Communities NSW

Southern Highlands Regional Shooting Complex

Water Cycle Management Plan

September 2010

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

Appendices

1. Introduction

1.1 General Purpose and Objective

The purpose of this Water Cycle Management Plan (WCMP) is to provide guidance during the operational and construction phases of the Southern Highlands Regional Shooting Complex to minimise the risk to human health or the environment by reducing the potential for sediment, metal (and other) contamination to migrate to nearby sensitive receptors. The management plan includes details on:

- Aspects of range design associated with pollution control and minimisation;
- Stormwater and wastewater management structures;
- Erosion control measures;
- The application of soil amendments to reduce the risk of metal mobilisation and transport;
- A long term environmental monitoring program and evaluation process;
- A clean up and recycling program for spent munitions; and
- Contaminated soil remediation and/or disposal.

This plan is prepared in accordance with US EPA *Best Management Practices for Lead at Outdoor Shooting Ranges* (EPA; 2005).

Construction phase activities for soil and water management have been detailed in the Soil and Water Management Plan attached in Appendix A. These plans have been prepared in accordance with Landcom's *Soils and Construction: Managing Urban Stormwater* (2004) manual (the "Blue Book").

1.2 WCMP Requirements

This management plan addresses particular issues contained within the Minister's Determination for the proposal, as listed in Table 1.

Table 1 Minister's Requirements

Requirement	Relevant Section
A Soil and Water Management Plan shall be prepared to meet the requirements outlined in Chapter 2 of the NSW Landcom's *Soils and Construction: Managing Urban Stormwater (2004)* manual – the "Blue Book". A copy of the Plan shall be submitted to NSW Planning	All and Appendix A
The design capacity of the amended soil wastewater treatment and disposal system for the proposed shooting complex, including upgrade or transfer of the wastewater system at the existing Hill Top rifle range, must be based on average and peak wastewater loads expected to be generated at the site.	Section 4.2.4
The amended soil mound must be located at least 100 metres from the Rocky Waterholes Creek or any other perennial or intermittent creek or watercourse, and at least 40 metres from any drainage depression and dam.	Section 4.2.2

Requirement	Relevant Section
A detailed water cycle management plan (WCMP) for the operation of the complex prepared by a person with knowledge and experience in the preparation of such plans which is to incorporate the elements of Appendix E of the Environmental Assessment.	All
Plans and procedures for the remediation of any contaminated soils on the site.	Sections 4.2.5 and 4.2.6
Emergency procedures for spill management of any contaminants including diesel.	Section 3.1.3
Ongoing monitoring plan, including monitoring of vegetation health, solids within and around all ranges, stopbutt material, sedimentation ponds, groundwater monitoring, rainwater and the pre and post construction water quality of Rock Waterholes Creek for the key contaminants associated with the development. This plan must incorporate exception reporting as well as annual reporting of outcomes to the Sydney Catchment Authority, with the reporting identifying appropriate mechanisms to modify management practices and procedure where deleterious impacts on vegetation and water quality are demonstrated.	Section 5
Methods for achieving neutral or beneficial impact on water quality.	Section 1.4

1.3 Integrated Water Cycle Management

This management plan incorporates the principles of integrated water cycle management (IWCM). IWCM involves the integration of all aspects of the water cycle, including the supply of water, sewerage and stormwater to deliver sustainable development. The integration of all aspects of the water cycles incorporates urban planning and design via Water Sensitive Urban Design (WSUD).

The objectives of WSUD is to maintain or replicate (as practically as possible) the pre-development water cycle of the site being developed through design techniques and implementation of measures that manage the impact of the change in the physical characteristics of the site in a sustainable manner.

1.4 NorBE Principles

Due to the nature of the development, a Neutral or Beneficial Effect (NorBE) analysis on water quality is not feasible to be modelled using commercially available water quality modelling software. The development's major pollutant generator (metal contaminants) cannot be modelled using the MUSIC program and the remaining site generated pollutants are minimal due to the operational management of the site. Nonetheless, consideration was given to the NorBE principles.

The following measures are designed to ensure a neutral effect on water quality:

- Water quality controls to divert clear water around the proposal location;
- Devices (trenches and sediment control ponds) to capture water from cleared areas to ensure heavy metals and sediments do not leave the proposed location;
- Stopbutts designed in accordance with the US EPA guidelines for *Best Management Practices for Lead at Outdoor Shooting Ranges*; and
- A maintenance management program would be implemented.

The following measures would be implemented to ensure a beneficial effect on water quality:

- The septic system at the existing club house would be upgraded;
- The existing stopbutt would be rebuilt to the same standard as the new stopbutts; and
- Areas of erosion around the existing firing mounds would be rehabilitated.

1.5 Management Principles

The following mitigation measures (in general) would be implemented to combat the potential environmental impacts from the proposal:

- Remediation of the existing stopbutt in accordance with DECC requirements so that it meets health and ecological investigation levels suitable for recreational open spaces. A Site Audit Statement prepared by a qualified site auditor to assess the stopbutt and confirm that it has been remediated and is suitable for its intended use;
- Future remediation of soils if monitoring indicates exceedance of relevant contamination criteria;
- Sediment control ponds would be established at the commencement of construction. A minimum of six (6) ponds, with a combined storage volume of 6,630m^3, would be provided and would be retained throughout the operation of the proposal;
- New stopbutts and target mounds would be designed to reduce erosion, including the construction of a 2.5-3(h):1(v) slope to improve stability, to promote low-velocity sheet flow, and to assist with vegetation establishment;
- Stopbutts would be constructed from suitable clean site soils or imported clean fill and all rocks and other debris removed to minimise the potential for ricochet;
- The stopbutt would be designed to minimise contact between water and projectiles to reduce the rate of shot deterioration and metal leaching; and
- Preparation of a soil and water sub plan as part of the operation environmental management plan, to include the following measures:
  - The usage of firing lanes at rifle and pistol ranges would be staggered to minimise effects on stopbutt stability;
  - The establishment of grass where possible as an erosion control, which would also assist with filtering pollutants from runoff;
  - Raking of fine agricultural grade lime into soils within the range, shot fall zones, and stopbutts to reduce the mobility of metals by increasing soil pH to within the range of 6.5 to 8.5;
  - Testing to identify the chemical characteristics of soil around stopbutts to confirm maximum quantity of phosphate application in stopbutt trenches in order to avoid phosphate accumulation and runoff to waterways;
  - Monitoring for pH where lime is added to soils;
  - Re-application of lime when pH of soils is found to drop below pH 6.5;
  - Where feasible the use of less toxic shot (i.e. non lead) would be promoted by the clubs; and
  - A long term monitoring program would be implemented at the site to monitor possible metal accumulation and migration from the site. The monitoring program is outlined in Section 5.

