRA Water Characteristics

4. Schedule for Planning, Design, Bidding and Construction

5. Water Rates and Estimated Costs

6. Next Steps
    - District Article
    - Continuation towards design of Glen Drive Treatment Improvements
    - Modeling Analysis of both LWD and LCWD
    - Data-based estimates for necessary infrastructure improvements

Lynnfield Center Water District — Board Meeting – Monday September 24, 2018

Long Term Water Quality Improvement Alternatives
Comparison of LCWD Water and MWRA Water

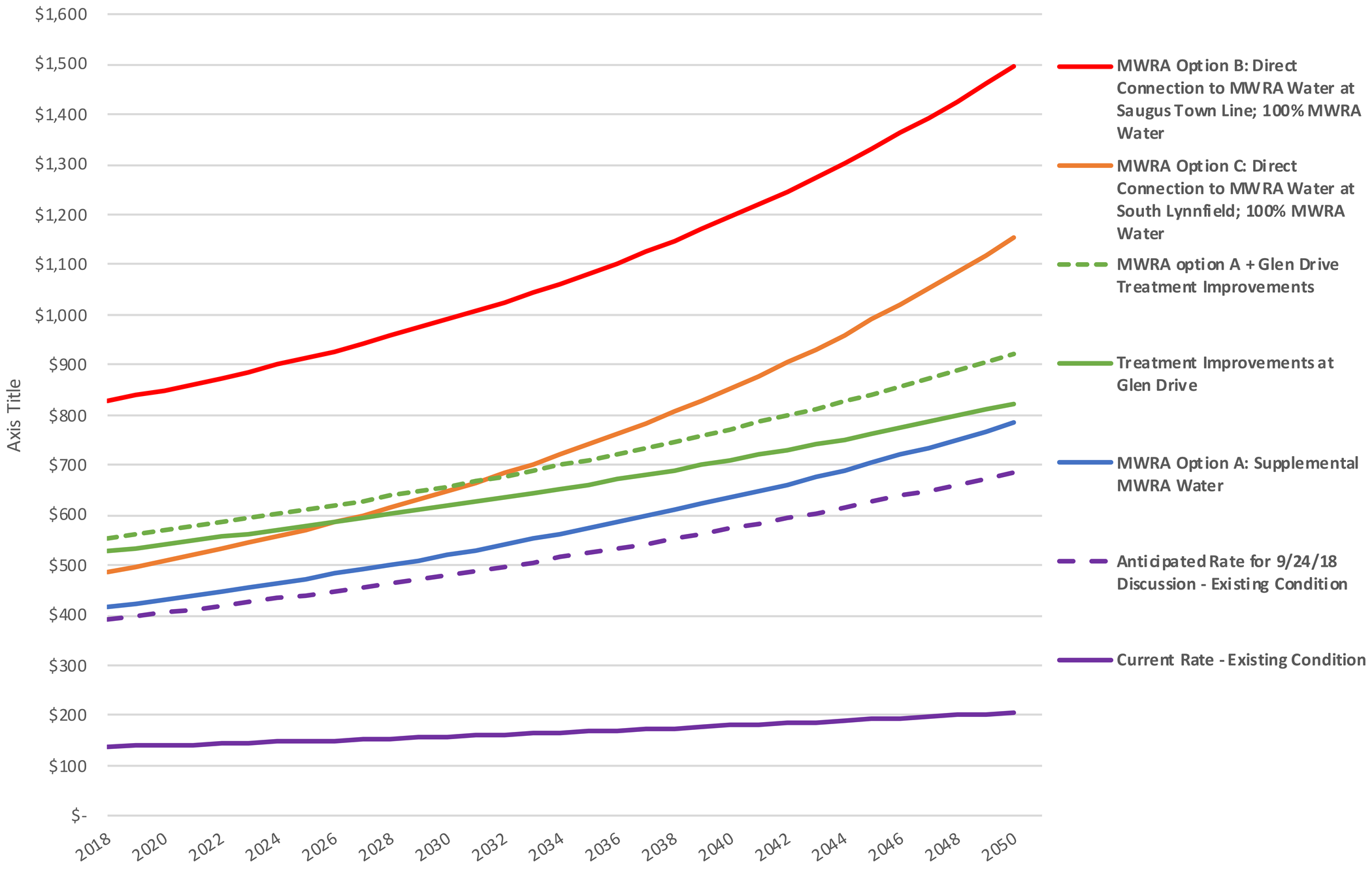
	LCWD Water	MWRA Water
Where does the water come from?	▪ Local groundwater wells ▪ Groundwater ▪ Naturally Filtered ▪ Colder Water Temperature	▪ Quabbin reservoir in western Massachusetts Wachusett reservoir in central Massachusetts ▪ Surface Water ▪ Unfiltered ▪ Warmer Water Temperature
How is the Water Disinfected?	Sodium Hypochlorite (Chlorine)	Ozone, UV and Monochloramines
What is the pH range?	7-7.5	9-9.5
What is the Water Rate Structure?	Multi-Tiered Rates set by the District (assumed 2% escalation / year)	MWRA Wholesale cost (planned 3.9% increase / year)
Watering Bans and Restrictions	Mandatory year-round restriction to limit outdoor sprinklers to even calendar days between 5PM & 9PM; Other drought related restrictions imposed by MassDEP.	MWRA policy states that all communities served by MWRA implement all practicable water conservation measures.
Operation and Maintenance Considerations	Water mains, storage tanks, groundwater sources, treatment facilities	▪ Supplemental tie in (MWRA Option A): Water mains, storage tanks, groundwater sources, treatment facilities ▪ 100% MWRA (MWRA Options B or C): water mains, storage tanks
Schedule	Treatment Improvements at Glen Drive On-Line in Year 2020	MWRA Option A, B or C Varies Between Year 2022 and Year 2024

CDM Smith

Lynnfield Center Water District — Board Meeting – Monday September 24, 2018

Long Term Water Quality Improvement Alternatives
Preliminary Schedule for Discussion Purposes

Estimated Annual Water Bill Projection
Includes Capital Costs, MWRA Tie In Fee, Water Rates & Service Fee
(same assumptions presented on 9/10/2018 Alternatives Summary Table)



CDM Smith

Appendix F

Informational Mailing to District Customers

Join us for a Special District Meeting

We want to hear from you!

Come to the Special District Meeting on December 10, 2018, at 7:00PM held at the Lynnfield Middle School on Main Street to vote to authorize funding for the construction of a new Greensand Filter Plant at the existing Glen Drive wellfield site to address iron and manganese and planning efforts to study additional water sources.

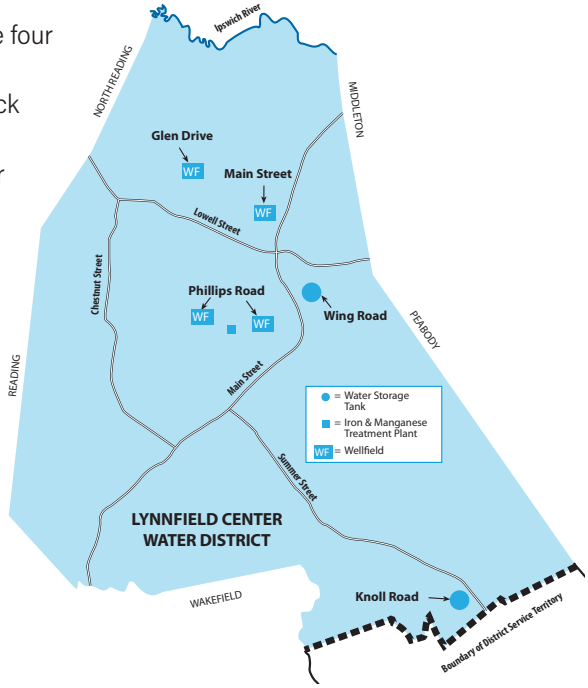
The new treatment will allow the District to maintain the quality of its locally sourced groundwater which will benefit all customers throughout the entire District.

About Lynnfield Center Water District (the District):

The District produces and distributes treated well water to over 2,600 rate-payer homes, businesses and public buildings located in the northwest two-thirds of the Town of Lynnfield, Essex County, Massachusetts. The District is bound by the Lynnfield Water District and the surrounding communities of Peabody, Middleton, North Reading, Reading, and Wakefield. The District is committed to providing safe, clean drinking water to its ratepayers. The District has been providing drinking water to its customers since 1939.

Where does my water come from?

The District receives its drinking water from two river basins, the Ipswich River Basin and the North Coastal River Basin. There are four groundwater wellfields in the District, two in each river basin, as shown on the map. The Glen Drive wellfield contains four bedrock wells. The Main Street wellfield contains a single gravel packed well. There are two well-fields in the Phillips Road area: a tubular wellfield with 60 wells, and a bedrock wellfield with five wells. In addition to the wellfields, the District operates two storage tanks, one at Knoll Road and one at Wing Road. The distribution system consists of approximately 48 miles of water mains ranging in size from 2- to 16-inch diameter.



Why Do We Have Watering Bans?

Due to the District's permitted withdrawal limit from the Ipswich River Water Basin, the District has had to implement water usage restrictions as specifically mandated by the Massachusetts Department of Environmental Protection (MassDEP). The District has a mandatory year-round restriction limiting outdoor sprinklers to even calendar days between the hours of 5PM and 9PM. The District is actively working to insure the long-term viability of its sources by aggressively promoting water conservation and identifying potential new water supply sources in town.

CDM Smith

25
Mn
Manganese

Information on Manganese:

Manganese is a naturally occurring mineral found in rocks, soil, groundwater, and surface water, and is commonly found in water supplies in Massachusetts. Manganese is necessary for proper nutrition and is part of a healthy diet, but can have undesirable effects on certain sensitive populations at elevated concentrations. Manganese can lead to staining of laundry and plumbing fixtures. The United States Environmental Protection Agency (EPA) and MassDEP have set an aesthetics-based Secondary Maximum Contaminant Level (SMCL) for manganese of 50 ug/L (microgram per liter), or 50 parts per billion. In addition, MassDEP's Office of Research and Standards (ORS) has set a drinking water guideline for manganese (ORSG), which closely follows the EPA public health advisory for manganese. Drinking water may naturally have manganese and, when concentrations are greater than 50 ug/L, the color and taste of the water may be affected.

Why does Glen Drive need treatment now?

The Glen Drive wellfield site was constructed in 1997 and consists of four existing deep bedrock wells, a clearwell, and a building that contains pumps and chemical injection points. Chemical addition at this site consists of sodium hypochlorite for disinfection, potassium hydroxide for pH control, and fluoride to reduce the incidence of dental cavities. When planning and testing for this site occurred in the 1990's several water quality tests were performed. The results showed pristine water quality coming from the ground with no immediate need for treatment. Given the excellent water quality, and high volume of water produced, Glen Drive has become one of the top water producers for the District. Nearly 40% of water in the District is pumped from the wells at Glen Drive. Although Glen Drive has been a reliable water source for the District, pumping water from the ground for over 20 years sometimes results in an increase of iron and manganese.

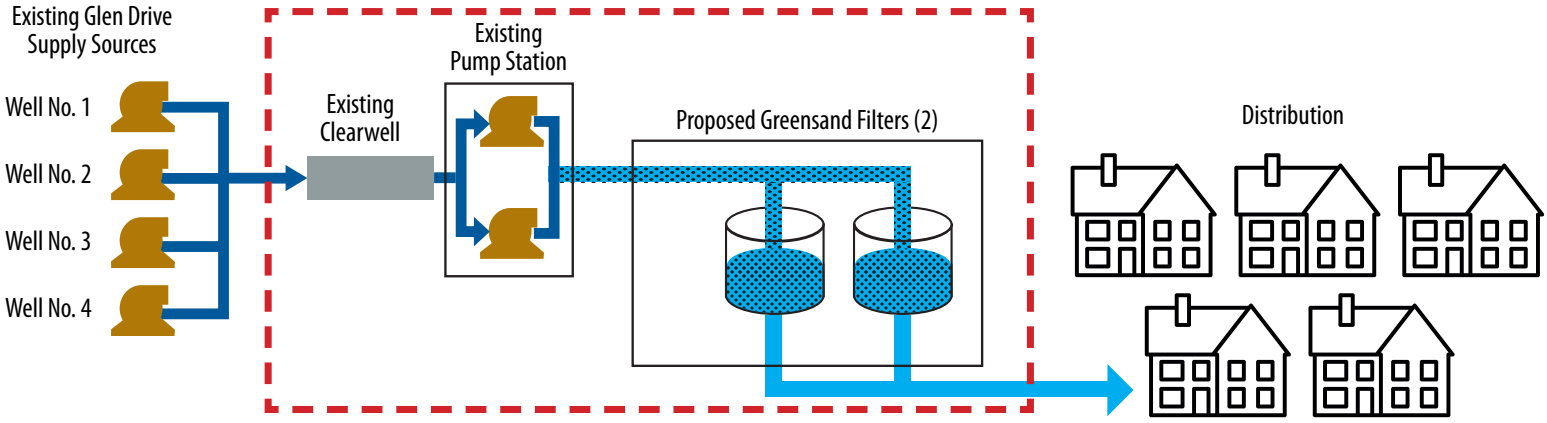
For comparative purposes, The original Phillips Road wellfield was constructed in the 1980's and contained a greensand filter. In the 2000's the District expanded the wellfields and upgraded the greensand filter. When planning and testing for the wellfield expansion occurred in the 2000s several water quality tests were performed. The results showed elevated levels of iron and manganese, therefore greensand filters were included in the design. The original and upgraded greensand filters have proven to be very successful, and as such, Phillips Road is also one of the top water producers for the District. Nearly 40% of water in the District is pumped from the wells at Phillips Road.

