Environmental Stewardship Plan for Pitt Meadows Gun Club

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PITT MEADOWS
GUN CLUB

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Introduction

The Pitt Meadows Gun Club (PMGC) is a local shooting sports club with an extensive history in the Pitt Meadows community. The club established in 1946 making it possibly the oldest community activity provider in Pitt Meadows. The PMGC has been at its current location since 1976 where it owns and occupies the 20 acre (8.1ha) property located at 17428 129th Ave, Pitt Meadows, BC (N49°14'08" W122°44'15"). The PMGC is a non-profit society established to allow recreational and competitive shotgun sports to be enjoyed by the local community.

The PMGC currently provides an opportunity for club members and the public to participate in clay target shooting sports. Membership in the club controlled by the PMGC executive and member privileges may be restricted or revoked if club rules are not adhered to. PMGC follows a set of range safety rules that are in alignment with the Royal Canadian Mounted Police (RCMP) Range Design and Construction Guidance (RCMP 2007).

PMGC is a safe environment for local shooters to practices their skills with clay targets. PMGC also holds regular trap shooting completions sanctioned under the Pacific International Trap Shooting Association (PITA) and PMGC is a member of the British Columbia Trapshooting Association (BCTA). Along with practice and competition the PMGC provides shooter education and safety instruction for members of the public interested in trying the shooting sports. PMGC takes pride in being a member of the local community and the club has hosted the Environmental School Project (School District 42) and provided a site for their outdoor education activities. PMGC also regularly allows local community groups (e.g. BC Wildlife Federation - Becoming an Outdoors Woman and vintage car clubs) to use the facility and clubhouse for meetings and events.

The PMGC normally operates year round on Sundays (10 AM to 4 PM) and Wednesday evenings (6 PM to 9 PM). During the year the PMGC also hosts a number of events that may occur on other days of the week; these events are posted on the PMGC website (http://pittmeadowsgunclub.com).

PMGC recognizes that protection of the environment is important and that having a plan to manage the lead shot used for trap shooting is a key responsibility. In recognition of this responsibility the PMGC has formed an Environmental Committee to manage environmental stewardship for the club. The Environmental Committee includes several members with extensive backgrounds in environmental science with more than 50 years of combined professional environmental experience.

This environmental stewardship plan has been developed by the members of the PMGC Environmental Committee and is based on information provided in the BC Wildlife Federation Standards and Best Practices for Lead Management, Implementation Manual (BCWF 2016).

The Purpose of this Environmental Stewardship Plan is the following:

- Identify potential environmental concerns
- Document a Monitoring Plan and criteria to measure success
- Evaluate appropriate management actions
- Provide an implementation schedule

Site Description

Range Facilities

Currently the PMGC has 4 trap fields located on the property. The general arrangement of the club including the club house, storage buildings, parking lot, shooting stations (concrete pads) and trap houses (contain the trap machines that throw the targets) are shown in Figures 1 and 2 below. The skeet field present at the northwest portion of the PMGC property is no longer in use.

Access to the PMGC is limited to a single driveway that has a lockable gate that is locked when the club is not open. The boundaries of the PMGC property are clearly marked with signage that conforms to the RCMP range design guidance (RCMP 2007).