2. Proposal Outline

The overall proposal would involve works to establish a regional recreational shooting complex incorporating the existing Hill Top Rifle Range (which would continue to operate), and include:

- An additional rifle range (500 metres by 100 metres);
- An additional range for rifle and pistol shooting (200 metres by 85 metres);
- A pistol range (50 metres by 140 metres);
- A shotgun range;
- An indoor air range (21 metres by 17 metres by 6.5 metres); and
- Supporting facilities and infrastructure, including:
  - Clubhouse and Toilet facilities;
  - Access roads (designed for two wheel vehicle access) connecting to Wattle Ridge Road and between the clubhouse and ranges;
  - Diesel generator, solar panels, water supply tanks and septic system;
  - Informal parking for 160 cars; and
  - Ponds to contain water for water quality control and fire fighting purposes.

The currently proposed Stage 1 works, covered by this plan, includes only the 500m range, pistol range, some form of clubhouse and supporting facilities. The 200m range, shotgun range and indoor air range would be constructed at a later date.

The project would be located in the vicinity of the existing Hill Top Rifle Range, on Wattle Ridge Road, approximately 5.5 km northwest of the centre of the village of Hill Top in the Wingecarribee local government area (LGA) (approximately 2 km to the nearest residence). The site location is shown below.

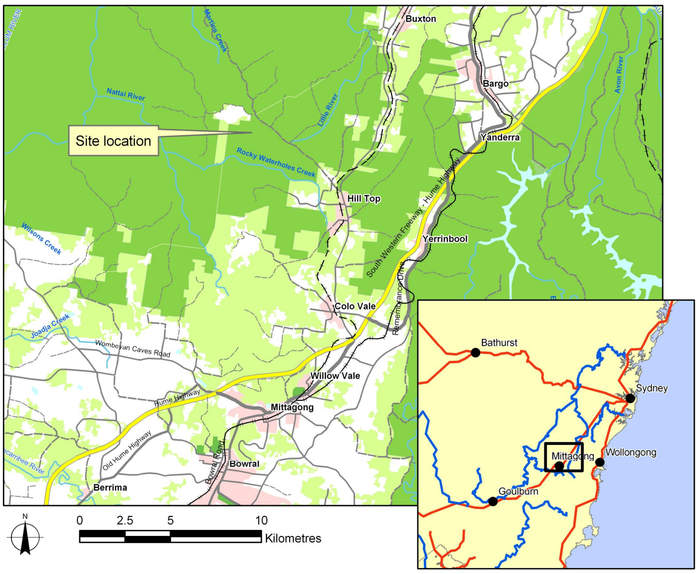

Figure 2.1 Site Location

2.1 Site Location and Description

The proposal is located in the Wingecarribee LGA near the village of Hill Top in the southern highlands of New South Wales, approximately 11 km north of Mittagong. Mittagong is located at the southwestern end of the Sydney Basin between the upper reaches of the Nepean River and other rivers such as the Wollondilly, Nattai, Bargo and Wingecarribee. These rivers flow into the Nepean River further to the north.

The Wingecarribee Local Environmental Plan 1989 (the LEP) applies to the site.

The site is currently the location of the Hill Top Rifle Range. The Southern Highlands Rifle Club licensed land on which the range is located, from the National Parks and Wildlife Service on 3 June 1993. The existing Hilltop Rifle Range consists of a seven-target rifle range 800 m long, with firing mounds at 100 m intervals. A small clubhouse, toilet facilities and informal car parking are also located on site.

1,036 hectares (ha) of land has been excised from the Bargo State Conservation Area by means of the *National Parks and Wildlife (Adjustment of Areas) Act 2006*. The new development would occupy an area of approximately 16 ha within this land (the proposal location). The area occupied by the range and associated facilities would be cleared as part of the proposal. The remainder of the land on the site (approximately 1000 ha) would be retained in its existing condition as a vegetation buffer zone. This area would act as a safety zone for the proposal.

2.2 Surrounding Land Uses and Sensitive Receptors

The site is bounded by:

- Wattle Ridge – a grazing property/residence which adjoins the site to the northwest (located approximately 2.5 km north west of the existing range);
- Bargo State Conservation Area to the southwest;
- A 330 kV cleared electricity easement (Transgrid) to the southeast; and
- Wattle Ridge Road to the northeast.

Bargo State Conservation Area is located further southwest, southeast and northwest. Nattai National Park is located further to the northwest, on the opposite site of the Wattle Ridge property. Nattai National Park is accessible from the end of Wattle Ridge Road approximately 3 km away.

Sensitive receptors include Rocky Waterholes Creek, located approximately 1.5 km south of the site. The creek is a tributary of the Nattai River. The Nattai River is located approximately 7.5 km west of the site.

2.3 Geology, Soils and Topography

Topographically and geologically the area is transitional between the Cumberland Plain of the Sydney Basin, and the southern uplands.

The underlying geology of the site comprises the Hawkesbury Sandstone of the Mittagong Formation (Herbert and Helby, 1980). The site lies within an outcrop of the Narrabeen group, which comprises sandstone, claystone and siltstone. The Hawkesbury sandstone overlies a Triassic shale unit, the Wianamatta Group.