Existing Greensand Filters at Phillips Road (Constructed in 2013)

Investing in new greensand filters at Glen Drive is an investment that benefits every household within the District. As clean drinking water is pumped from the wellfields into the District's 48 miles of water main buried beneath the streets, the water from each site is mixed. Because Glen Drive supplies nearly 40% of the drinking water to the District, improving the water quality at Glen Drive will improve the water quality for the entire District. The Glen Drive wellfield is an existing local water source available to the District.

The addition of greensand filters at Glen Drive will allow the District to explore new wells at the existing site, to secure the quantity of water available to its customers in anticipation of future needs.

Glen Drive Wellfield - Existing Process and Proposed New Greensand Filter Plant



Warrant Article

The Lynnfield Center Water district is requesting funds for a 2 phase project to improve water quality and increase capacity during peak periods of consumption during the summer months.

Phase I is the largest portion of the project scope. It involves construction of a treatment plant at the Glen Drive Pumping Station, which includes a greensand filtration system that removes iron and manganese from the water supply. This treatment plant will be the most efficient, cost-effective approach to ensure that customers district-wide enjoy clear, quality drinking water for the foreseeable future. The useful life of such a treatment plant is 20 to 40 years with normal maintenance. The cost for construction of this plant is estimated to be 5.25 million dollars.

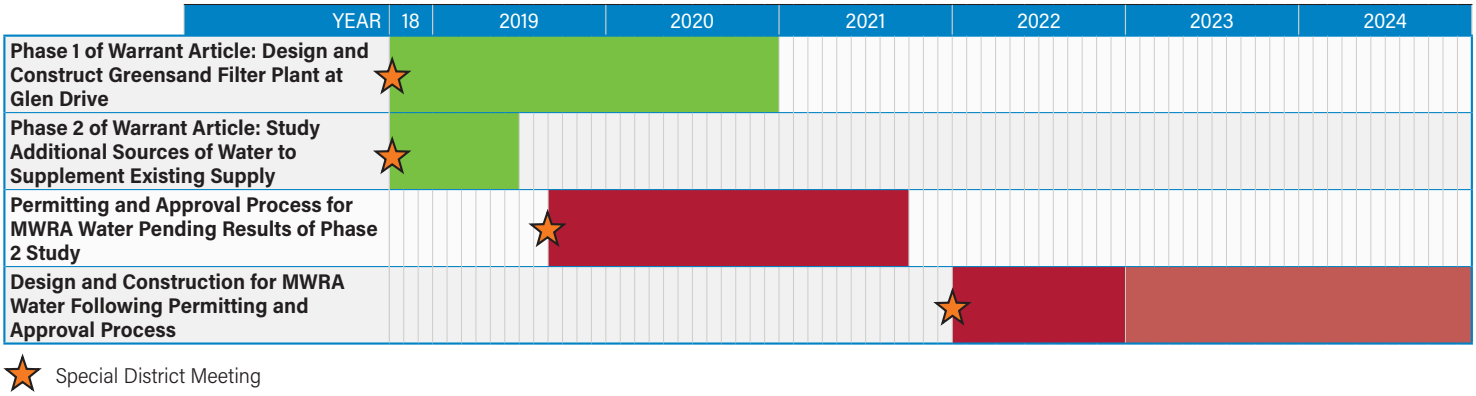
Phase 2 of the project is to study additional sources of water to supplement the existing water supply during peak periods of consumption - summer months. The objective of this phase is to understand options to increase the water supply available to our customers. Efforts are being made through discussions with the DEP to minimize watering restrictions imposed on ratepayers. The plan is to source MWRA water either through the Lynnfield Water District or from one of the surrounding communities (Andover, N. Reading, Reading, Wakefield). The most logical and economical tie to source MWRA water is through the Lynnfield Water District. The estimated cost for this discovery phase of the project is estimated to be $250,000.

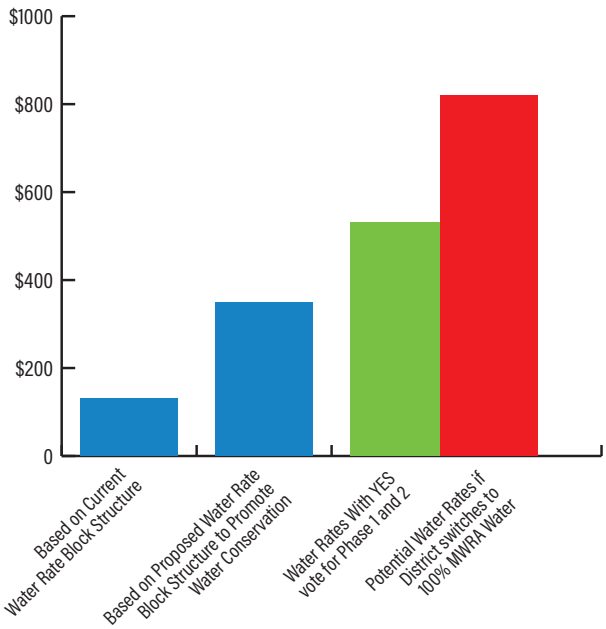
Total project cost is estimated to be 5.5 million dollars. The funding source for this project would be from debt, potentially through low interest state loans, specific to this type of project and modest rate increases to our customers. Rate increases would be based on a new rate structure which increases with higher consumption.

A YES vote on December 10 will address water quality concerns caused by high levels of manganese at the Glen Drive wellfield, and will provide funding to study additional water sources to supplement the District's water quantity during the summer months.

A NO vote on December 10 will mean no improvement to the water quality at the Glen Drive wellfield, and no funding to study additional water sources.

Preliminary Schedule





1 - Does not include District fees included in property tax bill.
2 - Water rates are expected to increase each year based on inflation and other factors.

Two Phase Project to Improve Water Quality and Quantity for the District

	Water Quality (Phase 1)	Water Quantity (Phase 2)
Problem		
Cause	high manganese at existing Glen Drive wellfield	MassDEP mandated water use restriction for the Ipswich River Basin
Solution	Design and construct new greensand filter plant at Glen Drive	Study additional sources of water to supplement the existing water supply during summer months
Approximate Cost	$5.25M	$250K
Approximate Year Each Phase Will Be Complete	2020	2019

Information on Supplemental Sources of Water

As part of Phase 2, the District will research sourcing water from surrounding communities and the potential to drill new wells at the existing wellfields. The Massachusetts Water Resources Authority (MWRA) has been discussed at recent Board Meetings. There are several options associated with tying into the MWRA: supplemental water from MWRA, 100% MWRA, tie directly into MWRA, or obtain MWRA water through the Lynnfield Water District. Each option has challenges. Tying directly into MWRA would involve an extensive amount of infrastructure improvements, possibly up to $20M in infrastructure improvements, and could take over 5 years before the connection is made. A hydraulic analysis of the District, Lynnfield Water District and the MWRA's water system is required to understand the infrastructure improvements associated with each option, the cost and the timeline. Obtaining any amount of water from MWRA involves a lengthy permitting process that may take up to two years. Following approval from State and Government agencies, the District would need to vote to proceed with design and construction for the infrastructure improvements to connect to MWRA.

How do your Water Rates Compare to Other Communities?

	Average Annual Water Bill
LCWD	$330
LWD	$315
Danvers	$640
N. Reading	$850
Wakefield	$700

Assumes 75,000 gallons of water used per year per household for an apples to apples comparison of what people pay for their water usage

Looking towards the future:

The addition of greensand filters at Glen Drive will allow the District to explore new wells at the existing site to secure the quantity of water available to its customers in anticipation of future needs. The Board is always looking for economical water sources within the District, and constantly researching and exploring potential new well sites to meet the needs of their customers.

The District is asking for your support to build a critical component to meet future needs. The addition of greensand filters at Glen Drive will help provide a local, sustainable water source for the needs of today and future generations to come.

Upcoming Meetings

(Held at the Lynnfield Middle School):

Wed. Nov 7, 2018, 6:30PM
(Board Meeting)

Mon. Nov 26, 2018, 6:30PM
(Board Meeting)

Mon. Dec 10, 2018, 7:00PM
(Special District Meeting)

The Board meets regularly every Second and Fourth Monday of the month at the District's office located at 83 Phillips Road, Lynnfield, MA. Agenda and Minutes for each meeting will be posted to the LCWD website.

Get Involved!

Please visit our website: http://www.lcwd.us/ for up-to-date information on upcoming meetings, operation and maintenance activities, current issues and additional information on the proposed new greensand filter plant at Glen Drive and planning efforts to study additional water sources. The District strives to maintain quality drinking water for its customers!

Lynnfield Center Water District
83 Phillips Road
Lynnfield, MA 01940

Appendix G

Glen Drive Facility Plan Scope of Work

TASK ORDER NO. 2 TO
MASTER SERVICES AGREEMENT
BETWEEN
OWNER AND ENGINEER

This is Task Order No. 2 dated June 13, 2018, 2018 attached to and made part of the Master Services Agreement dated June 13, 2018, between CDM Smith, Inc. (ENGINEER) and Lynnfield Center Water District (OWNER).

This Task Order describes the Scope of Services, Time Schedule, Charges, and Payment Conditions for the Task Order known as:

Glen Drive Wells Water Treatment Facilities Planning (the "Project").

1. Scope of Services

ENGINEER shall provide for OWNER the following specific Services:

The following efforts as part of facilities planning for the Glen Drive Wells: Facilities planning will include analysis of pumping rates, water quality, treatment requirements and facility construction costs. It is expected that the Glen Drive wells treatment will include greensand filters, similar to the manganese treatment facilities at the District's Phillips Road source wells location. This treatment will remove iron and manganese at the source, significantly reducing its impact on the distribution system.

The ENGINEER will:
1. Review historical water quality results from the four individual and combined well source water. Manganese levels, along with other water quality parameters including pH, copper and iron will be reviewed.
2. Review historical pumping rates for flow and water level per SCADA informaiton, and recommendations related to correlations identified. Trends or correlations regarding pumping rates, water levels in wells and water quality parameters will be identified. Existing hydraulic conditions, including flow and hydraulic gradeline requirements, will be considered.
3. Prepare conceptual drawings showing layout of treatment facilities options for the existing wells. Treatment options include sizing of greensand filter(s).
4. Prepare civil and mechanical design parameters, including capacity, raw and finished water quality parameters, and redundancy.
5. Design disciplines will be summarized in the memorandum for expected requirements, including electrical load estimates for determination of power availability, and instrumentation components for SCADA communications.
6. A list of anticipated permitting efforts will be included.
7. The existing facilities, including pumps, wet well and overall building structure information will be summarized for age and expected maintenance requirements.
8. Separate efforts associated with potential new well development in the Glen Drive area will be coordinated, so that facilities planning allows for existing equipment, along with planning for future additional wells.
9. A summary of schedule and requirements associated with drinking water state revolving fund (DWSRF) requirements will be included, as a potential funding mechanism for the construction costs.
10. Opinion of probable construction cost will be developed based on the civil and mechanical conceptual layout and

design parameters. Placeholders will be included for electrical and instrumentation construction costs.

Assumptions:
1. No survey is included in this effort.
2. No wetlands flagging and/or applications to the Lynnfield Conservation Commission are included.
3. No permitting efforts or applications are included. Note the facilities planning memorandum will list anticipated permitting efforts.

Deliverables
1. Develop a conceptual figure using GIS or other background showing possible connection location(s), length of water main, and potential pumping facility(ies) and treatment locations.
2. Prepare conceptual design drawings of treatment flow process and potential schematic layout.
3. A draft memorandum will be prepared summarizing the potential optoins, layout and recommendations for next steps will be prepared for the Owner's review. Draft opinions of conceptual cost estimate will be prepared. Following comments, the memorandum will be finalized.
4. Up to three site visits and/or meetings are included related to the components of this subtask.

The OWNER will:
1. Review draft documents and provide comments.
2. Assist with communications and scheduling of site walks, if applicable.

2. Time Schedule

The time periods for the performance of ENGINEER's Services are as follows:

A draft memorandum will be submitted within 3 months of Contract execution, All work of this Amendment is expected to be completed by October 31, 2018.

