REPORT ON THE INFLUENCE OF TOWN SALT STORAGE ON CHLORIDE IN DEERING LAKE IN 2024

SUMMARY AND MAIN CONCLUSIONS

Please refer to the attached Deering Lake Chloride Test Report prepared by the Conservation Commission. The report provides the methods and materials used in the study, test results, maps, and a discussion of our findings. Recommendations and best management practices for reducing the impact of Chloride in Deering Lake are proposed. The Conservation Commission is hopeful that the Board of Selectmen will be proactive in preserving the water quality of Deering Lake.

Key Findings of the Report

- The chloride level in Deering Lake is steadily increasing (40% increase since 2017).
- Chloride has a deleterious effect on aquatic life (at levels as low as 150 mg/L).
- Chloride levels above Deering Center Rd. (Church well and Gregg Hill stream) were low (0.72-0.8 mg/L) and likely represent naturally occurring ambient bedrock/groundwater chloride levels.
- Road salt applied by State DOT to Deering Center Rd is a contributor of Chloride to Deering Lake (Stream A: 9.14 – 27.6 mg/L). Chloride levels would likely be higher in winters with higher road salt usage compared to this past winter.
- Test results show that road salt from the Town Salt Storage area adds considerably higher levels of chloride.
- Road salt flushing/leaching from the storage area into an adjacent privately owned wetland (Tax map 228 Lot 2) is concerning (979 to 1620 mg/L) and might pose a liability for the Town. Because chloride does not break down, some percentage will, in time, find its way into Deering Lake.
- The chloride level (109-174 mg/L) in Steam B flowing below the salt storage area into Morotta Bay was the highest level ever recorded for a stream entering the Lake.

The Main Conclusions

- The principal source of Chloride pollution into Deering Lake found in this study was from the Deering Highway Salt Storage Shed area situated on high ground less than 1/3 mile from the Lake. Ideally, the salt storage shed would be located outside of the Watershed Protection Overlay.
- Road salt that is not fully covered and kept on an impervious floor will eventually find its way into Deering Lake (groundwater and streams)
- The use of dust-suppressing chemicals ($CaCl_2$ and $MgCl_{2)}$ in the Watershed Protection Overlay will contribute chloride to the Lake.

Recommendations

In summary, chloride levels are rising in the Lake and it is not too soon to adopt mitigation efforts. Winter road salting is the primary source of chloride in the Lake. This chloride comes from road surfaces and, our results show, the Town salt storage facility.

The following recommendations and best management practices can help in the effective and efficient use of de-icing materials while reducing the impact and preserving water quality of Deering Lake:

1. The chloride test results strongly support the need for the Road Agent and other interested Highway Department employees for training in salt application (calibrate equipment, use appropriate application rates, record storm events, time, application rates, and other important information describing maintenance activities and results, training, etc.). While NH DES Green SnowPro certification is not available to municipal employees, there are many training courses available under this program. DES will offer Municipal Green SnowPro Certification for the 2025/26 season, but details of this program are not yet available. We recommend that the Town provide tuition to all Highway Department Employees for Winter Snow Maintenance who wish to take the training. The Town should explore Green SnowPro Municipal Maintenance Certification when the details are known.

2. It is essential to minimize accidental dispersal of salt from the salt storage shed. The salt should be fully contained in the covered part of the shed with minimal spillage when loading trucks. **The best option is to relocate the salt storage shed to the Hedgehog Mountain sand pit, which is outside of the Deering Lake Watershed Protection Overlay.**

3. **Salt kept in the salt storage area must be covered** so as to limit the effect of the elements that are leaching chloride into the wetland below. It should be stored on an impermeable base.

4. **Prohibit the use of dust suppression chemicals in the Watershed Protection Overlay.** At the Select Board meeting of February 1, 2024, Chair Smith agreed with Conservation Commission concerns that it would be a good idea not to use dust suppression chemicals in the Watershed Protection Overlay. Our understanding was that these chemicals would not be used without further study. We urge the BOS to prohibit the use of calcium chloride or magnesium chloride in the Watershed Protection Overlay.

5. **Stop using magnesium chloride as a de-icer and dust suppressor**. Research indicates that magnesium chloride has a far greater deleterious effect on aquatic life than does calcium chloride, despite the advocation of its use by a company representative who was seeking to sell magnesium chloride to the Town. The Conservation Commission sent a message to BOS shortly after the meeting of February 1. A copy of that letter is attached here.

6. Reduce excessive salt application to the Town Hall parking lot. Piles of snow contain the salt that was applied as a de-icer to the parking lot. That salt will be washed into the Lake as the accumulated snow melts. **The snow should be trucked to the town sand pit as soon as possible.**

7. Vehicle washing to remove de-icing and dust suppression chemicals should have proper drainage to avoid discharge into surface and ground waters.

8. Properly maintain and improve storm ditches and culverts to slow and infiltrate stormwater runoff into the Lake and reduce road erosion from major rainfall events. **The Deering Hazard Mitigation Plan Update 2021 highlights several culverts that require upgrading.**

9. **Develop a Deering Lake Watershed Management Plan.**

10. The Conservation Commission will continue monitoring chloride levels in the Lake and provide water quality testing results to the BOS.

11. The Conservation Commission will work with the Town Administrator to schedule meetings with the Road Agent to identify and implement reduced salt usage areas in ecologically sensitive areas in Town. Identify safe alternatives to road salt in these areas.