The site is characterised by relatively flat topography, being situated on a spurline that trends to the north from Wattle Ridge Road. This spurline occupies a position between two tributaries of Rocky Waterholes Creek. All watercourses are upper tributaries of the Nattai River.

The three main groups of soils that occur within the region are (NPWS, 2001):

- Sandstone tableland soils;
- Valley soils (sandstone derived); and
- Soils associated with nutrient rich shales and igneous rocks.

Land surfaces in the site do not appear to have been significantly transformed. These soil landscape types are unstable when disturbed. They are highly susceptible to mass movement, such as slides and rock falls, as well as wind and water erosion (Hazelton and Tille, 1990). A major cause of erosion in an area of this type is fire. After a fire in which the crowns are consumed, the loose sandy soils remain bare for a long period. If rain then shortly follows a fire, there is a resulting increase in surface run-off, causing increased erosion, and a reduction in plant propagation and animal habitats.

2.4 Hydrogeology

The site is located within the Hawkesbury Sandstone – southeast groundwater flow system, which consists of layered aquifer system with yields ranging from less than one to 50 infills. Basalt caps are expected to occur in some areas of the Mittagong Ranges, with groundwater from this horizon discharging into seeps, springs and rivers (Sydney Catchment Authority, 2006).

According to the Department of Natural resources Groundwater Licence database, groundwater within the Hilltop area was found to be present at depths of approximately 20 metres in the sandstone aquifer. The depths to groundwater within the aquifers are expected to be dependent on rainfall and therefore are likely to vary seasonally. A borehole on site near the proposed clubhouse was terminated at 50 m depth with no water detection.

2.5 Hydrology

The nearest pluviograph station to the site is located at Moss Vale, which is considered too distant to provide representative hydrology data for the study area. A number of daily rainfall stations are located in close proximity to the study area. Table 2 summarises these stations, providing station number, name and recording start and end years.

Table 2 Daily Rainfall Data

Station Number	Station Name	Start Date	End Date	Max mean monthly rainfall (mm)	Min mean monthly rainfall (mm)
068044	Mittagong (Beatrice St)	1886	2004	92.9	53.2
068052	Picton Council Depot	1880	2004	88.6	44.8

An analysis undertaken on this data indicated that there is some variability in the rainfall with the maximum mean monthly rainfall of 93.8 mm in March, while the minimum mean monthly rainfall recorded is about 43.7 mm in September. The average annual rainfall at both gauges is 848 mm. The mild seasonal variability would indicate that rainwater collection via rainwater tanks is viable (the existing clubhouse utilises rainwater tanks and to date the tanks have never needed any top-up).

Mean monthly evaporation data for the region ranges from 40-50 mm in June to 200-250 mm in December, with an annual evaporation rate of approximately 1600 mm. The annual evaporation rate exceeds the average annual rainfall for the region, however the existing erosion control ponds still contained water during a site inspection in December 2006 despite a prolonged period with only limited rainfall.

The proposal only requires water for potable purposes and for construction dust suppression and vegetation establishment, so the low level of annual rainfall would not impact upon the proposal.

2.5.1 Waterways

Rocky Waterholes Creek, which is immediately south of the proposed ranges drains directly to the Nattai River approximately 6 km to the west of the existing Hilltop Rifle Range. The Nattai River drains north to Lake Burragorang. The catchment of Rocky Waterholes Creek is approximately 23.5 square kilometres, while the catchment of the Nattai River upstream of the junction with Rocky Waterholes Creek is some 240 square kilometres. The total catchment area of the Nattai River upstream of Lake Burragorang is 480 square kilometres. Figure 2.2 illustrates the major regional catchments.

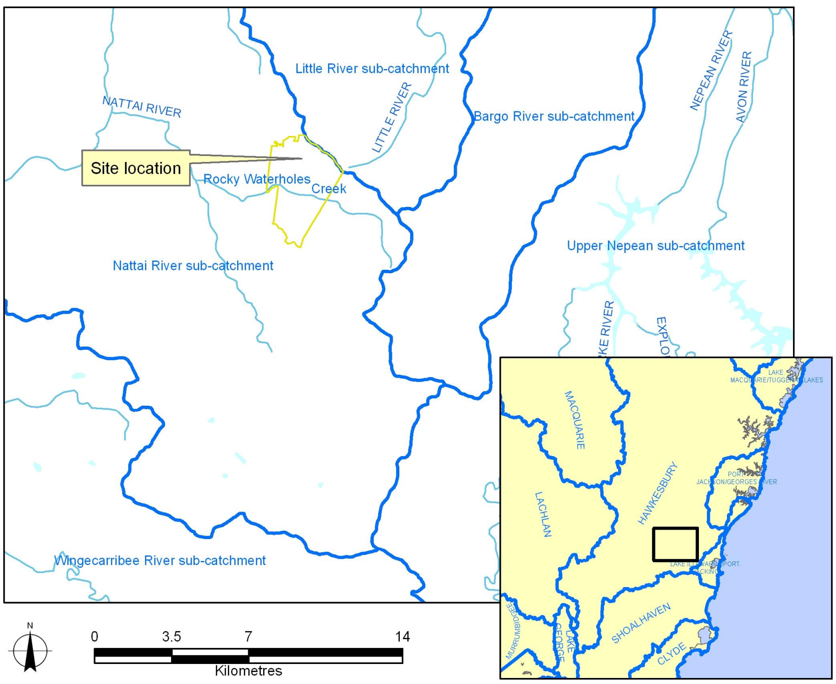

Figure 2.2 Water Catchment

2.5.2 Onsite Creeks

As the site sits on the top of a spurline that runs from north to south, the natural fall is from the centre of the spurline to the east and to the west into steep gullies. The gullies drop from the level of Rocky Waterholes Creek Road down to Rocky Waterholes Creek, a fall of approximately 100 metres over a distance of less than 1 km. As a result of the topography, the site is not subjected to flooding.

2.6 Water Quality

The Hawkesbury Nepean Catchment Management Authority has classified 98% of the Nattai River as being 'Near Intact'. The Draft Hawkesbury Nepean Catchment Action Plan (2007) identifies a strategy for managing the entire catchment and sets out procedures for looking after the near intact systems such as the Nattai River.