It is mutually agreed that payments toward the above amount shall be made on a monthly basis and that the amount of each monthly payment shall be based upon and proportionate to the amount of work completed.
The ENGINEER's schedule of Hourly Billing Rates is attached to this Exhibit as Attachment 1.
For the Engineering Services pertaining to this work, the OWNER shall pay the ENGINEER at the hourly billing rate for the category of the individual performing the work, for all time directly chargeable to the project plus actual out-of-pocket expense and subconsultant costs.
Actual out-of-pocket expense costs are all costs other than salary costs that are incurred during the progress of the

work. The actual out-of-pocket expense costs include: air fare, automobile rental if required, mileage charges, parking, tolls, taxi, meals, lodging, telephone, printing and reproduction costs, mailing and shipping costs, and other miscellaneous costs incurred specifically for this project.
OWNER and ENGINEER agree that these budgets are estimates of the anticipated time and cost per task are not intended as individual ceilings for specific tasks. ENGINEER shall be allowed to adjust budget amounts between and within the tasks.
The ENGINEER is not responsible to provide services, the costs of which if filled in accordance with the terms of this Agreement would exceed the above figures, unless authorized by the OWNER in writing and an increase in funds is made available.

4. Terms and Conditions

The terms and conditions of the Agreement referred to above shall apply to this Task Order except to the extent expressly modified herein. In the event of any such modification, the modification shall be set forth below and the Article of the Agreement to be modified shall be specifically referenced. Modifications included in this Task Order are:

None

5. Terms or Provisions in Conflict

If the provisions set forth in the Agreement are in conflict with the provisions set forth in this Task Order, the provisions of this Task Order shall govern.

Acceptance of the terms of this Task Order is acknowledged by the following authorized signatures of the parties to the Agreement:

OWNER

By: Kenneth Burnham
Title: Superintendent/Commissioner

Constance E. Leccese, Commissioner

Richard M. Lamusta, Commissioner

ENGINEER

By: Paul E. Ross, P.E.
Title: Vice President

Appendix B

Lynnfield Center Water District Distribution System Map

TOWN OF LYNNFIELD
Massachuset

LYNNFIELD CENTER WATER DISTRICT

Water System

December 2018

Water Network Features
- Hydrant
- Hydrant Valve
- System Valve
- Water Tank
- Distribution Pipe
- Hydrant Lateral
- Private Pipe
- Water District Boundary

Basemap
- Town Boundary
- Interstate
- U.S. Highway
- Local Road

0 300 600 1,200 1,800
Feet

Sources: Town of Lynnfield, CDM Smith, and MassGIS
Coordinate System: NAD83 Mass. State Plane Mainland FIPS 2001 Feet

CDM Smith

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NORTH READING
PEABODY
READING
WAKEFIELD
WAKEFIELD

Appendix C

Map of Existing Glen Drive Facility and Wellfield

TOWN OF LYNNFIELD
Massachuset

LYNNFIELD CENTER WATER DISTRICT

Glen Drive Wells

December 2018

Approximate Location of:

- Existing Well

Basemap

- Town Boundary
- Interstate
- U.S. Highway
- Local Road
- Building Footprints

Well 2
Well 3
Well 1
Well 4
Glen Drive Pump Station
NORTH HILL DRIVE
WILLIS LANE
GLEN DRIVE
WEST TAPLEY ROAD
MAIN STREET
USGS, MassGIS

N
W E
S

0 100 200 400 600
Feet

Sources: Town of Lynnfield, CDM Smith, and MassGIS
Coordinate System: NAD83 Mass. State Plane Mainland FIPS 2001 Feet

CDM Smith

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Appendix D

MassDEP Manganese Factsheet

MassDEP Fact Sheet

Manganese in Drinking Water: Questions and Answers for Consumers

Introduction

This fact sheet is intended to inform you about manganese in drinking water, typical concentrations, its contribution to overall manganese exposure in humans, especially infants, and provide guidance on health protective limits in drinking water.

What is manganese and where does it come from?

Manganese is a common naturally-occurring mineral found in rocks, soil, groundwater, and surface water. It is a natural component of most foods and is necessary for proper nutrition. It is also present in infant formulas.

How are people exposed to manganese?

Manganese exposures can come from air, food or water. This fact sheet focuses on water. The majority of manganese exposure in the general population comes from the diet. Grains, beans, nuts and teas in particular are rich in manganese. It is an **essential** trace mineral for the body to function, however excess manganese exposure has potential health implications.

In situations where manganese levels in drinking water are elevated, the contribution from drinking water can increase the overall intake of manganese.

In a residential setting, breathing in manganese is an unlikely route of concern for exposure, in contrast to certain occupational settings where workers may be exposed to manganese particles in the air (*e.g.*, steel welding). Manganese is poorly absorbed through the skin, thus, skin contact with food or liquid containing manganese is an unlikely exposure route of concern.

What health effects are associated with exposure to manganese?

Manganese is necessary for normal immune system function, digestion and bone strength. At elevated levels, manganese could produce neurological effects with some variation in sensitivity between individuals.

Infants and children younger than 12 months old are potentially most susceptible to excess manganese exposure because of their developing neurological and gastrointestinal systems. Infants appear to absorb more manganese than older age children and adults, but excrete less.

If infant formulas are prepared with water that also contains manganese at concentrations greater than our guideline levels (see below), the infant may get a higher amount of manganese than necessary. This represents a greater potential for exposure and adverse effects in the very young. Thus, it is very important to know what the levels in drinking water are when using it to make baby formula.

What are the levels of concern?

The United States Environmental Protection Agency (US EPA) and MassDEP currently list manganese as a secondary contaminant because of aesthetic concerns including unacceptable taste, staining of fixtures and dark, cloudy water at levels greater than 0.05 milligrams per liter (mg/L).

MassDEP recommends that infants up to 1 year of age should not be given water with manganese concentrations greater than 0.3 mg/L for more than a total of 10-days in a year, nor should the water be used to make formula for more than a total of 10-days in a year.

The recommended water concentration limit for lifetime exposures to manganese is 0.3 mg/L. People may also want to limit consumption of waters containing greater than 1 mg manganese/L. See the MassDEP Advisory at: http://www.mass.gov/eea/docs/dep/water/drinking/alpha/i-thru-z/mangorsg.pdf . Individual requirements for, as well as adverse effects from manganese can be highly variable. The general population water concentration exposure limits of 0.3 and 1 mg/L have been set based upon typical daily dietary manganese intake levels not known to be associated with adverse health effects. This does not imply that intakes above these levels will necessarily cause health problems. As a precaution, the general population should consider limiting their consumption of drinking water with high levels of manganese to decrease their exposures and to decrease the possibility of adverse neurological effects.

Should I be concerned if I am pregnant or am breastfeeding my child if the manganese levels are above 0.3 mg/L?

No. There is no correlation between manganese levels in water and manganese levels in breast milk and hence, if you are healthy and breastfeeding you should continue to do so. If you are pregnant, have significant health issues and/or are concerned, you should talk to your health care provider and bring a copy of this fact sheet with you.

How does manganese get into my drinking water?

Water that is used as a source of drinking water invariably has some natural manganese in it. In addition, minerals such as manganese can settle out and build up as fine sediment in water pipes as water flows through the distribution system of water mains to your tap. When there is a disturbance in the system, such as a water main break, use of fire hydrants, or a flushing operation to clean the pipes, sediment may get stirred up and drawn into home plumbing. This water may temporarily have higher than normal levels of manganese and may appear visibly discolored.

Can I cook with the water?

You may reduce your potential exposure to manganese by limiting use of this water and substituting bottled water or water from another low manganese source for preparing dried foods (e.g., pasta, rice, hot oatmeal, etc.) that absorb considerable water and for soups made with added water.

Can I brush my teeth with the water?

Yes. You are unlikely to ingest enough manganese to be of concern.

Can I bathe, shower or wash my hands with the water? Can I bathe my infant in this water?

Yes. Manganese is poorly absorbed through the skin.

Can I use it to wash dishes?

Yes.

Can I use ice made with the water?

Occasional use of ice for use in drinks represents only a fraction of water consumed daily and will not greatly increase your manganese intake. If you use ice frequently in drinks and your water has high manganese concentrations, you may choose to use bottled water or water from another low manganese source to make ice or you may just purchase ice.

I have already been using the water for some time for cooking, making ice and drinks. Should I be concerned? Is this something I should go to the doctor about?
See answers to concerns about these uses above. If you have still have concerns or have significant health issues, you should talk to your health care provider. When you meet with them, provide a copy of your manganese sampling results and this fact sheet.

I have used this water to make formula for my baby. Should I be concerned? Is this something I should go to the doctor about?
If you have concerns, you should speak to your health care provider. When you meet with them, provide a copy of your manganese sampling results and this fact sheet.

Can I give the water to my pets?
No information is available on the effect of elevated manganese in drinking water on pets.

How can I find out about manganese in my water?
If you get your water from a public water system you should contact them for this information. For a contact list for all public water systems in the Commonwealth you may visit:
http://www.mass.gov/eea/agencies/massdep/water/drinking/health-and-safety.html#4 then under "Contacts" click on "MA Public Water Supplier Contacts Sorted By Towns".

For private well owners, MassDEP recommends that a baseline sample be taken to determine the manganese concentration in their well water. Thereafter, the well owner should follow the: "Private Wells - Testing Parameters and Frequency Guidelines", which can be found on the MassDEP website http://www.mass.gov/eea/agencies/massdep/water/drinking/private-wells.html. First click on "Water Quality and Testing", and then scroll down to "Private Wells –Testing Parameters and Frequency Guidelines".

What options are available when manganese in drinking water is elevated?

- You may use:
  - ✓ Bottled water. Bottled water sold in Massachusetts must meet all federal drinking water quality standards and if originating in Massachusetts must also meet state drinking water quality requirements. For manganese, the recognized standard is 0.05 mg manganese/L.
  - ✓ Water from another MassDEP approved public water system that does not have elevated levels of manganese.
  - ✓ A water pitcher filter or a home water filter unit that is capable of removing dissolved metals (using a water softener employing cation exchange technology or reverse osmosis; activated carbon units alone have poor manganese removal capabilities). For more information on these types of filter units please visit National Sanitation Foundation (NSF) at NSF Consumer Information (http://info.nsf.org/Certified/DWTU/) or call 1-800-673-8010 or visit MassDEP's website (http://www.mass.gov/eea/agencies/massdep/water/drinking/health-and-safety.html#3) for Consumer Information on home water treatment .
- Do not:
  - ⊘ boil the water as boiling will not destroy manganese. If boiled too long, the manganese will be concentrated in the water.
  - ⊘ freeze or try to filter the water through paper filters to remove manganese as neither will reduce its concentrations.
  - ⊘ try to reduce manganese concentrations by letting the water stand overnight since it is not volatile but stays in the water

Please note: Only a Massachusetts state certified laboratory or another party who complies with Massachusetts General Law Chapter 111, Section 160D should test your water for manganese.
http://www.mass.gov/eea/agencies/massdep/water/drinking/certified-laboratories.html
http://www.mass.gov/eea/docs/dep/water/drinking/alpha/i-thru-z/reqdiscl.doc

Where can I get more information on manganese?
For more information on manganese in public drinking water please visit the MassDEP webpage at http://www.mass.gov/eea/agencies/massdep/water/drinking/manganese-in-drinking-water.html. You may also contact the MassDEP Drinking Water Program at program.director-dwp@state.ma.us.

For questions related to manganese exposure and health you may contact MassDEP's Office of Research and Standards (C.Mark.Smith@state.ma.us). You may also contact your Local Board of Health and/or your healthcare provider.