12. The Town Hall Wellhead must be reconfigured. The Town Hall well is buried beneath the asphalt parking lot. Due to the well cover plate being located in a depression (low point) within the asphalt, the cover is hidden by road sand and collects puddles of road salt water. The integrity of this well cover is unknown and whether road salt surface water leaks into and around the well casing. If the well pump fails during the winter, finding and accessing the well may be problematic for the pump service contractor.

Respectfully submitted,

Deering Conservation Commission,
Gary Samuels and Mike Thomas

REPORT ON

THE INFLUENCE OF TOWN SALT STORAGE ON CHLORIDE IN DEERING LAKE IN 2024

DEERING CONSERVATION COMMISSION

ABSTRACT

Regular testing of the water in Deering Lake reveals a steady increase in chloride over the past 10 years. Chloride at low levels (150 mg/L) is toxic to aquatic life. Deering Conservation Commission tested water in streams and a wetland above and below Deering Center Road and the Highway Department salt storage area in March 2024 before and after snow/rain events. Results show that water washed from Deering Center Road does add chloride to the Lake. The results also show that salt washing from the Highway Department salt storage area adds considerably higher levels of chloride. Several recommendations are proposed.

INTRODUCTION

Deering participates in the NH Department of Environmental Services (NH DES) Volunteer Lake Testing Program (VLAP). Lake water is sampled and analyzed for several parameters that are indicative of water quality three times each summer. Reports in recent years have indicated high chloride levels in a part of the northeast end of the Lake known as Morotta Inlet. The level has remained high despite the Road Agent's assurance of reduced winter road salting of the part of Reservoir Road (Parley's Way) that crosses a wetland and stream that feeds into Morotta Inlet.

The chloride ion is a part of the salt molecule, NaCl. The molecule disassociates into sodium and chloride ions when salt is dissolved in water. The chloride and sodium can then enter the groundwater, streams and, ultimately, the Lake and wells. The most likely source of chloride in the Lake is winter road salting, although chloride release from home water softeners/septic systems cannot be completely discounted but is difficult to assess. In an effort to understand the source or sources of chloride in the Lake, Deering Conservation Commission, in discussion with NH DES Watershed Management Bureau, undertook testing water in streams that feed the Lake in the area of Morotta Inlet and the northern, Zoski Road, part of the Lake. We present here those results, and recommendations stemming from those results.

MATERIALS AND METHODS

The water samples. NH DES provided 2-ounce plastic bottles. A label with a discrete sampling site identification code was affixed to each bottle. Water samples were taken by submerging the bottle into the water until filled. If needed, a coffee filter was used to strain samples having visible sediments. For each sample, the site code, GPS coordinate, date, time, stream conditions, air temperature, and notes on recent weather events were recorded and entered into a spreadsheet (Table 1). Samples were stored under refrigeration for maximum of 11 days before being transported to the DES Watershed Management Laboratory in Concord for testing for the presence of chloride ions.

Sampling dates. Water samples were collected on March 13 during a period of below average snowfall and road de-icing, and on March 28 following a snowstorm when de-icing material was applied to Deering Center Road.

Sampling sites (Fig. 1). Morotta Inlet and the Zoski end of the Lake are located below Deering Center Road, Deering Town Hall, and the Highway Department salt storage shed, each at an elevation of approximately 1050 ft and a little over ¼ mile from the Lake. The slope from these locations, and its drainage, drops steadily to the Lake. With winter salted Deering Center Road a likely source of chloride in the groundwater and streams flowing down from it, we selected two 'control' sites – sites that would not receive salt flowing from the road – on the northeast, uphill, side of Deering Center Road, above the road with an elevation of approximately 1080 ft. These included a stream flowing under Deering Center Road from Gregg Hill (Stream A), and the second from the well of the Deering Community Church. These 'control' sites are taken to represent naturally occurring ambient bedrock/groundwater chloride levels.

Samples were taken from four sites in the Town Hall/Highway department area, including the Town Hall well. The Town Hall well was sampled once, during the first sampling period, as were two sites immediately downslope of the salt storage shed (Fig. 1). A wetland immediately downslope of the salt storage shed was sampled twice. Stream A was sampled twice and at two locations, one at Fisher Road at the culvert and one at the point where the stream flows under Zoski Road and enters the Piscataquog River. An apparently unrecorded stream (Stream B, Fig. 1) was found to rise downslope of the Town Hall area at an elevation of approximately 980 ft. This stream enters the Lake at the end of Lake Shore Drive very close to the VLAP Morotta Inlet sampling site. Samples were taken from this point at both sampling times, before and after heavy rainfall.

The direction of flow is shown in a LIDAR depiction (Fig. 4).

RESULTS

Results are shown in Fig. 2 and Table 1. As can be seen from Fig. 2, the level of chloride found in water taken from below Deering Center Road (9.3 – 1620 mg/L) was a minimum of ten times greater than the ambient levels measured from above Deering Center Road (0.72 - 0.8 mg/L), and in most instances much greater. The level where Stream B enters the Lake at Morotta Inlet was 109 mg/L for the first sample and 174 mg/L following road salting and heavy rain, about 200 times the ambient, and the level of the chloride in the wetland immediately below the salt storage shed following road salting and heavy rain was 1670 mg/L in the first sampling and 979 mg/L in the second and following rainfall, about 1500 times the ambient chloride level. We observed dead and dying plants in this wetland.