Table 3 identifies the results of testing in the Nattai River undertaken by Sydney Catchment Authority. These results indicate the high standard of the river water.

Table 3 Water Quality Data at Gibbergunyah Creek

Water Quality Parameter	TP (mg/L)	TN (mg/L)	NH_3 (mg/L)	DO (mg/L)	Chlorophyll-A (mg/L)	Faecal Coliform (cfu/100ml)
Result	0.0985	4	0.01	74	2.5	6

3. Environmental Impact

This section outlines the potential contaminants that may affect the area as a consequence of the proposal.

3.1 Potential Contaminants of Concern

Ammunition shot is primarily composed of lead (i.e. greater than 90% of shot). Other metals, including antimony, arsenic, cadmium, copper, nickel, tin and zinc, are often also present but make up less than 7% of the shot. Each of these metals has the potential to be toxic to humans, aquatic and terrestrial organisms, and some vegetation under certain environmental conditions. However given the dominance of the lead within the shot, it is lead that is considered to present the greatest contamination risk.

3.1.1 Lead

Lead contamination at shooting ranges is normally limited to surface and near-surface soil. Lead from the shot is likely to become mobile more quickly in surface soils where it can be oxidised and leached by rainfall or runoff than in sediments accumulating within water bodies under anaerobic conditions. The longer lead is in contact with rainwater, the greater the amount of dissolved lead that will be present in stormwater runoff. Additionally, lead weathers faster for higher annual precipitation rates. Lead dissolves through the progressive weathering of the surface layer of projectiles. The accumulated lead corrosion compounds that form can dissolve rapidly in rainfall and can be easily transported through infiltration and runoff.

Lead is generally most mobile in acid environments below pH 6. Increases in pH will cause dissolved lead to precipitate out of solution, with only small concentrations of dissolved lead present at pHs above 7.5. However increased lead mobility has been observed at pHs above 7 in soils with moderate to high organic matter contents. The majority of rainwater in Australia is mildly acidic, and has the potential to leach lead from contaminated soils and corroding ammunition.

3.1.2 Clay targets

Clay targets used at shooting ranges may also contribute contaminants to the environment. In general one target is launched for every shot made, and at busy ranges mounds of target fragments can rapidly accumulate. Clay targets are typically composed of 70% limestone bound with 30% tar pitch, bitumen, or other organic material. The contaminants typically found in clay targets include:

- Polycyclic aromatic hydrocarbons (PAH); and
- Heavy metals (lead, cadmium, chromium, copper, nickel, mercury and zinc).

Studies suggest that PAHs in both new and aged targets are tightly bound in a petroleum pitch and limestone matrix and are unlikely to be bioavailable in this form.

3.1.3 Other Contaminants

Other contaminant sources include stored substances such as diesel, domestic chemicals, and oil and fuel from vehicles visiting the site. Containment and isolation of any spills of these substances should be first priority, should a spill occur. Containment measures would include bunded storage areas for large volume stored chemicals such as diesel so that any spills can be contained and disposed of appropriately, prior to any discharge to the environment.

In instances where chemical substances are discharged into the environment, procedures are to be in place for clean up of the spill through the use of chemical spill kits. Due to the relatively small volumes of chemical substances that are expected to be stored at the site, the use of personal spill kits should be sufficient. Otherwise, emergency procedures for chemical spill should include the need to contact Emergency Services in potentially catastrophic instances.

Any chemicals which cannot be removed following clean up would be subjected to the water cycle management processes implemented.

3.1.4 Distribution of contaminants

From a contamination perspective, the major difference between rifle/pistol ranges and shotgun ranges relates to the physical distribution of the lead shot. Most rifle/pistol ranges have a stopbutt, which helps concentrate lead in a small area of the stopbutt behind the targets. Shot may occasionally strike the foreground between the firing line and the targets, but here lead is usually sparsely distributed when compared to the concentrations found in the stopbutt. Ricochets can increase the distribution of lead to other areas. As bullets impact with targets or stopbutts located behind targets, they have the potential to produce lead dust and fragments. Recovery of lead shot may also generate dust at shotgun and rifle/pistol ranges.

At the proposed 200 metre, 500 metre and 50 metre pistol ranges it is considered that almost all bullets would be captured by the stopbutts or other capture systems. Whilst no exact figures are available, discussions with the Australian Army NSW Range Inspector indicated that at least 95% of all bullets are intercepted by the stopbutts.

3.2 Operational Impacts

No physical works are proposed that would alter stream characteristics, flows or creek morphology, therefore long term physical impacts to Rocky Water Holes Creek and its tributaries are unlikely.

Potential impacts are likely to be associated with:

- Migration of contaminants from the cleared areas to Rocky Water Holes Creek and its tributaries;
- Increase in surface water runoff from impervious surfaces; and
- Effluent water discharges.

3.2.1 Post Development Runoff

The clearing and development of bushland leads to an increase in the volume and rate of runoff as a result of pervious surfaces being replaced with surfaces that allow less infiltration. Whilst the proposal would result in increased runoff, the increase in runoff is expected to be low as most of the changes to the site would only result in a change of the vegetation type from woodland to grass.

Design measures are proposed to minimise the potential for runoff to affect downstream water quality and would include sediment control ponds and permanent erosion control. Ponds would allow sediment to settle before the water is discharged at the runoff discharge locations for each range. The minimum storage volume to be provided in the sediment control ponds is 6,630m^3, which equates to a storage volume of 414m^3/hectare. In addition to the sediment control ponds, it is proposed that water from roofs would be captured in rainwater tanks for general use around the site.

3.2.2 Wastewater

The site is not served by a centralised sewerage system. At present the existing clubhouse contains a typical septic system. It is proposed to replace this system by connecting the old clubhouse to a new on-site treatment system. This new system would be designed to meet current best practice standards. The new clubhouse will also be connected to an on-site treatment system. The retrofit of the system at the old clubhouse is to be installed when the new facilities are operational at the new range.