Appendix E

Distribution System Secondary Contaminant Sampling Results

Site Type	Address	Sample Date	Aluminum, MG/L	Calcium, MG/L	Copper, MG/L	Iron, MG/L	Magnesium, M	Manganese, MG/L	Potassium	Silver, MG/L	Sodium, MG	Zinc, MG/L	Alkalinity, MG/L	Chloride,	Color A	Hardness, Total, MG/L	Odor, TO	pH, pH at	Sulfate, MG/L	Total Dissolved Solids, MG/L	Turbidity	Nitrate as N, MG/L	Arsenic, mg/l	Lead, mg/l	Iron, Dissolved	Manganese, Dissolved, MG/L
Source	Station #1 Phillips Road, RS 10271	7/15/2014	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #2 Main Street, RS 10272	7/15/2014	-	-	-	-	-	0.059	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	7/15/2014	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	7/15/2014	-	-	-	-	-	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #1 Phillips Road, RS 10271	10/6/2014	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	8.3	-	-		
Source	Station #3 WTP, RS ST3	10/6/2014	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #2 Main Street, RS 10272	10/14/2014	-	-	-	-	-	0.025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	10/14/2014	-	-	-	-	-	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #1 Phillips Road, RS 10271	1/12/2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	-	-		
Source	Station #2 Main Street, RS 10272	1/12/2015	-	-	-	-	-	0.049	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	1/12/2015	-	-	-	-	-	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	1/21/2015	-	-	-	-	-	0.085	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #1 Phillips Road, RS 10271	4/27/2015	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #2 Main Street	4/27/2015	-	-	-	-	-	0.023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	4/27/2015	-	-	-	-	-	0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	4/27/2015	-	-	-	-	-	0.078	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #2 Main Street, RS 10272	7/13/2015	-	-	-	-	-	0.018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	7/13/2015	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	7/13/2015	-	-	-	-	-	0.094	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #1 Phillips Road, RS 10271	10/5/2015	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	6.4	-	-		
Source	Station #2 Main Street, RS 10272	10/5/2015	-	-	-	-	-	0.067	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	10/5/2015	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	10/5/2015	-	-	-	-	-	0.088	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #2 Main Street, RS 10272	1/11/2016	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	1/11/2016	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	1/11/2016	-	-	-	-	-	0.097	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #2 Main Street, RS 10272	4/25/2016	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	4/25/2016	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	4/25/2016	-	-	-	-	-	0.096	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #1 Phillips Road, RS 10271	7/6/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.2	-	-		
Source	Station #2 Main Street, RS 10272	7/6/2016	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	7/6/2016	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	7/6/2016	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #1 Phillips Road, RS 10271	10/11/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-		
Source	Station #2 Main Street, RS 10272	10/11/2016	-	-	-	-	-	0.011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	10/11/2016	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	10/11/2016	-	-	-	-	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #2 Main Street, RS 10272	7/17/2017	-	-	-	-	-	0.011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #3 WTP, RS ST3	7/17/2017	-	-	-	-	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	7/17/2017	-	-	-	-	-	0.087	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #4 Glen Drive, RS 10275	1/22/2018	ND	48.4	ND	0.017	13.3	0.111	8.7	ND	27.2	ND	88	87.7	ND	176	ND	7.2	34.3	292	0.15	-	-	-		
Distribution Sampling Point	Town Hall, RS5	1/22/2018	ND	23.2	0.185	ND	20.8	ND	8.4	ND	15.6	ND	98	40.5	ND	144	1	7.4	19.8	204	ND	-	-	-		
Source	Station #2 Main Street	3/27/2018	0.008	32.3	0.013	0.02	15.5	0.019	10.4	0.002	105	0.015	67	209	2	145	0	6.4	16.6	434	ND	-	-	-		
Source	Station #2 Main Street, RS 10272	3/27/2018	0.008	32.3	0.013	0.02	15.5	0.019	10.4	0.002	105	0.015	67	209	2	145	0	5.4	16.6	434	ND	-	-	-		
Source	Station #2 Main Street, RS 10272	4/2/2018	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station #2 Main Street, RS 10272	4/2/2018	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Residence	1 Murphy Way	4/21/2018	-	-	1.44	1.23	-	3.96	-	-	-	0.03	-	-	-	-	-	-	-	-	-	-	0.006	0.007		
Source	Station 4 Well #1	5/1/2018	-	-	-	0.213	-	0.213	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station 4 Well #2	5/1/2018	-	-	-	0.162	-	0.105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Source	Station 4 Well #3	5/1/2018	-	-	-	0.195	-	0.069	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
School/Daycare	Center Congregational Daycare	5/15/2018	-	-	-	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
School/Daycare	Center Congregational Daycare	5/15/2018	-	-	-	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
School/Daycare	Huckleberry School	5/15/2018	-	-	-	0.009	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
School/Daycare	Huckleberry School	5/15/2018	-	-	-	0.009	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
School/Daycare	Lynnfield High School	5/15/2018	-	-	-	0.005	-	0.005														-	-	-		
School/Daycare	Lynnfield High School	5/15/2018	-	-	-	0.005	-	0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
School/Daycare	Middle School	5/15/2018	-	-	-	ND	-	ND														-	-	-		
School/Daycare	Middle School	5/15/2018	-	-	-	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
School/Daycare	St. Paul's Daycare	5/15/2018	-	-	-	ND	-	ND														-	-	-		
School/Daycare	St. Paul's Daycare	5/15/2018	-	-	-	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
School/Daycare	Summer Street School	5/15/2018	-	-	-	0.008	-	0.007														-	-	-		
School/Daycare	Summer Street School	5/15/2018	-	-	-	0.008	-	0.007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Residence	785 Lowell Street	5/18/2018	ND	42.3	0.065	0.021	13.3	0.026	12	ND	-	0.042	95	86.4	5	185	0	7	35.7	346	0.2	-	-	-		
Residence	785 Lowell Street	5/18/2018	ND	52.3	0.065	0.021	13.3	0.026	12	ND	-	0.042	95	86.4	5	185	0	7	35.7	346	0.2	-	-	-		
Residence	815 Lowell Street	5/18/2018	ND	50.5	0.042	0.025	12.9	0.027	11.5	ND	-	0.026	93	86.5	5	179	2	7.1	35.8	330	0.3	-	-	-		
Residence	815 Lowell Street	5/18/2018	ND	50.5	0.042	0.025	12.9	0.027	11.5	ND	-	0.026	93	86.5	5	179	2	7.1	35.8	330	0.3	-	-	-		
Distribution Sampling Point	Lutheran Church	5/21/2018	-	-	-	0.017	-	0.044	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Distribution Sampling Point	Lutheran Church	5/21/2018	-	-	-	0.017	-	0.044														-	-	-		
Residence	794 Lowell Street	5/21/2018	ND	50.6	0.027	0.02	12.9	0.03	11.6	ND	-	0.026	95	87.3	ND	180	3	7	35.7	316	0.15	-	-	-		
Residence	794 Lowell Street	5/21/2018	ND	50.6	0.027	0.02	12.9	0.03	11.6	ND	-	0.026	95	87.3	ND	180	3	7	35.7	316	0.15	-	-	-		
Source	Station 4 Well #4	5/23/2018	-	-	-	0.188	-	0.062														-	-	-		
Residence	794 Lowell Street	6/19/2018	0.007	50.6	0.261	0.043	13.2	0.13	12.4	ND	-	0.008	98	85.6	8	181	0	7.2	34.7	-	4.2	-	-	-		
Residence	794 Lowell Street	6/19/2018	0.39	51.3	0.037	0.032	13.6	0.078	12.9	ND	-	0.006	96	85.8	2	184	0	7.5	34.5	-	0.6	-	-	-		
Residence	794 Lowell Street	6/19/2018	ND	50.6	0.021	0.013	13.4	0.012	12.6	ND	-	0.032	98	85.6	ND	182	1	7.2	34.7	-	ND	-	-	-		
Distribution Sampling Point	Elks Club	7/2/2018	-	-	-	0.004	-	ND														-	-	-		
Distribution Sampling Point	Fire Station	7/2/2018	-	-	-	0.009	-	ND														-	-	-		
Distribution Sampling Point	Lutheran Church	7/2/2018	-	-	-	0.021	-	0.052														-	-	-		
Residence	815 Lowell Street	7/2/2018	ND	50.2	0.033	0.022	13.2	0.07	11.8	ND	-	ND	94	83.6	12	180	1	7.1	33.3	314	0.65	-	-	-		
School/Daycare	High School	7/2/2018	-	-	-	0.008	-	ND														-	-	-		
School/Daycare	Huckleberry Hill School	7/2/2018	-	-	-	0.011	-	ND														-	-	-		
Distribution Sampling Point	Lutheran Church	7/20/2018	-	-	-	0.025	-	0.068	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	0.015
Source	Station #4 Glen Drive	7/20/2018	-	-	-	0.031	-	0.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	0.111
Residence	815 Lowell Street	7/20/2018	-	-	-	0.009	-	0.021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ND	ND
Distribution Sampling Point	Elks Club	7/23/2018	-	-	-	0.004	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Fire Station	7/23/2018	-	-	-	0.012	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	High School	7/23/2018	-	-	-	0.006	-	0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Huckleberry Hill School	7/23/2018	-	-	-	0.028	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Residence	815 Lowell Street	7/23/2018	-	-	-	0.005	-	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source	Station #4	7/23/2018	-	-	-	0.037	-	0.124	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source	Station #4 Glen Drive	7/23/2018	-	-	-	-	-	0.133	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source	Station #4 Glen Drive - Filtered	7/23/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.063

Site Type	Address	Sample Date	Aluminum, MG/L	Calcium, MG/L	Copper, MG/L	Iron, MG/L	Magnesium, M	Manganese, MG/L	Potassium	Silver, MG/L	Sodium, MG/	Zinc, MG/L	Alkalinity, MG/L	Chloride,	Color A	Hardness, Total, MG/L	Odor, TO	pH, pH at	Sulfate, MG/L	Total Dissolved Solids, MG/L	Turbidity	Nitrate as N, MG/L	Arsenic, mg/l	Lead, mg/l	Iron, Dissolved	Manganese, Dissolved, MG/L
Residence	785 Lowell Street	7/23/2018	-	-	-	ND	-	0.007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Residence	785 Lowell Street	7/23/2018	-	-	-	0.008	-	0.022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source	Station #4	7/31/2018	-	-	-	0.054	-	0.154	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Elks Club	7/31/2018	-	-	-	0.004	-	0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Fire Station	7/31/2018	-	-	-	0.025	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	High School	7/31/2018	-	-	-	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Huckleberry Hill School	7/31/2018	-	-	-	0.006	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Lutheran Church	7/31/2018	-	-	-	0.02	-	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	815 Lowell Street	7/31/2018	-	-	-	0.007	-	0.028	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Elks Club	8/7/2018	-	-	-	0.005	-	0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Fire Station	8/7/2018	-	-	-	0.013	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	High School	8/7/2018	-	-	-	0.008	-	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Huckleberry Hill School	8/7/2018	-	-	-	0.032	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Lutheran Church	8/7/2018	-	-	-	0.012	-	0.048	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	815 Lowell Street	8/7/2018	-	-	-	0.01	-	0.028	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source	Station #4	8/7/2018	-	-	-	0.068	-	0.131	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Elks Club	8/15/2018	-	-	-	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Fire Station	8/15/2018	-	-	-	0.017	-	0.007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	High School	8/15/2018	-	-	-	0.009	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Huckleberry Hill School	8/15/2018	-	-	-	0.023	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Lutheran Church	8/15/2018	-	-	-	0.02	-	0.058	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	815 Lowell Street	8/15/2018	-	-	-	0.012	-	0.021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source	Station #4 Glen Drive	8/15/2018	-	-	-	0.026	-	0.013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Elks Club	9/4/2018	-	-	-	0.031	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Fire Station	9/4/2018	-	-	-	0.03	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	High School	9/4/2018	-	-	-	0.009	-	0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Huckleberry Hill School	9/4/2018	-	-	-	0.015	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Lutheran Church	9/4/2018	-	-	-	0.026	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	815 Lowell Street	9/4/2018	-	-	-	0.018	-	0.031	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source	Station #4	9/4/2018	-	-	-	0.077	-	0.156	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Elks Club	9/18/2018	-	-	-	0.027	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Fire Station	9/18/2018	-	-	-	0.03	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	High School	9/18/2018	-	-	-	0.01	-	0.012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Huckleberry Hill School	9/18/2018	-	-	-	0.011	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Lutheran Church	9/18/2018	-	-	-	0.016	-	0.043	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source	Station #4 Glen Drive	9/18/2018	-	-	-	0.064	-	0.122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	815 Lowell Street	9/18/2018	-	-	-	0.01	-	0.019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Elks Club	10/1/2018	-	-	-	0.01	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Fire Station	10/1/2018	-	-	-	0.034	-	0.009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	High School	10/1/2018	-	-	-	0.013	-	0.009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Huckleberry Hill School	10/1/2018	-	-	-	0.009	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	Lutheran Church	10/1/2018	-	-	-	0.026	-	0.046	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution Sampling Point	815 Lowell Street	10/1/2018	-	-	-	0.03	-	0.028	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source	Station #4	10/1/2018	-	-	-	0.036	-	0.126	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix F

Safety Data Sheets

SAFETY DATA SHEET

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Potassium Hydroxide, Liquid 45-50%

Product Name: Caustic Potash, Liquid

Identified Uses: Chemical manufacturing, fertilizer, batteries, soaps

Company Information:
ASHTA Chemicals Inc.
P.O. Box 858
Ashtabula Ohio 44005
Phone: (440) 997-5221
Fax: (440) 998-0286
24-hour Emergency Phone: CHEMTREC: (800) 424-9300

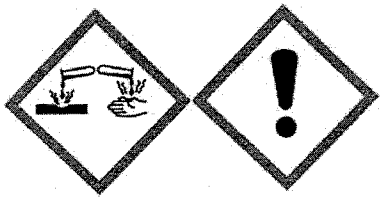
SECTION 2: HAZARDS IDENTIFICATION

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

GHS label elements, including precautionary statements:

Signal Word: **Danger**

Pictogram(s):



Hazard Statements	
H290	May be corrosive to metals.
H302	Harmful if swallowed.
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage.
H402	Harmful to aquatic life.