Distribution of Shot Fall

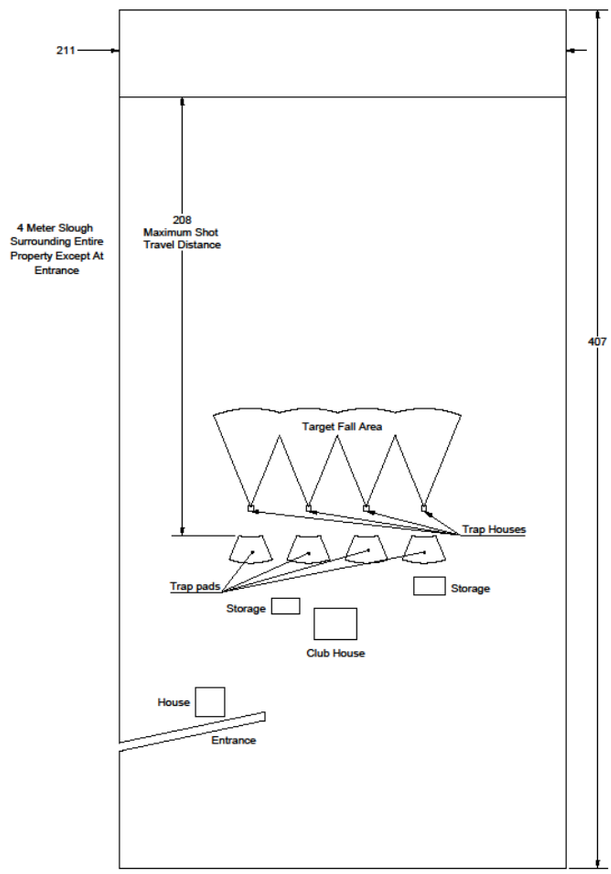
The Pitt Meadows Gun Club understands that control of shooting direction and the shot fall distribution is important for both safety and lead management. Understanding the shot fall distribution and control of shot fall allows PMGC to more effectively manage lead on the property. The PMGC and all of its facilities have been surveyed and the maximum shot travel and normal shot fall distributions are well understood. The majority of shot used for trap shooting lands between 115m and 180m (NSSF 1997) in front of the shooting stations. The maximum distance of shot travel for the largest shot size (7.5) allowed at PMGC is 208m (RCMP 2007). Based on the maximum distances shot travels, the layout of the trap fields and the maximum angles of targets thrown (Target Fall Area in Figure 2) the shot fall zone for the four trap fields is contained within the PMGC property.

Figure 1 Air photo of the Pitt Meadows Gun Club

Note: Image is from the south and facing to the north

The clay targets travel approximately 50 m east out of the trap houses (the four green boxes in image above) and land in an area that is covered by tall grass (Figure 1 and 3). The shot fall zone begins approximately 50m beyond the target fall zone and is covered by dense shrub and forest vegetation (Figures 1 and 3).

Figure 2 General arrangement of trap fields and facilities at the Pitt Meadows Gun Club.



Note: 1) Figure is shown with east at the top
2) Distances shown are in meters and the maximum shot travel distance is based a shot size of 7½ (Maximum allowed at PMGC) and the Canadian Firearms Centre Range Design and Construction Guidelines (RCMP 2007)

Environmental Conditions Effecting the Fate of Lead in the Environment

The fate of lead in the environment is influenced by a number of factors. The distribution of lead shot associated with shotgun ranges is normally limited to surface and near-surface soil layer within the shot fall zone. This lead has the potential to be dispersed into the environment in several ways:

- Lead oxidizes when exposed to moist air and can dissolve when exposed to water.
- Lead shot, shot particles, or dissolved lead can be moved by surface water runoff
- Lead particles or lead adsorbed to silt and clay can move in strong winds
- Dissolved lead can migrate through soils to groundwater.

The solubility of lead in water is dependent on pH and contact time with water. Increased contact time between lead and lower pH water generally results in an increased amount of dissolved lead in solution. In contrast, moderate pH (6.0-8.0) tends to cause dissolved lead to precipitate out of solution.

Soil factors such as clay and organic carbon are known to bind and limit the transport of dissolved lead through adsorptive and absorptive processes. Clay soil layers can also act as barriers to inhibit the mobility of soluble lead. Clay particles themselves are known to adsorb lead taking it out of solution.

Organic soil material may also remove lead from water. High organic carbon content can also induce reducing conditions favorable to the formation of lead sulfides, which are relatively insoluble and immobile. Thicker organic-rich soil covers (e.g., leaf and peat cover) result in lower concentrations of lead in solution (EPA 2005).

The movement of soil by surface water runoff or wind can transport lead particles. Soil type, slope of ground and vegetation cover can all influence soil erosion. Fine exposed soils in steep terrain are prone to erosion by wind and surface water. Larger particles and level terrain are less prone to erosion. The ability of surface water runoff to carry lead particles is proportional to the steepness of the terrain and the velocity of surface flow.

Clay Targets in the Environment

Clay targets used for trap shooting are composed of approximately 70% dolomitic limestone, 30% petroleum pitch. Historically concerns have been raised regarding the potential toxicity of the components used to make the targets. In direct toxicity tests Baer et al, (1995) found that clay target materials were essentially non-toxic to marine and freshwater organisms. In leachate tests they found, the leachate was not-toxic to test organisms. The targets did not exhibit characteristics of toxicity but did contain substantial amounts of polycyclic aromatic hydrocarbons (PAH). Testing of both new and weathered targets suggest that the PAHs in clay targets are tightly bound in the petroleum pitch and limestone matrix and are not readily available to the environment (Baer et al. 1995, Battelle. 1990, Lobb 2006).