4. Mitigation and Control

4.1 Construction Phase

Proposed controls and mitigation measures to be implemented during the construction phase are detailed in the Soil and Water Management Plan included in Appendix A.

Controls and mitigation measures to be implemented during the construction phase include:

- Stormwater management – Specific strategies include the provision of treatment practices, promotion of sheet flow across the range surface, prevention of stormwater from impacting the berms and areas that have the highest potential for erosion, construction of sediment control ponds and locating the stopbutts away from existing water courses;
- Waste water management – Portable toilets will be utilised during the construction phase. These toilets will be removed following construction;
- Erosion control – Stopbutts and target mounds designed to reduce erosion, promote low-velocity sheet flow and to assist with vegetation establishment;
- Application of soil amendments – It is proposed that fine agricultural grade lime be raked into the soils within the range, stopbutts and collection trenches to reduce the mobility of metals by increasing soil pH to within the range of 6.5 to 8.5; and
- Rapid stabilisation of cleared areas to minimise potential for erosion.

4.2 Operational Phase

4.2.1 Contaminant Containment

Metal migration at the rifle and pistol ranges would be managed primarily by positioning bullet stopbutts behind the targets and bullet traps to collect/contain projectiles to facilitate their recovery and recycling. Stopbutts would be constructed from suitable clean site soils or imported clean fill and all rocks and other debris removed to minimise the potential for ricochet. The stopbutt is designed to minimise contact between water and projectiles to reduce the rate of shot deterioration and metal leaching. To reduce lead migration within the stopbutt, a layer of crushed limestone is designed into the base of the stopbutt to reduce capillary rise reducing the contact between acidic water and spent bullets. The limestone would also act to raise the pH of acidified waters.

An impermeable membrane has also been included in the design to direct seepage to a lime filled trench, where any lead or contaminants would drop out.

Within the range fairways, additional lime filled trenches are provided at low points to ensure that any potential overland flow containing lead is intercepted. These trenches drain directly to sediment control ponds.

4.2.2 Stormwater Management

In the context of Water Sensitive Urban Design (WSUD), the planning and design sets out to minimise the hydrological impacts of development on the surrounding environment. The management of stormwater encompasses:

- Water quality management;
- Flood management;
- Flow management; and
- Flow attenuation.

Key planning and design objectives that have been adopted are:

- Protect and enhance natural water systems following development;
- Integrate stormwater treatment into the landscape by incorporating multiple-use corridors, that maximise the visual and recreational amenity of the development;
- Protect water quality draining from cleared areas; and
- Reduce runoff and peak flows from the site by employing local detention measures, minimising impervious areas and maximising re-use (for example through rain water tanks).

Stormwater management for the new facility is designed to prevent an increase in the amount of stormwater leaving the site, to maintain the water balance, and to slow the transmission of stormwater to receiving waters to match the existing predevelopment rates. Additionally, the stormwater management system prevents the transportation of gross and sediment-born pollutants as much as possible.

Specific strategies adopted include:

- Provision of treatment practices such as ‘treatment trains’ and ponds to manage water quality, downstream or close to the point of discharge;
- Promotion of sheet flow of runoff water over the range surface. Sheet flow lowers the water velocity, which will lower the water’s sediment load–carrying capacity. It reduces the potential for erosion on the range and avoids potential point source discharge issues and monitoring requirements that may occur with channelled flow. Promoting sheet flow is accomplished by regrading and flattening out the slope of the land surfaces and by creating broad, very shallow drainage pathways to replace ditches or deep, narrow channels;
- Prevention of storm water from impacting on berms or areas which have the highest potential for erosion. Prevention of potentially dirty water from flowing onto comparatively clean range areas or mixing with storm water from the clean areas. This tactic minimises the land area affected by mobilised contaminants in the runoff and the volume of dirty runoff requiring management. It is accomplished by grading the slope of range area surface to change drainage patterns and constructing diversion channels/swales and small berms to alter runoff flow and drainage patterns;
- Construction of sediment control ponds, which are a valuable last resort to manage storm water in areas where the runoff waters have the highest potential for carrying sediments and lead residues. Sediment control ponds are designed and sized to effectively slow the water and allow the suspended solids to settle out. The drainage area that the pond will serve is well defined, and the calculated volume of water the pond must handle is accurate; otherwise, the pond’s effectiveness will be minimal. It is proposed that for the Hill Top Shooting Complex there would be a minimum of six ponds, three located at the 500 m / 200 m range, one each at the shotgun and 50 m pistol range and one at the proposed clubhouse. The ponds have been sized in accordance with the requirements of Landcom Soils and Construction Volume 1 (Landcom; 2004) as required by the consent conditions. The sizes of the ponds are as follows:

- Pond 1 at 200 m range – 2,000 m^3;
- Pond 2 at 200/500 m range – 660 m^3;
- Pond 3 at 500 m range – 1,380 m^3;
- Pond 4 at 50 m pistol range – 270 m^3;
- Pond 5 at Shotgun range – 1,090 m^3; and
- Pond 6 at the carpark and clubhouse (this is the existing dam which is to be largely maintained in its existing configuration, with the addition of an outlet control structure) – 1,230 m^3;

The ponds have been designed based on the 5-day 85th percentile storm depth and for type D/F soils.

The ponds would be utilised for the life of the complex and monitoring would be required at the discharge location for each pond. Except in the case of large storms, discharge would only be permissible when the water within the ponds complied with the limits established in Table 4. This requirement would be revisited after annual monitoring.

The water in the ponds may be utilised for use in bushfire fighting, however it is noted that this water may contain contaminants such as lead. The continuing use of this water for bushfire fighting can be confirmed after the water is tested for contaminants in accordance with Table 4 below. Should the testing indicate contaminant levels greater than the nominated limits then the water should only be used in an emergency. This policy can then be reviewed after each round of testing.