DISCUSSION

Chloride pollution in Deering Lake appears to come from the three salted roads in the Lake's watershed - Deering Center Road, Reservoir Road, and Old County Road. These roads are salted when snow/ice conditions prevail. For many years volunteers (DES VLAP Program) have been testing for pollutants in the water of Deering Lake and the streams that feed it. These results, chiefly obtained from testing done from early summer to early fall, strongly suggest that chloride washed from the salted roads is entering the groundwater and, ultimately, Deering Lake and possibly drinking water wells.

The level of chloride in Deering Lake has been steadily increasing over the past fifteen years. VLAP Lake water testing since 2010 shows an increase of about 40% since 2017 when compared to the prior seven years, 2010 – 2017. While current chloride levels are lower than NH state chronic chloride standard of 230 mg/L, recent research has shown that chloride is toxic to aquatic life at levels as low as 150 mg/L. The chloride level in Morotta Inlet, in the north end

of the Lake and always the highest in the Lake, has reached 120 mg/L (2015, 2022) and typically runs around 100 mg/L. Increasing chloride in the Lake is a matter of concern.

The objective of this study was to determine whether the Deering Highway Department's salt storage shed, situated in the Town Hall area on high ground less than 1/3 mile from the Lake, is contributing to the chloride pollution in the Lake. We found a considerably lower level of chloride in 'control' sites, water taken from sites above Deering Center Road Deering Community Church Well and a stream that rises in the Gregg Hill Lot), as compared to the level of chloride in water sampled down slope of Deering Center Road, including the Town Hall well itself. This indicates that the salt applied by State DOT to Deering Center Road is a contributor of chloride to Deering Lake. The Town has only limited ability to control the amount of salt applied by State DOT.

However, our results show that streams down slope from the Highway Department salt storage shed contain considerably more chloride than do streams that do not receive runoff from the Town Hall area (compare Figs.1, 2).

While it is difficult to parse the source of the chloride, whether salt that washes from Deering Center Road is a greater contributor of chloride than the salt storge shed, Stream A can give a clue. The chloride levels in Stream A at the Fisher Road culvert are much lower than the levels found at sites immediately down slope from the salt storage shed and at the south end of Lake Shore Drive where Stream B enters the Lake at Morotta inlet. The Fisher Road Culvert is only about 20 ft lower than salt storage shed, thus likely receives less runoff from the storage shed.

These results highlight the salt storage shed as a source of chloride in the Lake. While chloride enters the Lake from all streams that feed it, likely from winter-salted roads in the watershed, that amount is considerably increased by chloride coming from the salt kept in the salt storage shed.

The most concerning site is the wetland below the salt storage shed. In the first sampling, when no salt was applied to Deering Center Road, chloride level was 1620 mg/L, which clearly shows high contamination by road salt from the salt storage area. Vegetative die-off was observed at the sampling site in the wetland. Chloride is likely flushing from an exposed pile of sand/salt in the Highway Department parking area into the wetland and, ultimately, the Lake, after each rain event. The chloride levels in the wetland decreased from 1620 to 979 mg/L after the March 23rd snowstorm, suggesting a flushing/dilution effect from the snowmelt/rain flowing into the wetland. Because chloride does not break down, some percentage of the high chloride level in the wetland.will, in time, find its way into Deering Lake. This wetland (Tax map 228 Lot 2) is privately owned. The salt contamination of the wetland and the private drinking well that are immediately below the salt storage shed might pose a liability for the Town.

Another source of chloride in groundwater and the Lake is from salt applied to the Town Hall parking lot, which is swept up with snow by road crews into salt-laced snow piles at its edge, a bluff overlooking the Highway Department, and left there to melt.

Our results may have resolved another perplexing question: why is the chloride level in Morotta Inlet always so high? We only sampled from the newly discovered Stream B in late winter and following road de-icing and heavy rain; chloride levels for the two sampling periods were high, respectively, 109 and 174 mg/L. Under our usual VLAP testing regimen for the Lake, we sample from a stream that rises in a wetland at the low point of Reservoir Road and enters the Lake at Parley's Way, very close to the end of Lake Shore Drive. The 2023 results, from samples taken in May, June and August – at times far removed from winter road salting -- ranged from 68 – 75 mg/L. We do not know what the chloride load of this stream is after a winter de-icing followed by rain, but the relatively high level observed in the summer suggests that the level could be quite

high. The fact that Morotta Inlet receives water from two sources that are high in chloride can possibly explain the consistently high chloride level in Morotta Inlet, despite diminished winter salting on Reservoir Road claimed by the Highway Department.

The results of our testing for the occurrence of chloride in waters that feed the Lake show that both salt applied to Deering Center Road, salt stored in the Highway Department's salt storage area, and salt in snow plowed from Town Hall parking lot add chloride to Deering Lake and that the chloride originating from the area of Town Hall is significantly augmenting that washed from Deering Center Road.

The water testing reported here only examined water flowing into the Lake at its north, Zoski Road, end and then shortly following the application of salt to Deering Center Road and of active use of the salt storage shed. Samples taken by VLAP from the Lake's main inlet, a wetland near the Wilkins Cemetery on Old County Road, during summer of 2023 ranged from 20 mg/L in June to 30 mg/L in August, considerably lower level of chloride than is found in water entering the Lake at Morotta Inlet, but still a likely contributor of chloride to the Lake.

Consequences of chloride in Deering Lake water. Figure 3 graphically illustrates the effects that road salt has on Deering Lake. There is no natural process by which chlorides are broken down, metabolized, or taken up by vegetation.