Even though the PAHs in the targets are unlikely to be released to the environment, the target landing zone at PMGC is maintained with a heavy cover of perennial grasses and vegetation is known to breakdown and mitigate hydrocarbons in soil. Phytoremediation, using living green plants to “clean-up” hydrocarbons such as PAHs in soil is a common management practice. There is an an extensive body of research on the phytoremediation of both organic and inorganic contaminants (Chaîneau et al., 1997; Singer et al., 2003). Plants exude organic compounds through their roots, which increase the density and activity of microorganisms around their roots, which in turn breakdown hydrocarbons and “clean” the soil (Siciliano et al. 1998).

Environmental Conditions at PMGC

The following section describes the environmental conditions, relevant for the management of lead shot, currently present at the PMGC.

Precipitation at the PMGC

The amount of annual precipitation can influence the contact time between water and lead. Increased precipitation may also influence surface water transport of lead particles. Annual average precipitation in Pitt Meadows is approximately 2252mm (Pitt Meadows Airport, approximately 2.0 km from PMGC).

Hydrology

The PMGC is surrounded by ditches on all four sides of the property (Figure 3). The first ditch runs along the west side of the property flowing to the north where it joins the ditch that flows along the north side of the property. The ditch running along the north side of the property flows to the east past the property and then turns north and flows toward the pump station on Katzie Slough. The drainage pattern is generally toward the north following the slope of the land toward Katzie Slough and the Pitt River. The second ditch runs along the south side of the property and then turns north and runs along the east side of the property before turning east again once it is beyond the PMGC property. The ditch running along the south and east side of the property is used to store and move water between the cranberry fields in the area. The direction of flow in these ditches is variable and is determined by pumping and redistribution among the cranberry fields. At the northwest corner of the PMGC property, the elevation of the water surface in the southern ditch (cranberry field irrigation) is approximately three meters higher than the northern ditch. *Refer to Figure 3*. The difference in water elevation between the two ditches indicates that any water exchange would be down gradient and to the north.

Data provided by iMAPBC taken from a groundwater well (49.24086 N 122.73325 W) located 500m north east of the PMGC shows the groundwater elevation in the area to be approximately three meters below the ground surface. The shallow water table indicates the groundwater in the area, including the groundwater of the PMGC property, is expected to be in continuum with the surface water in the northern ditch and as a result the movement of both are prone to follow the natural gradient toward Katzie Slough. It is recognized that the area is tidally influenced and that there are seasonal changes to the operation of the pumping station on Katzie Slough. This will create episodic backwatering and storage effects however it will not alter the general flow gradient.

Figure 3

Note: Blue arrows indicate direction of flow in west and north ditches.
Yellow arrows indicate the variable direction of flow in south and east ditches.

Potential for air born dispersion of lead

Lead exposure from air born particulates released during firearm discharge has been raised as a concern in indoor shooting ranges that have inadequate ventilation. Ventilation systems are routinely used to effectively address this concern (Public Health Ontario 2014) however the PMGC is an outdoor range only and as such there is no requirement for a for a ventilation system.

Potential for Surface Erosion in the Shot Fall Zone

The shot fall zone of the PMGC is very flat with minor surface undulations. A visual survey of the shot fall zone did not identify any evidence of surface water erosion or surface water movement. The level terrain and dense vegetation actively limits the potential for surface water movement or erosion as well

as the movement of lead particles by surface water or wind. A dense cover of suitable vegetation is an effective preventive measure to address soil erosion by wind and surface water runoff (EPA 2005).

Vegetative Cover in the Shot Fall Zone

The area in front of the trap fields where the shot fall occurs is heavily vegetated with trees, shrubs and groundcover (Figures 1 and 3). The vegetative cover is uniformly dense and includes black cottonwood *(Populus trichocarpa)*, red alder (*Alnus rubra*), western red cedar *(Thuja plicata)*, vine maple (*Acer circinatum*), himalayan blackberry (*Rubus armeniacus*), salmonberry *(Rubus spectabilis)*, hardhack (*Spirea douglasii),* sword fern (*Polystichum munitum*), red fescue (*Festuca rubra*), hard fescue (*Festuca brevipila*) and perennial ryegrass (*Lolium perenne*). The near field area where the targets fall is densely covered with perennial grass while the shot fall zone is covered by mixed forest that includes trees, shrubs and herbaceous groundcover.