- Stopbutts and target mounds would be designed to reduce erosion, including the construction of a 2.5-3(h):1(v) slope to improve stability, to promote low-velocity sheet flow, and to assist with vegetation establishment. In an effort to minimise impact to stopbutt stability usage of firing lanes at rifle and pistol ranges would be staggered. Grass would also be established as an erosion control, which would also assist with filtering pollutants from runoff. Diversion and sediment control drains are shown in the erosion control plans in the appendices.

  Stopbutt maintenance between lead recovery and recycling operations would involve replacement of eroded dirt, reseeding unvegetated areas, fertilizing, watering, and maintaining vegetation. The stopbutt would also be routinely inspected and filling undertaken to repair areas of concentrated impact points.

4.2.3 Post Development Runoff

The clearing and development of bushland leads to an increase in the volume and rate of runoff as a result of pervious surfaces being replaced with surfaces that allow less infiltration. Whilst the proposal would result in increased runoff, the increase in runoff is expected to be low as most of the changes to the site would only result in a change of the vegetation type from woodland to grass. Whilst the amount of runoff would increase as a result of the changes, it is proposed to construct permanent sediment control ponds, at the runoff discharge locations for each range. The minimum storage volume to be provided in the ponds is 6,630m^3, which equates to a storage volume of 414m^3/hectare, which would result in no increase in the amount of runoff leaving the site following construction of the new facilities. In times of bushfire, any water in the sediment control ponds could also be used to augment the fire fighting water stored at the proposed clubhouse.

4.2.4 Wastewater Management System

The existing clubhouse contains a simple septic system. It is proposed that this system and the new packaged sewage system to be installed at the new ranges would be designed and or upgraded to meet current best practice standards. It is proposed that a Kelair Blivet packaged sewage treatment plant or equivalent would be installed at all locations where wastewater is generated.

The functional elements of a Kelair Blivet packaged sewage treatment plant are:

- Primary settlement;
- Aerobic zone;
- Final settlement (humus tank); and
- Sludge storage.

The size of the packaged plant is determined by the number of potential range users. The GHD Submissions Report dated July 2008 contained information on the expected number of shooters as follows:-

- 1-10 shooters will use the venue on 65 days;
- 11-40 shooters will use the venue on 128 days;
- 41-80 shooters will use the venue on 6 days;
- 81-120 shooters will use the venue on 93 days;
- 121-160 shooters will use the venue on 5 days;
- More than 161 shooters will use the venue on 3 days;
- The venue will be closed on 66 days of the year;
- The maximum number of shooters forecast on a particular day is 200 (this will occur on three occasions); and
- 66% of available shooting days (199 days) will not exceed 80 participants; 97% of available shooting days (292 days) will not exceed 120 participants.

These figures are for the full development proposal consisting of the 500m range, 200m range, 50m pistol range, shotgun range and indoor air range, based upon shooting seven days a week. As noted earlier the currently proposed development only involves the construction of the 500m range and 50m pistol range, with the other ranges developed at a later date. In addition the development consent for the site only allows shooting to occur on a maximum of four days per week. As a result the number of shooters on site will be less than the above figures. It is therefore important that the packaged treatment system is sized for the actual flows otherwise the treatment process will generally fail if under or over sized. The Kelair Blivet system has the advantage that its modular construction allows for expansion in the future as the other ranges are developed and the flows increase.

The above usage figures have been factored down by 30% to take into account the proposed development. Thus the maximum number of shooters on site would be 140. Using the Sydney Water equivalent population (EP) for synchronous discharges coefficient for general public entertainment facilities of 0.05 EP, the peak number of shooters, 140 people, will give an EP of 7. The peak average amount of shooters, calculated to be 90 people, gives an EP of 4.5. Given the large fluctuation in flows i.e. high flows on weekends and minimal flows three days a week, an inlet balance tank will be provided to even out flows to ensure better unit performance. Therefore the packaged plant will be sized for average flows, corresponding to the Kelair Pump BL 300 with a unit average flow 4.1 m3 per day and a unit size of 2.1m length by 2.02m width by 2.2m height. The inlet balance tank will have a volume of 10000L.

The proposed Kelair Blivet system would be located adjacent to the proposed clubhouse. Operation and maintenance of the Kelair Blivet system would be in accordance with the manufacturer's recommendations. An operation and maintenance manual would be obtained from the manufacturer and the operators of the shooting range would be responsible for complying with any routine inspections and maintenance in accordance with that manual. Technical and customer support from the manufacturer would also be obtained on an as needed basis. As part of the construction works, a packaged wastewater treatment system will be constructed at the site of the new clubhouse. The amended soil mound will be located adjacent to the new club house, and must be a minimum of 40m from the existing dam and 100m from any perennial or intermittent creek.

The system operates as follows;

1. PRIMARY SETTLEMENT

Raw sewage enters the Blivet and hits a full-width baffle which intercepts any plastic bags and floatables. The rest of the raw sewage is directed downwards into the primary settlement tank. Primary settlement is enhanced by upwards flow through parallel or lamella plates. After flowing upwards through the parallel plates, the sewage flows over a notched weir and enters the first section of the Aerobic Treatment Unit, the Kelair-BMS Aerotor.

2. AEROBIC ZONE (BIOLOGICAL TREATMENT - AERATOR)

The Aerotor is a combination of two methods of aerobic biological treatment systems: Rotating Biological Contactor-style fixed film reaction and activated sludge.

The Biozone's speed of rotation ensures the biomass keeps stripping off leaving a healthy layer that can not get too thick and anaerobic. The biomass inside the rotor facilitates forcing the sewage through a set path inside the Biozone, ensuring that the influent is exposed to as much of the biomass as possible. The sewage is also actively aerated by sucking in air through a series of holes located along the perimeter of each Biozone and mixing it thoroughly with the influent. In the Blivet, the influent is directed to each Biozone and its passageways to get to the next stage, so it makes contact with the biomass for a considerable period.

3. FINAL SETTLEMENT

The final settlement tank, commonly known as the Humus tank, is a discrete compartment separate from untreated or partially treated liquor. The design is similar to the primary settlement tank in that the treated liquor flows upwards through parallel plates.