Road salting Is not the only source of chloride in the Lake. The Deering Lake watershed is served by many miles of paved and unpaved roads. While the unpaved roads are not salted during the winter, they are subjected to dust suppressing chemicals during the summer. These chemicals, in the past calcium chloride, but now magnesium chloride instead of calcium chloride. These chemicals, $CaCl_2$ and $MgCl_2$, slowly disassociate into their component ions and their main use is to bind to the road surface, but they do disassociate and release chloride and under current climate predictions, roads will be subjected to increasingly frequent and heavy downpours that will wash road surface materials into the surrounding environment. Thus summer application of calcium or magnesium chloride will contribute chloride to the Lake.

ACKNOWLEDGMENTS

Deering Resident Gary Smith contributed significantly to the project.

RECOMMENDATIONS

In summary, chloride levels are rising in the Lake and it is not too soon to adopt mitigation efforts. Winter road salting is the primary source of chloride in the Lake. This chloride comes from road surfaces and, our results show, the Town salt storage facility.

The following recommendations and best management practices can help in the effective and efficient use of de-icing materials while reducing the impact and preserving the water quality of Deering Lake:

1. The chloride test results strongly support the need for the Road Agent and other interested Highway Department employees for training in salt application (calibrate equipment, use appropriate application rates, record storm events, time, application rates, and other important information describing maintenance activities and results, training, etc.). While NH DES Green SnowPro certification is not available to municipal employees, the many training courses under this program are. DES will offer Municipal Green SnowPro Certification for the 2025/26 season but details of this program are not yet available to take courses under the UNH T2 Green

SnowPro Winter Maintenance program. We recommend that the Town provide tuition to all Highway Department Employees for Winter Snow Maintenance who wish to take the training. The Town should explore Green SnowPro Municipal Maintenance Certification when the details are known.

2. It is essential to minimize accidental dispersal of salt from the salt storage shed. The salt should be fully contained in the covered part of the shed with minimal spillage when loading trucks. **The best option is to relocate the salt storage shed to the Hedgehog Mountain sand pit, which is outside of the Deering Lake Watershed.**

3. **Salt kept in the salt storage shed must be covered** so as to limit the effect of the elements that are leaching chloride into the wetland below. It should be stored on an impermeable base.

4. Prohibit the use of dust suppression chemicals in the Watershed Protection Overlay. At the Select Board meeting of 1 February 2024, Chair Smith agreed with Conservation Commission concerns that it would be a good idea not to use dust suppression chemicals in the Watershed Protection Overlay. Our understanding was that these chemicals would not be used without further study. We urge BOS to prohibit use of calcium chloride or magnesium chloride in the Watershed Protection Overlay.

5. Stop using magnesium chloride as a de-icer and dust suppressor. Research indicates that magnesium chloride has a far greater deleterious effect on aquatic life than does calcium chloride, despite the advocation of its use by a company representative who was seeking to sell magnesium chloride to the Town. Conservation Commission sent a message with supporting references to BOS shortly after the meeting of 1 February. A copy of that letter is attached here.

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8. Properly maintain and improve storm ditches and culverts to slow and infiltrate stormwater runoff into the Lake and reduce road erosion from major rainfall events**. The Deering Hazard Mitigation Plan Update 2021 highlights several culverts that require upgrading.**

9. Develop a Deering Lake Watershed Management Plan.

10. The Conservation Commission will continue monitoring chloride levels in the Lake and provide water quality testing results to the BOS.

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Table 1. Sampling locations, conditions, and results of sampling for chloride in water in the Town Hall area of Deering, March 2024

Station	GPS	Date	Hour	Chloride level	Stream Conditions	Cloud Cover	Air Temp (°F)	Wind Conditions	Precip when Sampling	Ppt 24H Prior (")	Ppt 72H Prior (")	Time since last ppt (days)
DEERTHW	*Deering Town Hall Well*	3/13/204	1:00 PM	32.4	Town Hall Well	Hazy	41—60	Calm	None	0	0	4
		3/28/2024	-	-		-	-	-	-	-	-	-
DEER149GH	43.07548 -71.84781	3/13/204	1:06 PM	0.72	Moderate	Hazy	41—60	Calm	None	0	0	4
		3/28/2024	9:05 AM	0.72	High	Overcast	41—60	Calm	Light Drizzle/rain	Yes*	Yes*	-
DEER149FR1	43.07434 -71.84834	3/13/204	1:15 PM	9.29	Moderate	Hazy	41—60	Calm	None	0	0	4
		3/28/2024	9:05 AM	9.14	High	Overcast	41—60	Calm	Light Drizzle/rain	Yes*	Yes*	-
DEEDRGZ (VLAP Site)	43.07185 -71.85192	3/13/204	1:36 PM	10	Moderate	Hazy	41—60	Calm	None	0	0	4
		3/28/2024	9:12 AM	10.9	High	Overcast	41—60	Calm	Light Drizzle/rain	Yes*	Yes*	-
DEERRS2	43.06970 -71.84611	3/13/204	1:44 PM	109	Moderate	Hazy	41—60	Calm	None	0	0	4
		3/28/2024	9:13 AM	174	High	Overcast	41—60	Calm	Light Drizzle/rain	Yes*	Yes*	-
DEER149FR2	43.07221 -71.85198	3/13/204	1:56 PM	21.8	Moderate	Hazy	41—60	Calm	None	0	0	4
		3/28/2024	9:13 AM	27.6	High	Overcast	41—60	Calm	Light Drizzle/rain	Yes*	Yes*	-
DEERRS1	43.07304 -71.84685	3/13/204	2:36 PM	44.4	Groundwater	Hazy	41—60	Calm	None	0	0	4
		3/28/2024	-	-	-	-	-	-	-	-	-	-
DEERRS3	43.07331 -71.84689	3/13/204	2:58 PM	24.8	Groundwater	Hazy	41—60	Calm	None	0	0	4
		3/28/2024		-	-	-	-	-	-	-	-	-
DEERRSSW	43.07374 -71.84729	3/13/204	3:09PM	1620	Surface Water	Hazy	41—60	Calm	None	0	0	4
		3/28/2024	9:13 AM	979	High	Overcast	41—60	Calm	Light Drizzle/rain	Yes*	Yes*	-
DEERCHW	Deering Church Well	3/13/204	7:00 PM	0.802	Church Well	Hazy	41—60	Calm	None	0	0	5
		3/28/2024	-	-		-	-	-	-	-	-	-