Figure 4 Vegetation cover in relation to the Trap Fields

Note: Picture is along the southern side of the trap field looking east

Soil Conditions

The soil cover present at the PMGC is consistent with general soil conditions in Pitt Meadows. Parent soil material in the area has developed from mixed floodplain deposits of the Pitt River. Surface textures are either silt loam or silty clay loam while the subsurface is mainly silty clay loam with some variation to silty clay. Lithology data provided by iMAPBC taken from a groundwater well (49.24086 N 122.73325 W) located 500m north east of the PMGC identified the subsurface strata to 21.34m as silty sand gray clay. This silty/clay substrate was also confirmed in a stratigraphy core collected by Clague et al. (1983) at the Pitt Meadows Airport (49.21940N 122.71419W) located approximately 1500m south east of the PMGC. Within the shot fall zone of the PMGC the ground is covered by a thick layer of humus with organic material making up the majority of the upper 10cm to 15cm of the soil. As would be expected, preliminary pH monitoring indicated the soil pH conditions are slightly acidic (less than 7.0 pH) due to the high organic content of the soil.

Potential Mitigation and Management Options

There are a number of mitigation and management options available to control the fate of lead associated with lead shot used for clay target shooting.

Range Design

The layout of the trap range can be designed to keep shot fall within the boundary of the range property and to limit the extent of the shot fall zone. Placing the trap fields in a manner that promotes overlapping of the shot fall from each field concentrates the shot fall and limits the size of the shot fall zone.

Avoiding Surface Disturbance

Avoiding surface disturbance of soil within the shot fall zone will reduce the exposure of lead shot to the atmosphere and associated weathering of the shot. This will minimize the chemical and physical processes which breakdown the lead particles that result in the possibility of lead entering solution.

Controlling surface runoff and erosion

Avoiding steep terrain and maintaining vegetative cover within the shot fall zone reduces the potential for surface erosion and surface water runoff moving lead beyond the shot fall zone. If evidence of surface erosion is present, erosion control measures such as the installation of silt fencing, berms and planting cover vegetation may be effective in controlling soil erosion.

Record Keeping

A record of shooting activity may be used to document the amount of lead introduced to the shot fall zone on an annual basis. This information can be used for planning management activities.

Monitoring soil pH

Moderate soil pH of 6.0 to 8.0 tends to keep lead from dissolving and entering water that may be present within the soil. Soil pH below 6.0 may allow lead to dissolve and enter solution when water is present. Monitoring soil pH may be used to identify when mitigation measures are warranted to address the potential for lead being dissolved and transported by water within the soil.

Appling lime to the soil

If soil pH is found to be below 6.0 it is recommended that lime be spread on the shot fall zone to increase the pH (EPA 2005). Spreading lime in the shot fall zone will raise the pH of the soil layer where the lead shot is located and reduce the potential of lead entering solution. Spreading lime is a relatively inexpensive means of adjusting soil pH that is commonly used in agriculture to improve soil conditions. The use of aerial distribution systems is an effective means of treating a fairly large area quickly. Spreading lime may raise soil pH for up to four years following treatment (EPA 2005).

Appling phosphate to the soil

Another option to control lead migration is spreading phosphate. Spreading phosphate will not adjust soil pH but it will bind the lead and keep it out of solution. Phosphate spreading can be done separately or in conjunction with lime spreading.

Lead removal

The collection and removal of lead shot from the shot fall zone is an effective means of reducing the potential for lead moving beyond the shot fall zone. Lead shot is commonly reclaimed and used for the reloading of shotgun ammunition. The reclaimed lead is marketable and the value of the reclaimed shot may be used to offset the cost associated with the removal.

Collecting shot using small scale sifting and raking activities around existing vegetation can yield substantial amounts of shot without removing much of the vegetative cover.

Professional led reclamation companies claim to recover 75% - 95% of the lead in soil (BCWF

2016) however they tend to require heavier equipment and need to do more clearing of vegetation.