Precautionary Statements	
P234	Keep only in original container.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/eye protection/face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you

	feel unwell. Rinse mouth.
P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361+ P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse SKIN with water/ shower.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P304 + P340 + P310	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P363	Wash contaminated clothing before reuse.
P390	Absorb spillage to prevent material damage.
P405	Store locked up.
P406	Store in corrosive resistant stainless steel container with a resistant inner liner.
P501	Dispose of contents/container in accordance with local/state/national regulations.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms:

CHEMICAL NAME:	Potassium Hydroxide Solution
TRADE NAME:	Potash Liquor
SYNONYMS:	Caustic Potash Liquid, Potassium Hydrate, Lye, KOH
CONCENTRATION:	45-50%
C.A.S:	1310-58-3
WHMIS:	D1B, E
CHEMICAL FORMULA:	KOH (in aqueous solution)
CHEMICAL FAMILY:	Alkali

SECTION 4 FIRST AID MEASURES

Description of first aid measures:
Move out of dangerous area. Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If breathing is difficult, give humidified air. Give oxygen but only by a certified physician. If breathing stops, provide artificial respiration. Get medical attention immediately.

In case of skin contact
Immediately take off all contaminated clothing. Wash off IMMEDIATELY with plenty of water for at least 15-20 minutes. Get medical attention. Wash clothing separately before reuse.
Destroy or thoroughly clean contaminated shoes.

In case of eye contact
Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a physician or poison control center immediately.

If ingested
Never give anything by mouth to an unconscious person. Rinse mouth with water. Give plenty of water to drink. Consult a physician.

SECTION 5 FIRE FIGHTING MEASURES

Flash Point:	None.
Extinguishing Media:	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Auto Ignition Temp:	Non-combustible.
Special Fire Fighting Procedures:	Wear self-contained breathing apparatus and full protective clothing. In case of fire and/or explosion do not breathe fumes. Move containers from fire area if you can do so without risk. Use water spray to cool unopened containers.
Unusual Fire/Explosion Hazards:	Not combustible, however the product can react with metals such as aluminum, tin, zinc to form flammable and explosive hydrogen gas.
Fire-Fighting Measures:	Potassium hydroxide does not burn or support combustion. Use extinguishing agents compatible with potassium hydroxide and appropriate for the surrounding fire. If water is used, care should be taken, since it can generate heat and cause spattering if applied directly to potassium hydroxide.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Environmental Precautions:
Do not discharge into drains, water courses or onto the ground.

Containment and Cleaning:
Cleanup personnel must wear proper protective equipment. Completely contain spilled material with dikes, sandbags, etc., and prevent run-off into ground or surface waters or sewers. Recover as much material as possible into containers for disposal. Remaining material may be neutralized with dilute hydrochloric or acetic acid. Neutralization products, both liquid and solid, must be recovered for disposal.

Waste Control Procedures:
All disposals of this material must be done in accordance with federal, state and local regulations. Waste characterization and compliance with disposal regulations are the responsibilities of the waste generator.

SECTION 7: HANDLING AND STORAGE

Precautions to be taken for handling and storage:
Storage tanks should be contained in a diked area that has sufficient capacity to hold the contents of the tank. This area should be free of potential contact with acids, organics, and reactive metals. Keep container tightly closed. Store in a cool, dry, well-ventilated place. Store in corrosive resistant container with a resistant inner liner. Store away from incompatible materials. Store at temperatures not exceeding 40°C/104°F. Compatible storage materials may include, but not be limited to, the following: nickel and nickel alloys, steel, plastics, plastic or rubber-lined steel, FRP, or Derakane vinyl ester resin. Do not allow material to freeze.

Precautions for repair:
Equipment: Only personnel trained and qualified in handling this product should prepare equipment for maintenance. Wash thoroughly with water.

Other Precautions: Spillage can be slippery.

SECTION 8: EXPOSURE CONTROL/PERSONAL PROTECTION

Principal Component: Potassium hydroxide, water
Occupational Exposure Limits:
Regulatory Limits:

ACGIH TLV	=	2 mg/m^3 (ceiling)
OSHA PEL	=	none
15 Minute STEL	=	none
NIOSH IDLH	=	none

Exposure Controls:

Eye Protection:	Chemical splash goggles and face shield.
Respiratory Protection:	None is normally required, however, if misting or heavy vapor formation should occur, a NIOSH approved mist respirator should be worn.
Other Protection:	Rubber boots. Rubbers over leather shoes are not recommended. Rubber apron, rainwear or disposal tyvek suit with hard hat should be worn.
Ventilation Recommended:	Provide adequate ventilation to meet TLV requirements.
Glove Type Recommended:	Rubber, nitrile, neoprene, PVL.
Additional Information:	Safety eyewash/shower stations must be available in the work area.

Appropriate Engineering Controls:
Good general ventilation should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties:

Appearance	Colorless, viscous liquid.
Odor	No odor
Odor Threshold	Not available
pH	>14
Boiling point	45% KOH Solution: 132.2°C (270°F) 50% KOH Solution: 143.3°C (290°F)
Flash point	No data available
Evaporation rate	Slightly less than water

Flammability	Not flammable
Upper/lower flammability or explosive limits	Not flammable
Explosive properties	Not flammable
Autoignition Temperature	No data available
Water solubility	100%
Physical State	Liquid at room temperature
Decomposition Temperature	No data available
Molecular Weight	56.1
Freeze/Solidification	45% KOH Solution: -28.8°C (-20°F) 50% KOH Solution: 8.9°C (48°F)
Specific Gravity (water = 1)	45% KOH Solution: 1.457 at 15.6°C (60°F) 50% KOH Solution: 1.516 at 15.6°C (60°F)
Density Liquid (pounds per gallon)	45% KOH Solution:12.2 lbs/gal 50% KOH Solution:12.5 lbs/gal
Vapor Density	No data available
Vapor Pressure	45% KOH Solution: 39mm Hg at 140°F (60°C) 50% KOH Solution: 27 mm Hg at 140°F (60°C)
Partition Coefficient: n-octanol/water	No data available

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable under normal conditions.

Conditions to avoid: Exposure to air can form potassium carbonate.

Incompatibility: Organic chemicals, nitrocarbons, halocarbons and metals or alloys mentioned above. Oxidizing agents. Acids. Phosphorus. Aluminum. Zinc. Tin. Initiates or catalyzes violent polymerization of acetaldehyde, acrolein or acrylonitrile.

Hazardous decomposition products: Flammable hydrogen gas may be generated when KOH and certain metals react.

Polymerization: Hazardous polymerization WILL NOT occur.

Additional Information: Trichlorethylene will react to form dichloracetylene, which is spontaneously flammable.

SECTION 11: TOXICOGICAL INFORMATION

Information on likely routes of exposure:

Skin Contact: Major potential hazard - contact with the skin can cause severe burns with deep ulcerations. Contact with solution or mist can cause multiple burns with temporary loss of hair at burn site. Solutions may not cause immediate pain or irritation upon skin contact. Prolonged or repeated contact with dilute solutions may cause drying and cracking of skin and possible skin damage.

Skin Absorption: It can penetrate to deeper layers of skin and corrosion will continue until removed. The severity of injury depends on the concentration and the duration of exposure.

Eye Contact: Major potential hazard – Liquid in the eye can cause severe destruction and blindness. These effects can occur rapidly affecting all parts of the eye. Mist or dust can cause irritation with high concentrations causing destructive burns.

Inhalation: By analogy with sodium hydroxide, inhalation of solution mist is expected to cause mild irritation at 2 mg/m^3. More severe burns and tissue damage in the upper respiratory tract can occur at higher concentrations. Pneumonitis can result from severe exposures.

Ingestion: Ingestion of potassium hydroxide can cause severe burning and pain in lips, mouth, tongue, throat and stomach. Severe scarring of the throat can occur after swallowing. Death can result from ingestion.

Information on toxicological effects:

Irritancy:	A study with a 10% solution showed severe tissue damage when applied to skin for 4 hours.
Sensitization:	Not available
Carcinogenicity:	One study was identified relative to potassium hydroxide and carcinogenicity. Mice painted with a 3 to 6% aqueous potassium hydroxide solution for 46 weeks developed skin tumors. This study was conducted in 1925 and the adequacy of the test and its design are unknown. No conclusions can be drawn from this study Potassium hydroxide is not listed on the IARC, OSHA or NTP carcinogen lists.
Teratogenicity & Mutagenicity:	Not available
Reproductive Toxicology :	Not available
Toxicological Synergism :	Not available

Product Species Test Results:

LD_{50}: there are several different numbers published:
- 205 mg/kg (rat oral) (1975)
- 365 mg/kg (rat oral) (1975)
- 273 mg/kg (male rat oral) (1987)
- 273 mg/kg (rat oral) (1996)

LC_{50}: Fresh water mosquito fish: 80.0 mg/L (24 Hours, static)

SECTION 12: ECOLOGICAL INFORMATION

Ecological Information:

Persistence and degradability:	No data is available on the degradability of this product.
Bioaccumulative potential:	No data available for this product.
Mobility in soil:	Not available.
Other adverse effects:	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.
Aquatic Toxicity:	May cause shifts in water pH outside the range of pH 5 - 10. This change may be toxic to aquatic organisms.

Biodegradability:
Not biodegradable (Biodegradability term pertains to an organic material capable of decomposition as a result of attack by microorganisms). However, potassium hydroxide will be neutralized by acidity present in natural environment.

SECTION 13: DISPOSAL CONSIDERATIONS

Collect and reclaim or dispose in sealed containers at licensed waste disposal site if possible. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose of contents/container in accordance with local/regional/national/international regulations. Empty containers or liners may retain some product residues.

SECTION 14: TRANSPORT INFORMATION

Shipping:

Usual Shipping Containers:	Tank car, Tank truck, ABS Drums.
Usual Shelf Life:	Sealed containers, unlimited.
Storage/Transport Temperatures:	Ambient.

Suitable Storage:

Materials/Coatings:	Steel, plastic, polyethylene (when dry).
Unsuitable:	Aluminum or galvanized containers.

D.O.T. Information:
UN number: 1814
Class: 8
Packing group: II
Proper shipping name: Potassium hydroxide, solution
Reportable Quantity (RQ): 1000 lbs (100% basis)
Marine pollutant: No
Poison Inhalation Hazard: No

SECTION 15 REGULATORY INFORMATION

SARA 302 Components
SARA 302: Not listed.

SARA 313 Components
SARA 313: Not regulated.

SARA 311/312 Hazards
EPCRA reporting quantities: TQ:10,000 pounds (100% KOH basis).

Massachusetts Right To Know Components
Potassium Hydroxide CAS#: 1310-58-3
Pennsylvania Right To Know Components

Water	CAS#: 7732-18-5
Potassium Hydroxide	CAS#: 1310-58-3

New Jersey Right To Know Components

Water	CAS#: 7732-18-5
Potassium Hydroxide	CAS#: 1310-58-3

California Prop. 65 Components
This product does not contain any chemicals known to state of California to cause cancer, birth defects, or any other reproductive harm.

OSHA PSM TPQ: Not listed

Toxic Substances Control Act (TSCA):
CAS# 1310-58-3 is listed on the TSCA inventory.

Comprehensive Environmental Response Compensation Liability Act: (CERCLA)
CAS# 1310-58-3 is listed on the CERCLA list.

SECTION 16 OTHER INFORMATION

NFPA Rating:
Health Hazard: 3
Fire Hazard: 0
Reactivity Hazard: 0

HMIS Rating:
Health hazard: 3
Chronic Health Hazard:
Flammability: 0
Physical Hazard 0

This information is drawn from recognized sources believed to be reliable. ASHTA Chemicals, Inc. Makes no guarantees or assumes any liability in connection with this information. The user should be aware of changing technology, research, regulations, and analytical procedures that may require changes herein. The above data is supplied upon the condition that persons will evaluate this information and then determine its suitability for their use. Only U.S.A regulations apply to the above.

Version 1.0	For the new GHS SDS Standard	Revision Date: 12/15/2014
Version 1.1	Hazard and precautionary statements	Revision Date: 2/4/2015
Version 1.2	Updated graphics	Revision Date: 3/9/2015
Version 1.3	UN#, ICC GHS Edits	Revision Date: 5/20/2015
Version 1.4	Edits in Section 9	Revision Date: 5/21/2015
Version 1.5	Edits to Section 5	Revision Date: 6/2/2015
Version 1.6	Additions to Section 9	Revision Date: 6/25/2015
Version 1.7	Change to Section 1	Revision Date: 4/15/2016
Version 1.8	Changed P501 text (Section 2)	Revision Date: 6/15/16

Univar USA Inc Safety Data Sheet

For Additional Information contact SDS Coordinator during business hours, Pacific time: (425) 889-3400

Notice

Univar USA Inc. ("Univar") expressly disclaims all express or implied warranties of merchantability and fitness for a particular purpose, with respect to the product or information provided herein, and shall under no circumstances be liable for incidental or consequential damages.