*Late season snow-ice storm on Saturday, March 23rd; approx. 5-7 of snow with a layer of ice; Road Salt applied to paved roads.
Rain on Wednesday night and Thursday, March 27-28th resulted in extensive snow melt into streams and high stream flow.

Figure 1. Map of Sampling Sites

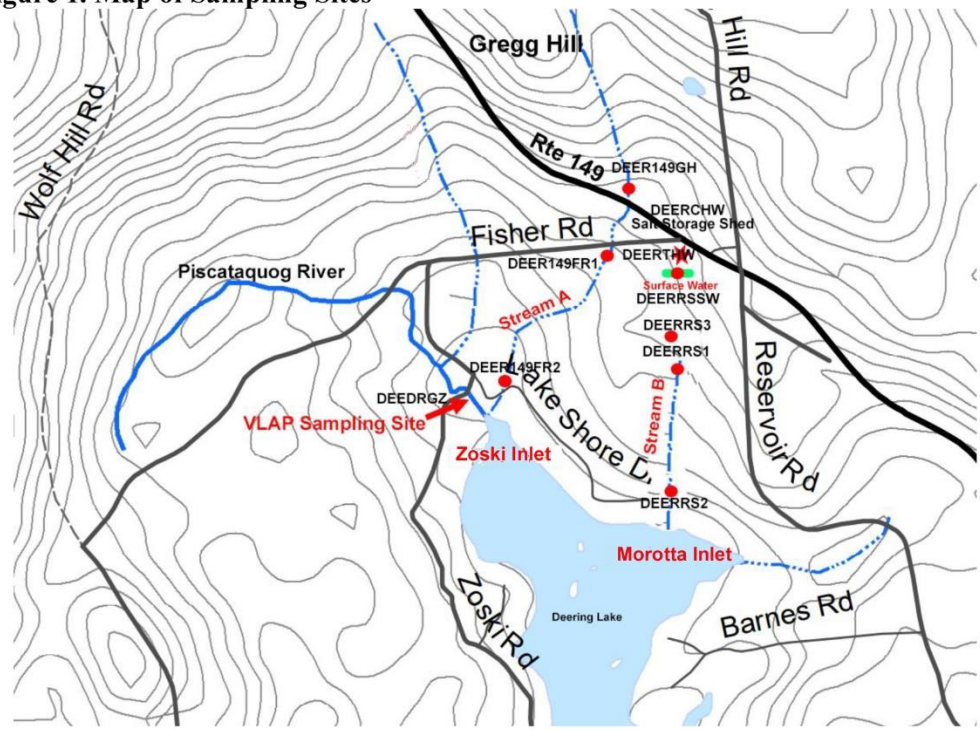


Figure 2. Chloride test Results

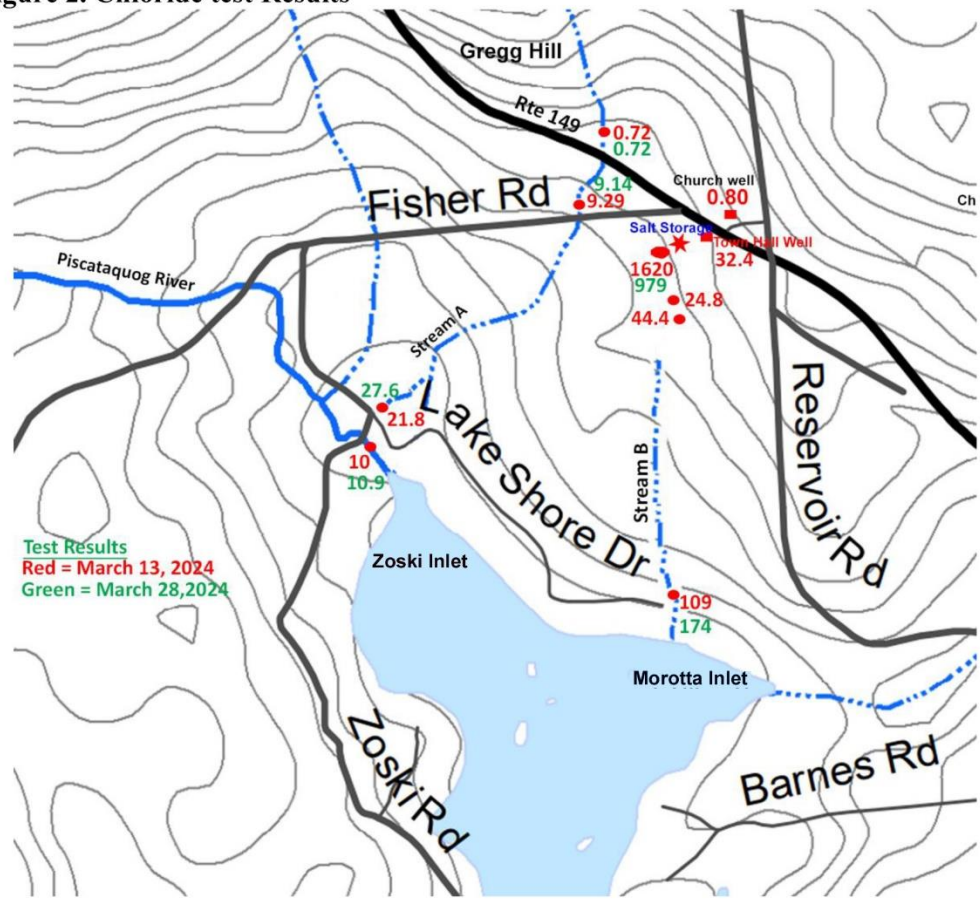


Figure 3. Consequences of Chloride in Deering Lake water

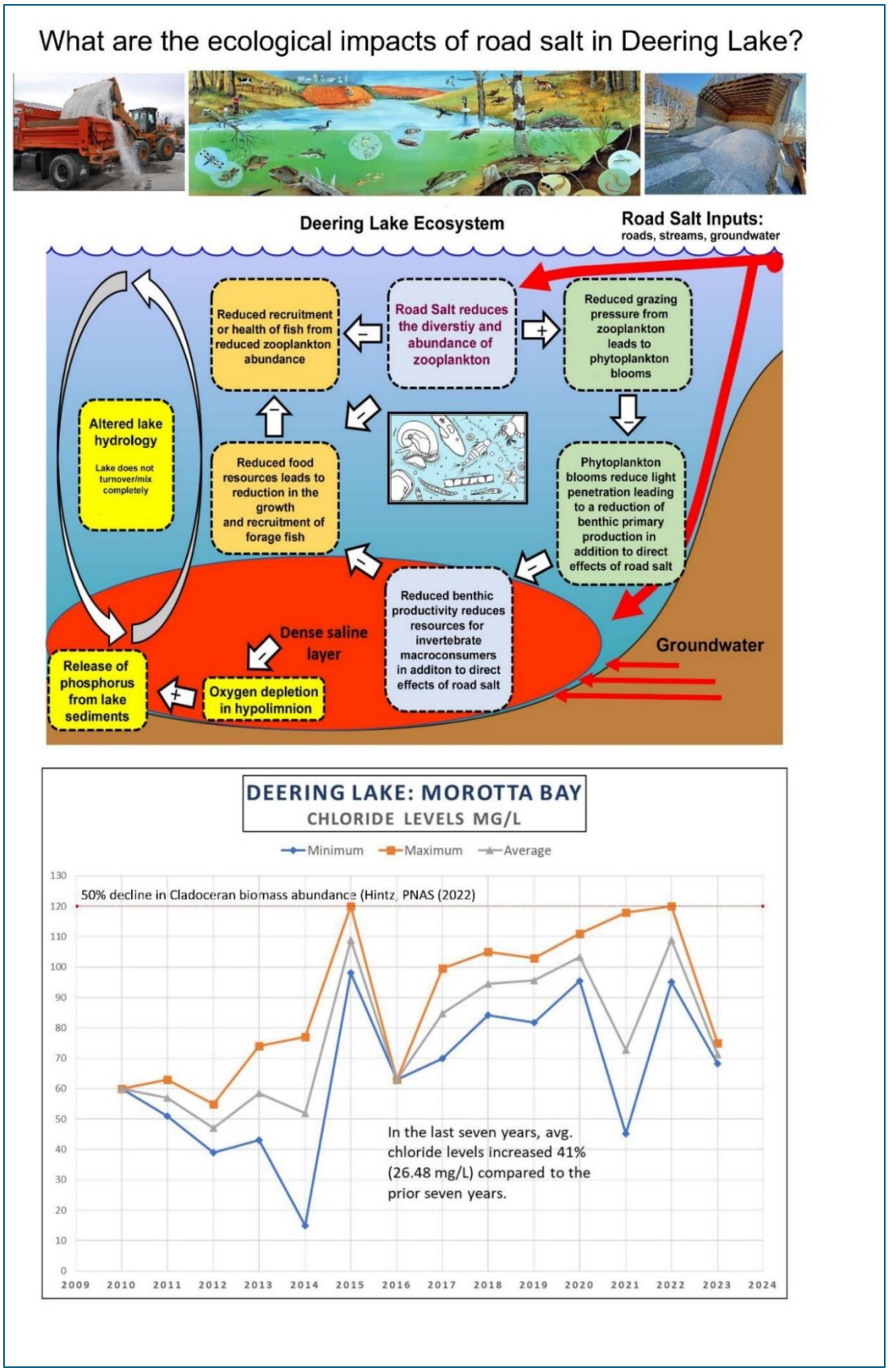
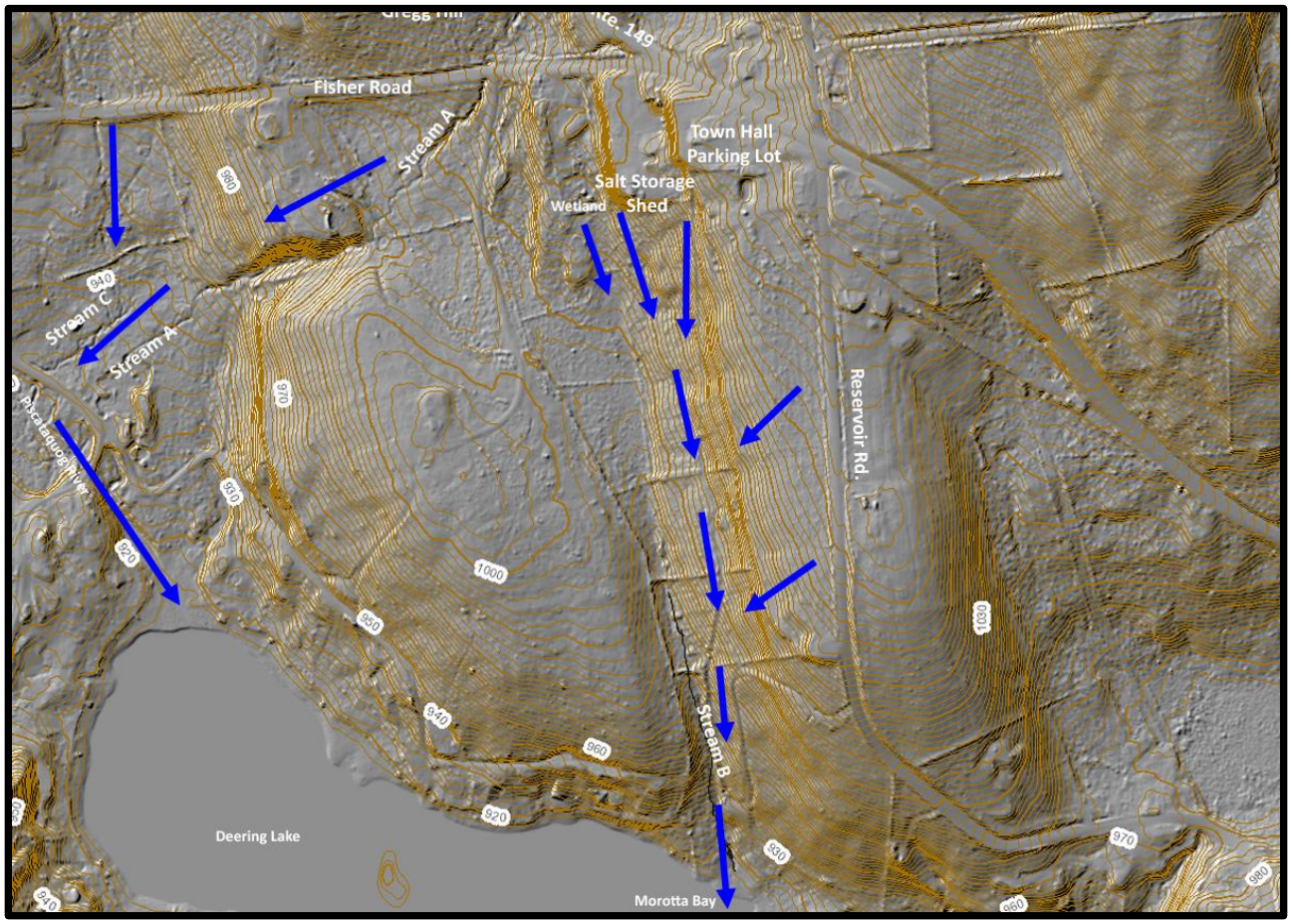