Management Options to be implemented at PMGC

The PMGC will implement the following management and mitigation measures:

1. PMGC will monitor vegetative cover within the shot fall zone.

2. PMGC will maintain vegetative cover within the shot fall zone to mitigate surface erosion and maintain the contribution of organic material to the soil for the purpose of reducing the potential for lead movement within the soil.

3. If monitoring results indicate it is appropriate seeding of vegetative ground cover will be implemented to maintain the level of vegetative cover present in the shot fall zone.

4. PMGC will monitor for evidence of surface erosion within the shot fall zone.

5. If monitoring results indicate it is appropriate surface erosion control measures will be implemented.

6. PMGC will monitor soil and surface water pH within and around the shot fall zone.

7. If soil monitoring indicates it is appropriate the application of lime will be used to adjust the pH of the soil in the shot fall zone.

8. PMGC will initiate planning and the development of a lead recovery strategy that is appropriate for the site.

9. PMGC will maintain a record of shooting activity so the amount of lead introduced to the shot fall zone can be tracked.

Monitoring Plan

The PMGC monitoring program will focus on several parameters that are known to influence the fate of lead in the environment. The monitoring program will use visual observation to monitor the vegetative cover within the shot fall zone. The monitoring program will use visual observation to identify evidence of surface water flow and soil erosion within the shot fall zone. Finally the program will monitor soil pH within the shot fall zone and surface water pH in the perimeter ditches that surround the PMGC property.

Vegetative cover monitoring

Vegetation monitoring will be conducted at four locations annually in the summer (July-August). The locations that will be spaced evenly across the shot fall zone. The monitoring stations will be located along a transect that runs north to south across the property in the approximate center of the shot fall zone (150m in front of the shooting stations). The estimation of percent cover for herb, shrub and tree level vegetation will be based upon the methods described in British Columbia Field Manual for Describing Terrestrial Ecosystems, Land Management Handbook Number 25 (BCMELP 1998). The monitoring sites will be flagged and coordinates will be recorded using a hand held GPS so the same sites are used each year. Digital photos will record the vegetation at the time of monitoring.

The results of each vegetation monitoring event will be documented and kept to form a record (Table 1).

Surface erosion monitoring

Visual observation will be used to conduct an annual survey of the ground surface within the shot fall zone to look for evidence of surface water flow that could lead to soil erosion. The same transect that the vegetation monitoring stations will be located along will be followed and the

condition of the ground surface will be observed looking for evidence surface erosion. Areas of exposed soil, minor channels (rills) and gullies will documented. The perimeter of the shot fall zone will then be surveyed and observations for soil erosion will be made in a similar manner and evidence of soil erosion will be documented. Soil erosion monitoring will be conducted during the winter (December – January) when the leaves of deciduous vegetation have fallen and perennial vegetation has died back so the ground surface may be more readily observed.

The results of each surface erosion monitoring event will be documented and kept to form a record (Table 2).

Soil pH monitoring

Four soil pH monitoring sites will be distributed across shot fall zone to evaluate soil pH conditions present within the shot fall zone. The stations will be spaced approximately 50 m apart along a transect running north to south across the shot fall zone (Figure 4). The transect will be located 150 m in front of the shooting stations as this is central to the shot fall zone. Each monitoring location will be flagged and its coordinates documented using a hand held GPS to maintain consistency in the monitoring between monitoring sessions and years.

- Four terrestrial soil pH monitoring locations will be spread evenly from north to south across the shot-fall zone using the same transect that will be used for vegetation and erosion monitoring.

Soil pH monitoring will be conducted twice each year with one monitoring session occurring in the summer (July - August) and a second session occurring in the winter (November - December).

Soil pH will be monitored at each site using a handheld soil pH meter that will be calibrated using standardized 7.0 pH calibration solution prior to each monitoring session.

The results of each soil pH monitoring event will be recorded and kept on file (Table 3).

Surface water monitoring and sampling

Three surface water monitoring stations have been established in the ditches directly surrounding the PMGC. Station 1 is a reference site located in the western ditch upstream of the PMGC. The other two sites (Stations 2 and 3) are located downstream of PMGC property, in the ditches flowing along the western and northern sides of the property (Figure 4). Station 2 is located in the northern ditch after its confluence with the western ditch and just upstream of the small weir located near the driveway into the PMGC property. Station 3 is located in the northern ditch just downstream of the PMGC property.