Do not use ingredient information and/or ingredient percentages in this SDS as a product specification. For product specification information refer to a product specification sheet and/or a certificate of analysis. These can be obtained from your local Univar sales office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Univar makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Univar's control and therefore users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product, or from the publication or use of, or reliance upon, information contained herein.

This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process

Univar
3075 Highland Pkwy STE 200
Downers Grove, IL 60515
425-889-3400

SAFETY DATA SHEET

1. Identification

Product identifier: SODIUM HYPOCHLORITE 10-16%

Other means of identification

Synonyms:	Liquichlor, Bleach
CAS NUMBERS:	7681-52-9
SDS number:	000100001054

Recommended use and restriction on use

Recommended use: Reserved for industrial and professional use.

Restrictions on use: Not known.

Manufacturer/Importer/Supplier/Distributor Information

Univar

3075 Highland Pkwy STE 200

Downers Grove, IL 60515

425-889-3400

Emergency telephone number:For emergency assistance Involving chemicals

call CHEMTREC day or night at: 1-800-424-9300. CHEMTREC INTERNATIONAL Tel# 703-527-3887

2. Hazard(s) identification

Hazard Classification

Physical Hazards	
Corrosive to metals	Category 1
Health Hazards	
Acute toxicity (Oral)	Category 5
Skin Corrosion/Irritation	Category 1
Serious Eye Damage/Eye Irritation	Category 1
Environmental Hazards Acute hazards to the aquatic environment	Category 1
Chronic hazards to the aquatic environment	Category 1

Version: 1.6
Revision Date: 05/31/2018

UNIVAR®

Label Elements

Hazard Symbol

Signal Word	Danger
Hazard Statement	May be corrosive to metals. Causes severe skin burns and eye damage. Causes serious eye damage. May be harmful if swallowed. Very toxic to aquatic life with long lasting effects. Very toxic to aquatic life.
Precautionary Statements	
Prevention	Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Do not breathe dust or mists. Wear protective gloves/protective clothing/eye protection/face protection.
Response	IF INHALED: Remove person to fresh air and keep comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Immediately call a POISON CENTER/doctor. Wash contaminated clothing before reuse.

Version: 1.6
Revision Date: 05/31/2018

Storage	Store locked up.
Disposal	Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.
Other hazards which do not result in GHS classification	None.

3. Composition/information on ingredients

Substances

Chemical Identity	Common name and synonyms	CAS number	Content in percent (%)*
Sodium hypochlorite		7681-52-9	10 - 16%
Sodium hydroxide		1310-73-2	0.3 - 5%
Water		7732-18-5	80 - 89.7%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

General information:	Get medical advice/attention.
Ingestion:	Do NOT induce vomiting. Never give liquid to an unconscious person. Get medical attention immediately.
Inhalation:	Call a physician or poison control center immediately. If breathing stops, provide artificial respiration. Move to fresh air. If breathing is difficult, give oxygen.
Skin Contact:	Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Eye contact:	If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor.

Most important symptoms/effects, acute and delayed

Symptoms: No data available.

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Indication of immediate medical attention and special treatment needed

Treatment: Symptoms may be delayed.

5. Fire-fighting measures

General Fire Hazards: No unusual fire or explosion hazards noted.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media: Use: Foam. Carbon dioxide or dry powder.

Unsuitable extinguishing media: No data available.

Specific hazards arising from the chemical: During fire, gases hazardous to health may be formed.

Special protective equipment and precautions for firefighters

Special fire fighting procedures: No data available.

Special protective equipment for fire-fighters: Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Keep unauthorized personnel away.

Methods and material for containment and cleaning up: Absorb spillage with non-combustible, absorbent material.

Notification Procedures: Dike for later disposal. Prevent entry into waterways, sewer, basements or confined areas. Stop the flow of material, if this is without risk.

Environmental Precautions: Do not contaminate water sources or sewer. Avoid release to the environment.

7. Handling and storage

Precautions for safe handling: Do not taste or swallow. Wash hands thoroughly after handling. Do not get in eyes. Do not get in eyes, on skin, on clothing.

Conditions for safe storage, including any incompatibilities: Store locked up.

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8. Exposure controls/personal protection

Control Parameters

Occupational Exposure Limits

Chemical Identity	Type	Exposure Limit Values	Source
Sodium hydroxide	Ceiling	2 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
Sodium hydroxide - Particulate.	ST ESL	20 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (02 2013)
	AN ESL	2 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (02 2013)
Sodium hydroxide	Ceiling	2 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (02 2012)
	Ceiling	2 mg/m3	US. ACGIH Threshold Limit Values (03 2016)
	Ceil_Time	2 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	PEL	2 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (03 2016)
	Ceiling	2 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)

Appropriate Engineering Controls Adequate ventilation should be provided so that exposure limits are not exceeded.

Individual protection measures, such as personal protective equipment

General information: Provide easy access to water supply and eye wash facilities. Use personal protective equipment as required. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing to remove contaminants. Discard contaminated footwear that cannot be cleaned.

Eye/face protection: Wear a full-face respirator, if needed. Wear safety glasses with side shields (or goggles) and a face shield.

Skin Protection

Hand Protection: Chemical resistant gloves

Other: Chemical resistant clothing

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Respiratory Protection:	In case of inadequate ventilation use suitable respirator.
Hygiene measures:	Do not eat, drink or smoke when using the product. Wash hands after handling. Do not get in eyes. Observe good industrial hygiene practices. Wash contaminated clothing before reuse. Do not get this material in contact with skin. Wash hands before breaks and immediately after handling the product.

9. Physical and chemical properties

Physical state:	liquid
Form:	liquid
Color:	Pale yellow-green, Clear
Odor:	Odor of chlorine
Odor threshold:	No data available.
pH:	10 - 12
Melting point/freezing point:	-20 °C
Initial boiling point and boiling range:	> 40 °C
Flash Point:	No data available.
Evaporation rate:	No data available.
Flammability (solid, gas):	No data available.
Upper/lower limit on flammability or explosive limits	
Flammability limit - upper (%):	No data available.
Flammability limit - lower (%):	No data available.
Explosive limit - upper (%):	No data available.
Explosive limit - lower (%):	No data available.
Vapor pressure:	No data available.
Vapor density:	No data available.
Relative density:	1.224
Solubility(ies)	
Solubility in water:	Soluble
Solubility (other):	No data available.
Partition coefficient (n-octanol/water):	No data available.
Auto-ignition temperature:	No data available.
Decomposition temperature:	No data available.

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Viscosity:	No data available.

10. Stability and reactivity

Reactivity:	No data available.
Chemical Stability:	Material is stable under normal conditions.
Possibility of hazardous reactions:	Stable
Conditions to avoid:	Avoid heat or contamination.
Incompatible Materials:	Oxidizers, acids Ammonia. Amines.
Hazardous Decomposition Products:	By heating and fire, toxic vapors/gases may be formed.

11. Toxicological information

Symptoms related to the physical, chemical and toxicological characteristics

Ingestion:	No data available.
Inhalation:	No data available.
Skin Contact:	No data available.
Eye contact:	No data available.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral	
Product:	LD 50 (Rat): 3 - 5 g/kg
Dermal	
Product:	LD 50 (Rabbit): > 2 g/kg
Inhalation	
Product:	May be harmful if inhaled.
Repeated dose toxicity	
Product:	No data available.
Skin Corrosion/Irritation	
Product:	Causes severe skin burns.
Serious Eye Damage/Eye Irritation	
Product:	Causes serious eye damage.
Respiratory or Skin Sensitization	
Product:	Not a skin sensitizer.
Carcinogenicity	
Product:	No data available.

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IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:
No carcinogenic components identified

US. National Toxicology Program (NTP) Report on Carcinogens:
No carcinogenic components identified

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):
No carcinogenic components identified

Germ Cell Mutagenicity

In vitro

Product: No data available.

In vivo

Product: No data available.

Reproductive toxicity

Product: No data available.

Specific Target Organ Toxicity - Single Exposure

Product: No data available.

Specific Target Organ Toxicity - Repeated Exposure

Product: No data available.

Aspiration Hazard

Product: No data available.

Other effects: No data available.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish

Product: LC 50 (Shiner perch (Cymatogaster aggregata), 96 h): 0.033 - 0.097 mg/l LC 50 (Bluegill (Lepomis macrochirus), 48 h): 0.6 mg/l

Aquatic Invertebrates

Product: LC 50 (Aquatic crustacea): 1 mg/l LC 50 (Daphnia magna, 96 h): 2.1 mg/l

Chronic hazards to the aquatic environment:

Fish

Product: No data available.

Aquatic Invertebrates

Product: No data available.

Toxicity to Aquatic Plants

Product: EC 50 (Green algae (Dunaliella bioculata), 24 h): 0.6 mg/l

Persistence and Degradability

Biodegradation

Version: 1.6
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Product: The product solely consists of inorganic compounds which are not biodegradable.

BOD/COD Ratio

Product: No data available.

Bioaccumulative potential

Bioconcentration Factor (BCF)

Product: The product is not bioaccumulating.

Partition Coefficient n-octanol / water (log Kow)

Product: No data available.

Mobility in soil: No data available.

Known or predicted distribution to environmental compartments

Sodium hypochlorite: No data available.
Sodium hydroxide: No data available.
Water: No data available.

Known or predicted distribution to environmental compartments

Water: No data available.

13. Disposal considerations

Disposal instructions: Discharge, treatment, or disposal may be subject to national, state, or local laws.

Contaminated Packaging: Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN Number: UN 1791
UN Proper Shipping Name: Hypochlorite solutions
Transport Hazard Class(es)
Class: 8
Label(s): 8
Packing Group: III
Marine Pollutant: Marine Pollutant

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Special precautions for user: –

IMDG

UN Number:	UN 1791
UN Proper Shipping Name:	HYPOCHLORITE SOLUTION
Transport Hazard Class(es)	
Class:	8
Label(s):	8
EmS No.:	F-A, S-B
Packing Group:	III
Marine Pollutant:	Marine Pollutant
Special precautions for user:	–

15. Regulatory information

US Federal RegulationsUS. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):

Sodium hypochlorite	Reportable quantity: 100 lbs.
Sodium hydroxide	Reportable quantity: 1000 lbs.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

☐ Acute (Immediate) ☐ Chronic (Delayed) ☐ Fire ☐ Reactive ☐ Pressure Generating

SARA 302 Extremely Hazardous Substance

None present or none present in regulated quantities.

SARA 304 Emergency Release Notification

Chemical Identity	RQ
Sodium hypochlorite	100 lbs.
Sodium hydroxide	1000 lbs.

SARA 311/312 Hazardous Chemical

Chemical Identity	Threshold Planning Quantity
Sodium hypochlorite	500 lbs
Sodium hydroxide	500 lbs

SARA 313 (TRI Reporting)

None present or none present in regulated quantities.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)

Sodium hypochlorite	Reportable quantity: 100 lbs.
Sodium hydroxide	Reportable quantity: 1000 lbs.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

None present or none present in regulated quantities.

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US State Regulations

US. California Proposition 65

No ingredient regulated by CA Prop 65 present.

US. New Jersey Worker and Community Right-to-Know Act

Sodium hypochlorite	Listed
Sodium hydroxide	Listed

US. Massachusetts RTK - Substance List

Sodium hypochlorite	Listed
Sodium hydroxide	Listed

US. Pennsylvania RTK - Hazardous Substances

Sodium hypochlorite	Listed
Sodium hydroxide	Listed

US. Rhode Island RTK

Sodium hypochlorite	Listed
Sodium hydroxide	Listed

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Inventory Status: Australia AICS:	On or in compliance with the inventory
Canada DSL Inventory List:	On or in compliance with the inventory
EU EINECS List:	On or in compliance with the inventory
EU ELINCS List:	On or in compliance with the inventory
Japan (ENCS) List:	On or in compliance with the inventory
EU No Longer Polymers List:	Not in compliance with the inventory.
China Inv. Existing Chemical Substances:	On or in compliance with the inventory
Korea Existing Chemicals Inv. (KECI):	On or in compliance with the inventory
Canada NDSL Inventory:	Not in compliance with the inventory.
Philippines PICCS:	On or in compliance with the inventory
New Zealand Inventory of Chemicals:	On or in compliance with the inventory
Japan ISHL Listing:	Not in compliance with the inventory.
Japan Pharmacopoeia Listing:	Not in compliance with the inventory.
US TSCA Inventory:	On or in compliance with the inventory

16.Other information, including date of preparation or last revision

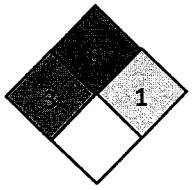
HMIS Hazard ID

Health	3
Flammability	0
Physical Hazards	1
PERSONAL PROTECTION	B

B - Safety Glasses & Gloves

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; RNP - Rating not possible; *Chronic health effect

NFPA Hazard ID



Flammability
Health
Reactivity
Special hazard.