The normal design effluent quality is 20mg/l BOD5, 30 mg/l suspended solids. A membrane (Saran) filter or equivalent will be fitted just below top-water level, to further improve the effluent quality to 10 mg/l BOD5, 15 mg/l suspended solids.

The filter is a static design, i.e.; not powered and set in frames that are easily removable for cleaning. Settled humus is automatically removed to the primary settlement tank via a timed submersible pump (0.48kW, 2-4 min/hour maximum loading).

4. SLUDGE STORAGE

Sludge storage is provided in the base of the units. Depending on the load applied, there is approximately 12 weeks capacity provided. Normally, desludging is carried out by suction tanker.

The treatment processes which are applied to the effluent as it flows through the amended soil include: filtration, pH adjustment, ion exchange, volatilization, biological water and nutrient uptake, oxidation and reduction, sorption, chemical precipitation, detention, and evaporation or dilution depending on rainfall/evaporation balance.

In addition to the removal of contaminants by Kelair Blivet system, natural processes - which occur after discharge from the system and as treated effluent percolates to the water table or is transported to the natural drainage system, would further reduce risk of water quality or public health impact to surface water or groundwater.

It is proposed that treated effluent will be disposed of by irrigation. Primary irrigation would be to the area around the clubhouse with excess water diverted to the 500m range. The average effluent discharge is expected to be 0.2L/s based upon Sydney Water guidelines of 0.0021L/s/EP.

4.2.5 Application of Soil Amendments

The deepness of the water table, the shallow depth at which bedrock is encountered and the topography of the site indicates that the risk for groundwater contamination is minimal. However there is a risk for contaminant migration to occur through dissolution of metals via rainfall and transport through surface water runoff. As such, fine agricultural grade lime would be raked into soils within the range, shot fall zones, stopbutts and collection trenches to reduce the mobility of metals by increasing soil pH to within the range of 6.5 to 8.5. The dose of lime required would be determined by laboratory testing and specifications provided for individual lime products.

Re-application of lime would be undertaken when the pH of soils is found to drop below pH 6.5.

4.2.6 Spent Munitions Clean–Up and Contaminated Soil Remediation

Spent munitions would be regularly recovered and recycled from fall zones and stopbutts through raking, sifting and screening methods. The removal of spent shot from the stopbutts would be focused primarily around the bullet pocket/toe of the berm. The regularity of shot recovery would be dependent upon the level of activity at the shooting complex (clubs would be expected to keep records of the amount of spent munitions), but as a minimum would be undertaken annually. Inspections of the complex and buffer zones would be undertaken quarterly to identify any additional zones that may require clean-up. Removal of bullets would also be triggered when operational or maintenance issues arise such as fired bullets ricocheting off old fired bullets and casings that have accumulated over time. The quantity of shot recovered from the complex would be compared to firing records to monitor the effectiveness of range operational and engineering controls.

Soil testing at the complex would be undertaken annually for lead. If lead concentrations exceed the criteria of 600 mg/kg the extent of contamination should be clearly identified (both areal and depth) and the area remediated and validated in accordance with NSW EPA and NEPM guidelines. Contaminated soils would be appropriately managed, in accordance with NSW EPA guidelines, and will not be re-used around other areas of the site. Waste classification would be undertaken for any contaminated materials removed from the site for disposal.

Appropriate personal protective equipment, including gloves, eye protection, and respiratory protection, will be worn by those handling the shot during collection to minimise exposure risks. The collected munition would be held in appropriate labelled covered storage containers prior to recycling to prevent leaching and migration of contaminants from the recovered shot. Projectiles would be stored on site for no longer than one month before being moved to the recycling facility.

Used gun cleaning solvents, oily and dirty rags, cartridges and wads, and target fragments, would be collected, stored and disposed of in accordance with the NSW Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes.

After the 500m range and 50m ranges are constructed and are operational, the existing 800m stopbutt is to be remediated and validated in accordance with NSW EPA and NEPM guidelines.

5. Ongoing Monitoring

5.1 Construction Phase Monitoring

Details of the construction phase monitoring have been detailed in the Soil and Water Management Plan included in Appendix A. Areas to be monitored during construction include surface water and inspections of engineering controls.

5.2 Long Term Monitoring Program

A long term monitoring program would be implemented at the site to monitor possible metal accumulation and migration from the site. The monitoring program includes:

- Soil monitoring;
- Sediment monitoring;
- Surface water monitoring;
- Inspection of stop butts, shot fall zones and erosion control structures; and
- Inspection of vegetation health and density.

Descriptions and requirements for the monitoring program are summarised in Table 4. Although spent bullets contain several potentially contaminating metals, monitoring would be focused primarily on metals that have been detected at elevated concentrations in soils sampled from within the target floor zone.

Records of the number of rounds fired at the range would be kept to provide an estimate of the quantity of lead shot at the range to compare against the quantity of shot collected during recovery to assess the effectiveness of range operational and engineering control. This information will also be used to help determine when reclamation may be required to prevent accumulation of excess amounts of lead.

Table 4 Proposed Monitoring program

Task	Location	No. of Samples	Analytes	Timing	Criteria	Comments
Soil Monitoring	Surface Soils within shot fall zones, target floor, and stopbutt Subsurface soils within stopbutt	Shot fall zone and target floor = 5 samples /ha Stop Butt = 1 sample / 500m^3 (See Note 1) Sampling to be undertaken on a grid basis	Total Lead, Antimony, Zinc and Copper pH	Total Lead, Antimony, Zinc and Copper = annually pH = annually	Lead = 600 mg/kg Antimony = 20 mg/kg Zinc = 14,000 mg/kg Copper = 2,000 mg/kg pH = 6.5 to 8.5	Exceedance of any metal criteria will trigger soil remediation and disposal. A drop in soil pH will trigger the application of agricultural lime and/or phosphates. Note soil pH will not exceed 8.5 through the application of agricultural lime.
Sediment Monitoring	Rocky Waterholes Creek Tributaries	1 sample at each location erosion control pond Rocky Waterholes Creek Tributaries = 3 locations (upstream, midstream and downstream)	Total Lead, Antimony, Zinc and Copper	Total Lead, Antimony, Zinc and Copper = annually	Lead = 220 mg/kg Antimony = 25 mg/kg Zinc = 410 mg/kg Copper = 270 mg/kg	An exceedance of sediment any metal criteria will trigger immediate investigation into the source of the exceedance and an inspection of engineering and operational controls. Further investigation and testing may be required.