Figure 4. LIDAR map depiction showing direction of flow



Board of Selectmen,

Thank you for giving the Conservation Commission the opportunity to speak on the increasing levels and harmful effects of chloride from de-icing and dust suppression chemicals in Deering Reservoir at your meeting of 1 February. Attached for your review are the data provided by DES on the chloride measurements from Deering Lake and inlet/outlet streams since 2010, as well as a map of the sampling sites located within the Watershed. A summary of the data follows:

During the past seven years (2017-2023), the average chloride levels in Deering Lake and the inlet/outlet streams (34.78 mg/L) have increased by 40 percent when compared to the average levels of the prior seven years (24.82 mg/L, 2010-2016). Although chloride levels are well below NH chronic chloride levels (250 mg/L), the significant increase in a relatively short period is of concern, esp. in Morrotta Inlet (near the Zoski end of the Lake, east side), where levels reached 120 mg/L in 2015 and 2022. DES has commented that elevated levels of chloride in the Lake suggest negative impacts from winter road salts and encourages NH Salt Applicator License through the Green SnowPro Certification Program. We note that many of the public roads within the Watershed Overlay area are in fact much more intimately associated with Deering Lake than are the more peripheral paved roads such as Reservoir or Old County Roads. They are dirt and subject to the application of chloride-containing dust suppression materials during warm months, which can be washed into adjacent soil by runoff from the Lake's surrounding slopes. It's too early to tell if the chloride levels have stabilized or will continue to increase in the coming years. Much of this will depend on how much de-icing and dust suppression chemicals containing chloride are used within the Watershed compared to current amounts.

A summary of the data is provided below:

Morotta Inlet:

- 7 yrs 2010-2016: avg chloride was 63.7 mg/L; min 15mg/L in 2014 & max of 120 mg/L in 2015.
- Last 7 yrs 2017-2023: avg chloride was 90.18 mg/L; min 70mg/l 2017 & max of 120 mg/L in 2022.

In the last seven years, the avg. level of chloride measured in Morotta Inlet has increased by 26.48 mg/L when compared to the prior seven years. This represents a 41 percent increase. Something changed in 2015 when there was a significant increase in the chloride levels in Morotta Inlet that continues to present. The Conservation Commission, with assistance from DES, will be conducting more frequent chloride testing this year to understand the source of the problem better.