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; RNP - Rating not possible

Issue Date:	05/31/2018
Revision Date:	No data available.
Version #:	1.6
Further Information:	No data available.

Version: 1.6
Revision Date: 05/31/2018

Univar USA Inc Safety Data Sheet

For Additional Information contact SDS Coordinator during business hours, Pacific time: (425) 889-3400

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Do not use ingredient information and/or ingredient percentages in this SDS as a product specification. For product specification information refer to a product specification sheet and/or a certificate of analysis. These can be obtained from your local Univar sales office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Univar makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Univar's control and therefore users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product, or from the publication or use of, or reliance upon, information contained herein.

This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process

Univar USA Inc Material Safety Data Sheet

LYNNFIELD CENTER WATER DI
83 PHILLIPS ROAD

LYNNFIELD
MA 01940

MSDS No:	SOL82877
Version No:	001 08/13/12
Order No:	RP403627

Univar USA Inc., 17425 NE Union Hill Rd., Redmond WA 98052
(425) 889 3400

Emergency Assistance

For emergency assistance involving chemicals call
Chemtrec - (800) 424-9300

SAFETY DATA SHEET
North American Version

SODIUM FLUORIDE

1. PRODUCT AND COMPANY IDENTIFICATION

1.1. Identification of the substance or mixture

Product name	:	SODIUM FLUORIDE
Product grade(s)	:	Coarse Blends Granular Powder USP Coarse Crystal
Chemical Name	:	Sodium fluoride
Molecular formula	:	NaF
Molecular Weight	:	42 g/mol

1.2. Use of the Substance/Mixture

Recommended use	:	- Welding and soldering agents - Metallurgy - Glass industry - Dental application
Recommended use		- Water treatment

1.3. Company/Undertaking Identification

Address	:	SOLVAY FLUORIDES, LLC 3333 RICHMOND AVENUE HOUSTON TX 77098-3099 United States

1.4. Emergency and contact telephone numbers

Emergency telephone number	:	**1 (800) 424-9300 CHEMTREC ® (USA & Canada)** **01-800-00-214-00 (MEX. REPUBLIC)**
Contact telephone number (product information):	:	**US: +1-800-765-8292 (Product information)** **US: +1-713-525-6500 (Product information)**

2. HAZARDS IDENTIFICATION

2.1. Emergency Overview:

NFPA	:	H= 3 F= 0 I= 0 S= None
HMIS	:	H= 3 F= 0 R= 0 PPE = Supplied by User; dependent on local conditions

General Information

Appearance	:	crystalline, powder
Colour	:	white

SOLVAY Fluorides

SOLVAY

Odour : odourless

Main effects
- Toxic if swallowed.
- Irritating to eyes and skin.
- Contact with acids liberates very toxic gas.
- Hazardous decomposition products formed under fire conditions.

2.2. Potential Health Effects:

Inhalation
- Irritating to mucous membranes
- At high concentrations, risk of hypocalcemia with nervous problems (tetany) and cardiac arrhythmia.
- Repeated or prolonged exposure: Risk of sore throat, nose bleeds, Nose bleeding, chronic bronchitis.

Eye contact
- Severe eye irritation
- Redness
- Lachrymation
- Risk of temporary eye lesions.

Skin contact
- Irritation
- Repeated or prolonged exposure: Causes burns..

Ingestion
- Severe irritation
- Salivation
- risk of hypocalcemia with nervous problems (tetany) and cardiac arrhythmia
- Risk of convulsions, loss of consciousness, deep coma and cardiopulmonary arrest.
- Symptoms: Nausea, Vomiting, Abdominal pain, Diarrhoea.

Other toxicity effects
- See section 11: Toxicological Information

2.3. Environmental Effects:
- See section 12: Ecological Information

3. COMPOSITION/INFORMATION ON INGREDIENTS

Sodium fluoride

CAS-No.	:	7681-49-4
Concentration	:	**>= 97.0 %**

4. FIRST AID MEASURES

4.1. Inhalation
- Remove the subject from dusty environment and let him blow his nose.
- Oxygen or artificial respiration if needed.
- If symptoms persist, call a physician.

4.2. Eye contact
- Rinse the eyes with a calcium gluconate 1% solution in physiological serum (10 ml of calcium gluconate 10% in 90 ml of physiological serum)
- Immediate medical attention is required.

4.3. Skin contact
- Take off contaminated clothing and wash before reuse.

- Wash off with plenty of water.
- Immediately apply calcium gluconate gel 2.5% and massage into the affected area using rubber gloves; continue to massage while repeatedly applying gel until 15 minutes after pain is relieved.
- If fingers/finger nails are touched, even if there is no pain, dip them in a bath of 5% calcium gluconate for 15 to 20 minutes.
- If symptoms persist, call a physician.

4.4. Ingestion

- Immediate medical attention is required.
- Take victim immediately to hospital.

If victim is conscious:

- If swallowed, rinse mouth with water (only if the person is conscious).
- Give to drink a 1% aqueous calcium gluconate solution.
- Do NOT induce vomiting.

If victim is unconscious but breathing:

- Artificial respiration and/or oxygen may be necessary.

5. FIREFIGHTING MEASURES

5.1. Suitable extinguishing media

- Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2. Extinguishing media which shall not be used for safety reasons

- none

5.3. Special exposure hazards in a fire

- The product is not flammable.
- Not combustible.
- Heating can release hazardous gases.

5.4. Hazardous decomposition products

- Hydrogen fluoride
- The release of other hazardous decomposition products is possible.

5.5. Special protective equipment for firefighters

- In the event of fire, wear self-contained breathing apparatus.
- Fire fighters must wear fire resistant personnel protective equipment.
- Wear chemical resistant oversuit

5.6. Other information

- Control the use of water due to environmental risk (see section 6).

6. ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. Advice for non-emergency personnel

- Avoid dust formation.

6.1.2. Advice for emergency responders

- Sweep up to prevent slipping hazard.

6.2. Environmental precautions

- If the product contaminates rivers and lakes or drains inform respective authorities.
- Do not flush into surface water or sanitary sewer system.

6.3. Methods and materials for containment and cleaning up

- Sweep up and shovel into suitable containers for disposal.
- Avoid dust formation.
- Keep in properly labelled containers.
- Keep in suitable, closed containers for disposal.
- Treat recovered material as described in the section "Disposal considerations".

6.4. Reference to other sections

- Refer to protective measures listed in sections 7 and 8.

7. HANDLING AND STORAGE

7.1. Handling

- Used in closed system
- Handle small quantities under a lab hood.
- Use only in well-ventilated areas.
- Use only equipment and materials which are compatible with the product.
- Keep away from heat.

7.2. Storage

- Keep in a dry place.
- Store in original container.
- Keep container closed.
- Keep away from Incompatible products.

7.3. Packaging material

- no data available

7.4. Other information

- Avoid dust formation.
- Refer to protective measures listed in sections 7 and 8.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Exposure Limit Values

Sodium fluoride

- US. ACGIH Threshold Limit Values 12 2010
  time weighted average = 2.5 mg/m3
  Remarks: as F
- US. OSHA Table Z-1-A (29 CFR 1910.1000) 1989
  time weighted average = 2.5 mg/m3
  Remarks: as F
- US. OSHA Table Z-2 (29 CFR 1910.1000) 02 2006
  time weighted average = 2.5 mg/m3
- US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) 02 2006
  Permissible exposure limit = 2.5 mg/m3
  Remarks: as F
- US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A 06 2008
  time weighted average = 2.5 mg/m3
  Remarks: as F

ACGIH® and TLV® are registered trademarks of the American Conference of Governmental Industrial Hygienists.
SAEL = Solvay Acceptable Exposure Limit, Time Weighted Average for 8 hour workdays. No Specific TLV STEL (Short Term Exposure Level) has been set. Excursions in exposure level may exceed 3 times the TLV TWA for no more than a total of 30 minutes during a workday and under no circumstances should they exceed 5 times the TLV TWA.

8.2. Engineering controls

- Ensure adequate ventilation.
- Provide appropriate exhaust ventilation at places where dust is formed.
- Refer to protective measures listed in sections 7 and 8.
- Apply technical measures to comply with the occupational exposure limits.

8.3. Personal protective equipment

8.3.1. Respiratory protection

- In case of insufficient ventilation, wear suitable respiratory equipment.
- When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
- Self-contained breathing apparatus in medium confinement/insufficient oxygen/in case of large uncontrolled emissions/in all circumstances when the mask and cartridge do not give adequate protection.
- Use only respiratory protection that conforms to international/ national standards.
- Use NIOSH approved respiratory protection.

8.3.2. Hand protection

- Protective gloves - impervious chemical resistant:
- Suitable material: PVC, Neoprene, Natural Rubber

8.3.3. Eye protection

- Chemical resistant goggles must be worn.
- Dust proof goggles obligatory.

8.3.4. Skin and body protection

- Long sleeved clothing
- Apron/boots in case of dusts.
- Neoprene
- Natural Rubber

8.3.5. Hygiene measures

- Eye wash bottles or eye wash stations in compliance with applicable standards.
- Use only in an area equipped with a safety shower.
- When using do not eat, drink or smoke.
- Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1. General Information

Appearance	:	crystalline, powder
Colour	:	white
Odour	:	odourless

9.2. Important health safety and environmental information

pH	:	7.4 *Remarks*: saturated aqueous solution *Temperature*: 20 °C (68 °F)
Boiling point/boiling range	:	ca. 1,700 °C (3,092 °F)
Flash point	:	*Remarks*: not applicable
Flammability	:	*Remarks*: not applicable
Explosive properties	:	*Explosion danger*: *Remarks*: Not explosive

Oxidizing properties	:	*Remarks*: Non oxidizer
Vapour pressure	:	1.33 hPa *Temperature*: 1,077 °C (1,971 °F)
Bulk density	:	from 1,000 - 1,400 kg/m3
Solubility(ies)	:	Water 42 g/l *Temperature*: 20 °C (68 °F)
Partition coefficient: n-octanol/water	:	*Remarks*: not applicable
Vapour density	:	*Remarks*: not applicable
Evaporation rate	:	*Remarks*: not applicable

9.3. Other data

Melting point/range	:	ca. 992 °C (1,818 °F)
Auto-flammability	:	*Remarks*: not applicable
Granulometry	:	90 % > 0.1 mm

10. STABILITY AND REACTIVITY

10.1. Stability
- Stable under recommended storage conditions.

10.2. Conditions to avoid
- Exposure to moisture.
- To avoid thermal decomposition, do not overheat.

10.3. Materials to avoid
- Strong acids, glass

10.4. Hazardous decomposition products
- Hydrogen fluoride
- The release of other hazardous decomposition products is possible.

11. TOXICOLOGICAL INFORMATION

Toxicological data

Acute oral toxicity
- LD50, rat, 52 - 250 mg/kg

Acute dermal irritation/corrosion
- LD 10, mouse, ca. 300 mg/kg

Skin irritation
- rat, Skin irritation

Eye irritation
- rabbit, Eye irritation

Sensitisation
- Did not cause sensitization.

Carcinogenicity
- Limited evidence of a carcinogenic effect.

Reproductive toxicity
- rat, 10 - 14 mg/kg, NOAEL

Remarks
- no data available
- Chronic exposure may entail dental or skeletal fluorosis
- Carcinogenic effect not applicable to human

12. ECOLOGICAL INFORMATION

12.1. Ecotoxicity effects

Acute toxicity
- Fishes, Salmo gairdneri, LC50, 96 h, 51 mg/l (Sodium fluoride)
  Remarks: fresh water, static test
- Crustaceans, Daphnia magna, EC50, 96 h, 10.5 mg/l (Sodium fluoride)
  Remarks: salt water
- Crustaceans, Daphnia magna, EC50, 48 h, 26 mg/l (Sodium fluoride)
  Remarks: fresh water

Chronic toxicity
- Fishes, Oncorhynchus mykiss, NOEC, 21 Days, 4 mg/l (Sodium fluoride)
  Remarks: fresh water, static test
- Crustaceans, Daphnia magna, NOEC, 21 Days, 8.9 mg/l (Sodium fluoride)
  Remarks: static test, fresh water
- Algae, various species, EC50, 96 h, 43 mg/l (Sodium fluoride)
  Remarks: fresh water
- Algae, various species, EC50, 81 mg/l (Sodium fluoride)
  Remarks: Marine water
- Algae, various species, NOEC, 7 d, 50 mg/l (Sodium fluoride)
  Remarks: fresh water, static test
- Algae, various species, NOEC, 7 d, 50 mg/l (Sodium fluoride)
  Remarks: Marine water, static test

12.2. Mobility
- Air
  Remarks: mobility as solid aerosols
- Water, Solubility(ies), Mobility
- Soil/sediments
  Remarks: adsorption on mineral and organic soil constituents

12.3. Persistence and degradability

Abiotic degradation
- Water/soil
  Result: complexation/precipitation of inorganic and organic materials

Biodegradation
- Remarks: The methods for determining biodegradability are not applicable to inorganic substances.