Surface Water Monitoring	Erosion control pond discharges Rocky Waterholes Creek Tributaries	1 sample per pond discharge Rocky Waterholes Creek Tributaries = 3 locations (upstream, midstream and downstream)	Total Lead, Antimony, Zinc and Copper Phosphate Turbidity/Suspended Solids (SS) pH	Total Lead, Antimony, Zinc, Copper and Phosphate= six monthly Turbidity/SS = quarterly and after rainfall events with more than 20 mm of rain pH = quarterly	Lead = 0.001 mg/L Antimony = 0.009 mg/L Zinc = 0.0024 mg/L Copper = 0.001 mg/L Phosphate = 0.015 mg/L Turbidity/SS = 25 NTU / 50 mg/L pH = pH of creek water or if not available 6.5 to 8.5	An exceedance of any of the surface water criteria will trigger immediate investigation into the source of the exceedance and an inspection of engineering and operational controls. Further investigation and testing may be required.
Sedimentation pond discharge location	Pond outlets	Visual Inspection	Evidence of scour	Annually and after any severe storm events		If evidence of erosion, undertake stabilisation work using rock mattresses, grass and geofabrics
Inspect areas of around ranges annually for evidence of shot loss and ricochet	Range Perimeter	Visual Inspection	Evidence of damage / bullets	Annually		If there is significant evidence of shot loss and ricochet then clubs to reinstruct all members on issues of responsible shooting and to undertake spent munitions cleanup procedures.

Inspection of engineering controls	All controls – ponds / berms / silt fences / diversion drains /	Visual Inspection	Evidence of damage, erosion, sediment outside controlled areas.	Annually and after any severe storm events		Repairs made where required, and failing controls reassessed possibly replaced/upgraded

Notes: 1. 57 no. for 500m Rifle Range, 14 no. for 200m Rifle Range and 45 no. for Pistol Range (based on preliminary volumes, to be confirmed at completion of construction).

5.3 Assessment Criteria

5.3.1 Relevant Guidelines

The guidelines used to assess site contaminants are based primarily on guidelines 'Made or Approved' by the DECC under Section 105 of the Contaminated Land Management Act 1997. These guidelines include:

- NSW DECC (2006) 'Guidelines for the NSW Site Auditor Scheme';
- ANZECC (2000) 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality';
- ANZECC / NHMRC (1992) 'Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites'; and
- NECP (1999) 'National Environmental Protection (Assessment of Site Contamination) Measure 1999', (NEPM).

Reference is also made to the US EPA (U.S. Environmental Protection Agency) (2005) '*Best Management Practices for Lead at Outdoor Shooting Ranges'* EPA-902-B-01-001', which provides guidance with particular relevance to the site use as a shooting range.

5.3.2 Criteria Used

The criteria used to assess levels of contamination include:

- Soil:
  - Australian and New Zealand Environment and Conservation Council (1992), Guidelines for the Assessment and Management of Contaminated Sites, Environmental Investigation Thresholds Level;
  - National Environment Protection Measures, for Ecological Investigation Levels (EILs) and Health Investigation Levels (HIL) Commercial/Industrial;
- Surface Water:
  - ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Chapter 3 Aquatic Ecosystems (fresh water pristine system);
  - Australian Drinking Water Quality Guidelines (health based); and
- Sediment:
  - ANZECC 2000 Interim Sediment Quality Guidelines.

5.4 Responsibilities

The ongoing monitoring of the proposal shall be undertaken by Communities NSW Sport & Recreation.

5.5 Reporting

The results of the monitoring are to be incorporated into an annual report to be prepared by Communities NSW (Sport and Recreation) and submitted to Sydney Catchment Authority. The report will highlight any failed tests or issues that may have arisen during monitoring and will identify remedial actions or modified management practises to prevent recurrence of the failures. The report as a minimum is to contain the following sections:-

- Summary, highlighting any test failures and site observations;
- Map and summary of testing locations;
- Analysis of testing results including trend analysis ie changes over the monitoring period;
- Recommendations for remedial work, and modifications to management procedures; and
- Recommendations to change the monitoring program i.e. additional testing, change of frequency etc.

6. Conclusion

The site is characterised by relatively flat topography, being situated on a spurline that trends to the north from the Wattle Ridge Range. This spurline occupies a position between two tributaries of the Rocky Waterholes Creek. All watercourses are upper tributaries of the Nattai River. As a result of the proposal location, testing for contaminants was undertaken to determine a baseline, to assess the potential for migration of contaminants from the proposed range facilities and to identify the levels of contamination at the existing facility.

Testing of the existing 800m range has indicated that there is some contamination of soils adjacent to the stopbutt. The testing has also indicated that the extent of contamination is limited to the cleared range area, with no indication of contamination in the adjoining buffer or adjacent creeks.

As a result of these investigations a water cycle management plan and soil and water management plan has been developed for the site that incorporates both engineered controls and a long term monitoring program so that no contaminants can leave the cleared areas of the site. The plan generally follows the requirements of the US EPA Best Management Practises for Lead at Outdoor Shooting Ranges (EPA 2005). In addition to preventing contaminants leaving the site, the engineered controls will prevent an increase in runoff from the site.

Appendix A

Soil and Water Management Plan

Provided separately

GHD

133 Castlereagh St Sydney NSW 2000

-

T: 2 9239 7100   F: 2 9239 7199   E: sydmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	S. Burns	F.Carrozza	* On File	A. Horton	* On File	2/9/10
1	F Carrozza	A Horton	* On File	A Horton	* On File	29/9/10