Zowski Inlet

- 7 yrs 2010-2016: avg chloride was 13.31 mg/L; min 1.5mg/L in 2010 & max of 24 mg/L in 2014.
- Last 7 yrs 2017-2023: avg chloride was 19.96 mg/L; min 10.5mg/l 2020 & max of 27.6 in 2019.

In the last seven years, the avg. level of chloride measured in Zowski Inlet has increased by 6.65 mg/L when compared to the prior seven years, a 49 percent increase.

Main Inlet

- 7 yrs 2010-2016: avg chloride was 24.39 mg/L; min 7.7mg/L in 2013 & max of 38 mg/L in 2011.

- Last 7 yrs 2017-2023: avg chloride was 31.77 mg/L; min 16.7mg/l 2021 & max of 44.9 in 2022.

In the last seven years, the avg. level of chloride measured in the Main Inlet, on Old County Road at Wilkins Cemetery, has increased by 7.38 mg/L when compared to the prior seven years, a 30 percent increase.

Main Outlet

- 7 yrs 2010-2016: avg chloride was 11.27 mg/L; min 7.8mg/L in 2013 & max of 15 mg/L in 2016.

- Last 7 yrs 2017-2023: avg chloride was 16.16 mg/L; min 19.3mg/l 2021 & max of 20 mg/L in 2021.

In the last seven years, the avg. level of chloride measured in the Main Outlet, at the dam, has increased by 4.89 mg/L when compared to the prior seven years, a 43 percent increase.

Deep Spot

- 7 yrs 2010-2016: avg chloride was 11.37 mg/L; min 7.6mg/L in 2012 & max of 16 mg/L in 2015.

- Last 7 yrs 2017-2023: avg chloride was 15.84 mg/L; min 12.1mg/l 2018 & max of 18.7 mg/L in 2023.

In the last seven years, the avg. level of chloride measured in the Deep Spot has increased by 4.47 mg/L when compared to the prior seven years, a 39 percent increase.

I combined the sampling data from all of the above sampling sites and did a similar comparison.

Deering Lake and Inlet/Outlet Streams (Five Sampling Sites)

- 7 yrs 2010-2016: avg chloride was 24.82 mg/L

- Last 7 yrs 2017-2023: avg chloride was 34.78 mg/L

In the last seven years, the avg. level of chloride measured in Deering Lake and the inlet/outlet streams increased by 9.96 mg/L when compared to the prior seven years, a **40 percent increase**.

As requested by the Select Board, references and links referring to the effects on water bodies and their biota of salt and other chloride-containing produicts to roads are provided below. As Mr. Beliveua commented, there are conflicting viewpoints on the pros/cons and environmental impacts of using CaCl2 vs. MgCl2. As with much research, the results and conclusions sometimes differ. However, one thing is clear – increasing usage of either of these chemicals in the Watershed above current levels will most likely result in higher chloride levels in the groundwater and Lake.

- An excellent video (https://www.youtube.com/watch?v=5YmeoWUaizU) on the "Ecological Consequences of Salting our Freshwater Ecosystems" presented by Dr. Bill Hintz at the University of Toledo, Department of Environmental Sciences. He presents an easily understood overview of the negative impact of chloride on the food web (Zooplankton) and the ecological consequences (increased algal blooms). When watching the video, keep in mind that the Chloride levels in Morotta Inlet reached 120 mg/L in 2022 and 2015.

- "The combined effects of macrophytes and three road salts on aquatic communities in outdoor mesocosms" Kayla Coldsnow & R. Relyea, Dept. of Biological Sciences, Darrin Fresh Water Institue, Rensselaer Polytechnic Institute, Troy, NY. Environmental Pollution, Vol 287, 15 Oct. 2021.
  "$MgCl_2$ had the largest and longest lasting effects on zooplankton, specifically cladocerans and copepods, which resulted in a significant increase in phytoplankton and rotifers."

  Link: https://www.sciencedirect.com/science/article/abs/pii/S0269749121012343

- Detrimental Effects of Magnesium Chloride on Aquatic Macroinvertebrates
  Link: https://www.enviroad.com/detrimental-effects-of-magnesium-chloride-on-aquatic-macroinvertebrates/#:~:text=Posted%20June%2016%2C%202020%20.,2017

- A comparison of Calcium chloride vs. Magnesium chloride (performance, corrosiveness, & environmental impact); Pollard Highway Products.
  http://pollard.mnsi.net/calvsmag.html

- A Case for Calcium Chloride; AKJ Chemicals
  https://www.akjchem.com/cacl-versus-magcl#:~:text=The%20NACE%20survey%20also%20indicates,to%20mild%20steel%20than%20CaCl2.&text=Although%20CaCl2%20and%20MgCl2%20are,a%20common%20measure%20of%20toxicity

We thank the Board of Selectmen for being proactive in addressing the chloride levels in Deering Lake and for prohibiting the use of MgCl2 within the Watershed Protection Overlay until more data can be collected to understand the reasons for the increased chloride levels.

Four action items were proposed at the February 1st BOS meeting:

1) Prohibited use of MgCl2 in the Watershed Protection Overlay,

2) Cionservation Commission to identify/recommend low salt usage areas in town,

3) Green SnowPro education/certification, calibration of equipment, and record keeping,

4) Increased monitoring of chloride levels by the CC. These actions will help maintain the health of Deering Lake for future generations.

Thank you,

Gary Samuels and Mike Thomas

Deering Conservation Commission