12.4. Bioaccumulative potential
- Bioaccumulative potential: log Pow
  Result: not applicable
- (Fluorides)
  Result: accumulation into vegetable leafs

12.5. Other adverse effects
- no data available

12.6. Remarks
- Harmful to aquatic organisms.
- Hazard for the environment is limited due to product properties:
- . low chronic toxicity.
- Product fate is highly dependent on environmental conditions: pH, temperature, redox potential, mineral and organic content of the medium,...

13. DISPOSAL CONSIDERATIONS

13.1. Waste from residues / unused products
- In accordance with local and national regulations.
- Dilute with plenty of water.
- Can be eliminated from water by precipitation.
- Filtrate the product and send the cake to a landfill for industrial waste.
- Discharge liquid filtrate to a wastewater treatment system

13.2. Packaging treatment
- Empty containers.
- Dispose of as unused product.
- Must be incinerated in a suitable incineration plant holding a permit delivered by the competent authorities.
- Where possible recycling is preferred to disposal or incineration.
- In accordance with local and national regulations.

13.3. RCRA Hazardous Waste
- Listed RCRA Hazardous Waste (40 CFR 302) - No
- Unlisted RCRA Hazardous Waste (40 CFR 302) - No

14. TRANSPORT INFORMATION

IATA-DGR

UN number	UN 1690
Class	6.1
Packing group	III
ICAO-Labels	6.1 - Toxic

Proper shipping name: SODIUM FLUORIDE SOLID

IMDG

UN number	UN 1690
Class	6.1
Packing group	III
IMDG-Labels	6.1 - Toxic
EmS	F-A S-A

Proper shipping name: SODIUM FLUORIDE SOLID

U.S. Dept of Transportation

UN number	UN 1690
Class	6.1

Packing group	III
Label	6.1 - Toxic
EmS	154
Reportable Quantity	454 kg

Proper shipping name: SODIUM FLUORIDE SOLID

Canada (TDG)

UN number	UN 1690
Class	6.1
Packing group	III
Label	6.1 - Toxic
EmS	154

Proper shipping name: SODIUM FLUORIDE SOLID

Mexico (NOM-002-SCT)

UN number	UN 1690
Class	6.1
Packing group	III
Label	6.1 - Toxic

Proper shipping name: SODIUM FLUORIDE SOLID

- DOT Packing Group: III

15. REGULATORY INFORMATION

15.1. Inventory Information

Australian Inventory of Chemical Substances (AICS)	: -	In compliance with inventory.
Canadian Domestic Substances List (DSL)	: -	In compliance with inventory.
Inventory of Existing Chemical Substances (China) (IECS)	: -	In compliance with inventory.
Japanese Existing and New Chemical Substances (MITI List) (ENCS)	: -	In compliance with inventory.
New Zealand Inventory of Chemicals (NZIOC)	: -	In compliance with inventory.
Toxic Substance Control Act list (TSCA)	: -	In compliance with inventory.
EU list of existing chemical substances (EINECS)	: -	In compliance with inventory.
Korean Existing Chemicals Inventory (KECI (KR))	: -	In compliance with inventory.
Philippine Inventory of Chemicals and Chemical Substances (PICCS)	: -	In compliance with inventory.

15.2. Other regulations

US. EPA Emergency Planning and Community Right-To-Know Act (EPCRA) SARA Title III Section 302 Extremely Hazardous Substance (40 CFR 355, Appendix A)

- not regulated.

SARA Hazard Designation (SARA 311/312)

- Acute Health Hazard: Yes.
- Chronic Health Hazard: Yes.

US. EPA Emergency Planning and Community Right-To-Know Act (EPCRA) SARA Title III Section 313 Toxic Chemicals (40 CFR 372.65) - Supplier Notification Required

- not regulated.

US. EPA CERCLA Hazardous Substances (40 CFR 302)

- not regulated.

US. New Jersey Worker and Community Right-to-Know Act (New Jersey Statute Annotated Section 34:5A-5)

- yes.

US. Pennsylvania Worker and Community Right-to-Know Law (34 Pa. Code Chap. 301-323)

- yes.

US. California Safe Drinking Water & Toxic Enforcement Act (Proposition 65)

- not regulated.

16. OTHER INFORMATION

Ratings :

NFPA (National Fire Protection Association)

Health = 3 Flammability = 0 Instability = 0 Special =None

HMIS (Hazardous Material Information System)

Health = 3 Fire = 0 Reactivity = 0 PPE : Supplied by User; dependent on local conditions

Further information

- New (SDS)
- Distribute new edition to clients

Material Safety Data Sheets contain country specific regulatory information; therefore, the MSDS's provided are for use only by customers of the company mentioned in section 1 in North America. If you are located in a country other than Canada, Mexico or the United States, please contact the Solvay Group company in your country for MSDS information applicable to your location.

The previous information is based upon our current knowledge and experience of our product and is not exhaustive. It applies to the product as defined by the specifications. In case of combinations or mixtures, one must confirm that no new hazards are likely to exist. In any case, the user is not exempt from observing all legal, administrative and regulatory procedures relating to the product, personal hygiene, and integrity of the work environment. (Unless noted to the contrary, the technical information applies only to pure product).

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Univar USA Inc Material Safety Data Sheet

For Additional Information contact MSDS Coordinator during business hours, Pacific time: (425) 889-3400

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Do not use ingredient information and/or ingredient percentages in this MSDS as a product specification. For product specification information refer to a product specification sheet and/or a certificate of analysis. These can be obtained from your local Univar sales office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Univar makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Univar's control and therefore users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product, or from the publication or use of, or reliance upon, information contained herein.

This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process

Appendix G

Greensand Filter Proposal from Roberts Water Technologies, Inc.

Roberts Water Technologies, Inc.
Innovations for Generations

214 North Jackson Street • Media, PA 19063
www.robertsfilter.com • **p** 610.583.3131 • **f** 610.583.0117

August 27, 2018

CDM Smith
75 State Street #701
Boston, MA 02109

Attention: Ms. Meredith M. Sullivan

Reference: Lynnfield, Massachusetts
Roberts' Contract 3925-T

Subject: Roberts' Budget Proposal BP-PF-18-0801-T-**Rev 1**

Dear Meredith:

Roberts Water Technologies, Inc. ("Roberts") is pleased to offer the below budget scope of supply for the referenced project.

Filter Tanks:

1. Two (2) - 144" OD x 90" straight side Vertical Pressure units shall be furnished. Vessels shall be designed and fabricated of SA-516 Grade 70 carbon steel in accordance with the ASME Code for a 100 psig working pressure (130 psig test pressure) and shall be so certified and stamped. Each tank shall be fabricated with tank connections, two (2) manways, lifting lugs, and structural supports.

2. Tank interior surfaces shall be sandblasted to SSPC-SP10 Near White Blast, primed and coated.

3. Tank exterior surfaces shall be sandblasted to SSPC-SP6 Commercial Blast and primed with one (1) coat of primer.

Inlet Distributor/Backwash Collector:

1. Two (2) sets of Inlet Distributor/Backwash Collectors shall be furnished. Each assembly shall be fabricated with XH steel arms and malleable iron fittings and shall be installed by others.

Supplemental Air Wash:

1. Two (2) Air Wash Distributor assemblies fabricated of Schedule 80 PVC shall be furnished for assembly and installation by others.

2. Air Wash Distributor laterals shall be fabricated of Schedule 80 PVC shall be equipped with Type 304 stainless steel air diffuser nozzles.

Underdrain:

1. Two (2) sets of filter underdrain assemblies shall be furnished for assembly and installation by others. Underdrain headers and laterals shall be fabricated of Schedule 80 PVC. Laterals shall be equipped with Macrobaffle strainers fabricated of Type 304 stainless steel.

Gravel Support Bed:

1. Support gravel shall be furnished for Contractor's placement in each filter. A sufficient quantity of gravel shall be furnished in five (5) grades for a total finished depth of 15".

Filter Media:

1. GreensandPlus™ shall be furnished for Contractor's placement in each filter. Greensand Plus shall be provided in sufficient quantity to obtain a finished depth of 24" within each filter and shall have an effective size of 0.30-0.35 mm with a maximum uniformity coefficient of 1.6.

2. Anthracite shall be furnished for Contractor's placement in each filter. Anthracite shall be provided in sufficient quantity to obtain a finished depth of 12" within each filter and shall have an effective size of 0.60-0.80 mm with a maximum uniformity coefficient of 1.6.

Filter Vessel Accessories:

1. Two (2) - 1" diameter automatic air release valves and isolation gate valves shall be furnished.

2. Two (2) – 4-1/2" diameter Filter Influent pressure gauges shall be furnished.

3. Two (2) – 4-1/2" diameter Filter Effluent pressure gauges shall be furnished.

4. Two (2) Filter Loss of Head d/P transmitters with 3-valve manifolds.

5. A total of six (6) sample valves shall be furnished.

6. Two (2) - 6" Filter Influent magnetic flow meters with transmitters shall be furnished.

Control Valves:

1. The following hydraulically operated diaphragm valves with solenoids shall be furnished:

Qty	Service	Size	Operation
(2)	Filter Influent	6"	Modulating
(2)	Filter Effluent	6"	Open/Close
(2)	Backwash Inlet	8"	Open/Close
(2)	Backwash Waste	8"	Open/Close
(2)	Filter to Waste	6"	Open/Close
(2)	Air Pressurization	3"	Open/Close
(2)	Air Inlet	3"	Open/Close
(2)	Draindown	4"	Open/Close

2. The following manually operated butterfly valves shall be furnished:

Qty	Service	Size
(2)	Filter Influetn Isolation	6"
(2)	Filter Effluent Isolation	6"
(2)	Backwash Inlet Isolation	8"

Air Blower:

1. One (1) positive displacement air blower package shall be furnished. Air blower shall be sized to deliver 91 SCFM at 6 psi. Blower package shall include blower, motor, inlet filter, inlet silencer, flexible couplings, non-elevated base, discharge silencer, v-belt drive with OSHA style guard, discharge pressure gauge, discharge temperature gauge, discharge pressure switch, control panel, manual isolation valve and check valve.

Hydropneumatic System:

1. One (1) Hydropneumatic System shall be furnished including 40 gallon ASME 200 PSI pressure tank, duplex multistage centrifugal pumps with 5 HP, 3450 RPM, TEFC, 115 V/ 1 Ph/60 Hz electric motors, schedule 10 type 304 stainless steel suction and discharge headers with flange connections, two (2) isolation ball valves, two (2) spring loaded check valves, pressure safety relief valve, pressure gauge all mounted and piped on skid.

2. One (1) duplex control panel shall be furnished in NEMA 4 enclosure with main disconnect switch, two (2) manual motor protectors, two (2) motor contractors, H-O-A switches, run lights, low suction pressure switch shutdown, alarm light, auto reset, lead and lag pressure switches with minimum run timers, transformers, auto alternator and lead/lag selector switch.

Filter Control Panel:

1. One (1) NEMA 12 Filter Control Panel shall be furnished. Control panel shall include all relays, operator interface terminal (OIT), programmable logic controller (PLC), Ethernet switch, programming, UPS, UL Label and all associated components to automatically control the filter operations.

2. The programmable logic controller and operator interface terminal unit shall be as manufactured by Allen-Bradley.

Supervisory Services:

The services of a Roberts Representative shall be provided to perform the following functions up to a maximum number of days and trips as listed below.

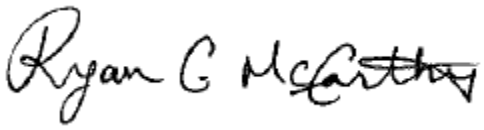
Installation Supervision:	Five (5) Days Service One (1) Round Trip
Startup Assistance:	Five (5) Days Service One (1) Round Trip
Operator Training:	Two (2) Days Service One (1) Round Trip
Performance Testing:	Three (3) Days Service One (1) Round Trip
Follow-up Service:	One (1) Days Service One (1) Round Trip

Budget Price:

To be provided by Roberts' Sales Representative copied below.

We thank you for the opportunity of submitting this quotation. If you should have any questions, please contact the undersigned or our representative copied below.

Respectfully submitted,
ROBERTS WATER TECHNOLOGIES, INC.



Ryan McCarthy
Regional Sales Manager

RCM:kpr

CC: Mr. Mike Brillon
Bartlett & Brillon
(508) 668-1337