Surface water pH monitoring and water samples will be collected at each location twice per year, once during the summer and once during the winter. The seasonal sampling events will correspond with the summer and winter water management strategies currently implemented by the City of Pitt Meadows. The surface water pH will be documented and the surface water samples will be sent for analysis at a qualified laboratory where total lead will be determined.

The results of the monthly water sampling taken from November 2017 through March 2019, found that the levels of lead present in water samples from all three sites was below the BC water quality guidelines for the protection of aquatic life (BC ENV 2017). Based on this sampling the lead shot deposited on the PMGC grounds has not contributed to the measured concentrations of lead in the surrounding surface waters. Furthermore, a blind replicate samples were collected from Station 3 for quality control purposes and these sample was within 95% of the original sample.

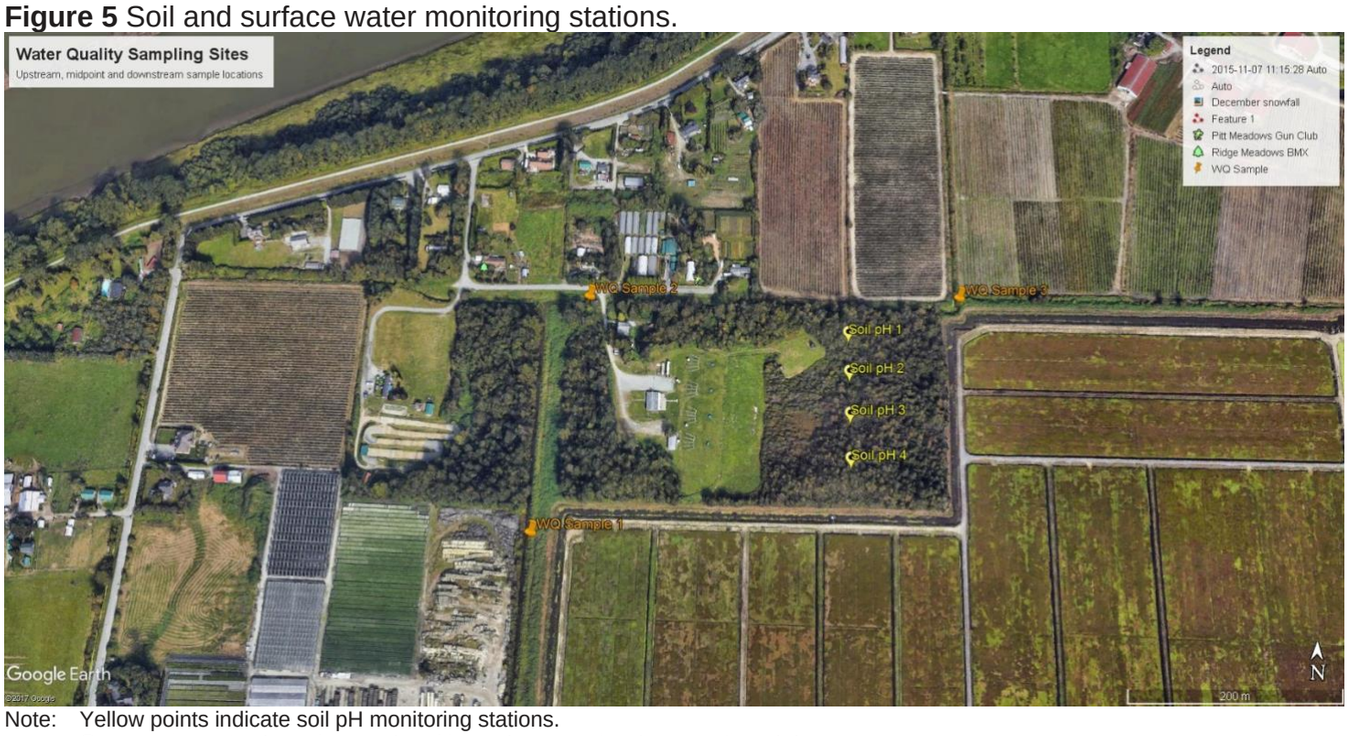
Surface water pH will be monitored at each site using a handheld pH meter that will be calibrated using standardized pH calibration solution prior to each monitoring session.

The results of each surface water pH monitoring event will be recorded and kept on file (Table 3).

The laboratory results for total lead in the water samples will also be recorded and kept on file

(Table 3).

Figure 5 Soil and surface water monitoring stations.



Note: Yellow points indicate soil pH monitoring stations.
Orange pins indicate surface water pH monitoring and water sampling stations.

Monitoring criteria for triggering the implementation of mitigation measures

The following monitoring criteria will be used to evaluate and trigger the application of mitigation or management measures.

Vegetative cover

If visual estimation of vegetation cover identifies a reduction of 20% for the combined vegetative cover provided by trees, shrubs and ground level vegetation, planting of additional ground level vegetation through the application of an appropriate seed mixture (DFO – MELP 1992) will be applied during the next appropriate planting season (spring or fall).

Surface erosion

If visual surveys identify an area with evidence of surface erosion that is larger than 5 m_2 or there is evidence of channel formation that may conduct surface water for more than 10 m, mitigation to address the erosion (surface cover planting) or channel formation (installation of berms, straw bales or silt fencing) will be implemented within one month of the monitoring being conducted. Once implemented the mitigation will be regularly monitored and maintained as necessary.

Soil pH

If soil pH is found to be below 6.0 at one soil pH monitoring site additional soil monitoring will be done at 5 m spacing around the area to delineate the area affected and once the area is delineated localized treatment with lime will be implemented within one calendar year.

If soil pH is found to be below 6.0 at more than one soil pH monitoring site, broad scale treatment with lime will be implemented across the shot fall zone within one calendar year.

The timing and area for the application of each mitigation measure will be documented and kept on record (Table 4).

Lead Recovery Planning and Evaluation

PMGC has been investigating and will continue to investigate lead recovery options for the shot fall

zone. The use of reclaimed lead shot for reloading shotgun shells is a common practice. Most large scale lead shot recovery projects involve vegetation clearing, machine work and extensive soil disturbance. The vegetative cover in the shot fall zone at the PMGC is seen as a benefit and an effective mitigation measure for controlling the movement of lead.

In order to evaluate the potential for lead recovery, while maintaining the vegetative cover, the PMGC implemented a small scale recovery project during 2017, using hand tools and limiting clearing of the vegetation in the shot fall zone. Approximately 950 lbs. (430 kg) of lead shot was successfully collected within a relatively small area.

It was noted that exposed lead shot located at the soil surface showed minor weathering and evidence of oxidation (white powdery covering), the shot that was within the organic soil layer within a few centimeters of the surface showed little or no evidence of weathering or oxidation.

The club will maintain a record of all lead recovery efforts including the areas of lead shot recovery and the quantity (lbs. / kg) of lead collected (Table 5).

Schedule for Implementation

The monitoring plan described above was implemented during 2017 with the first monitoring events occurring during the winter.

The application of identified mitigation measures will be implemented following monitoring and when conditions are suitable for their implementation (e.g. seeding in the spring or fall).

Lead recovery planning is ongoing and will continue.

Environmental Lead Management Plan Review and Revision

The PMGC executive in conjunction with the PMGC Environmental Committee will review this environmental lead management plan on an annual basis in January of each year and will document any adjustments or revisions to the plan. A current version of the plan will be maintained on file at the PMGC.

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Table 1: Vegetation Monitoring Record

DATE	% Cover Herb	% Cover Shrub	% Cover Canopy
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Table 2: Surface Erosion Monitoring Record

DATE	Location	Observation	Area / Length Affected

Table 3: pH Monitoring Record

DATE	Weather Conditions	Soil pH	Surface Water pH	Total Pb
		1) 2) 3) 4)	Station 1) Station 2) Station 3)	Station 1) Station 2) Station 3)
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		1) 2) 3) 4)	Station 1) Station 2) Station 3)	Station 1) Station 2) Station 3)

Table 4: Site Treatment Record

DATE	ACTIVITY PERFORMED	AREA OF TREATMENT

Table 5: Lead Recovery Record

DATE	ACTIVITY PERFORMED	AREA / AMOUNT OF LEAD
July 2017	Test of hand tool collection methods	Approximately 200 m2 in front of trap field 1 / 430 kg