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Integrated Practical Solutions

Report on Detailed Site Investigation

Due Diligence
Proposed Residential Subdivision
Foti Fireworks Factory
51 St Andrews Road, Leppington

Prepared for
Cornish Group Pty Ltd

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Executive Summary

This report presents the methodology and results of a Detailed Site Investigation conducted by Douglas Partners Pty Ltd (DP) for the Foti Fireworks Site located at 51 St Andrews Road, Leppington. The Site covers an area of approximately 13 hectares and is referred to herein as "the Site". The work was commissioned by Mr Paul Parfenow of SMEC Urban Pty Ltd on behalf of Cornish Group Pty Ltd.

It is understood that this assessment is required for pre-purchase due diligence purposes. It is also understood that this assessment will be required to support a development application for a future residential subdivision.

A six hectare portion of the site has been used for manufacturing fireworks and the residual portion of the site is vacant land.

The objectives of this investigation are to:

- assess the potential for contamination at the site based on past and present site use;
- determine the contaminants of concern;
- identify potential areas of environmental concern (AEC);
- identify potential human and ecological receptors;
- comment on the suitability of the site for the proposed residential subdivision, from a contamination standpoint, or identify the need for further investigation and/or management (if required).

A review of historical aerial photographs, EPA public registers, tittle deeds, council records, section 149 certificate and WorkCover searches were undertaken for the Site. The site history and site inspection indicated that the site had primarily been vacant and used for agricultural purposes prior to being used for the manufacturing and storage of pyrotechnics.

Potential sources of contamination at the site are considered to be from the current landuse of manufacturing and storage of pyrotechnics, the storage of chemicals and flammables and shallow filling within roadways and stockpiles of unknown origin.

A total of 80 test pits were excavated as part of this contamination assessment. Filling was encountered in 17 locations to depths of between 0.1 m to 0.5 m bgl. Soil stockpiles were located within the northern portion of the site. The filling, including the stockpiles, was underlain by natural silty clays. These soils were underlain in turn by siltstone bedrock.

A total of 80 soil samples were analysed for a combination of heavy metals, TPH, BTEX, PAH, OCP, OPP, PCB, phenols and asbestos. Four intra-laboratory replicates and four Inter-laboratory replicates were analysed, QA/QC samples were tested for heavy metals and PAH.

All analyte concentrations in the analysed soil samples collected for this investigation were reported either below their respective laboratory limits of detection or below the SAC with the exception of:

- Sample 49/0.1-0.2 which reported a copper concentration of 290 mg/kg which exceeds the EIL screening level of 80 mg/kg.
- Samples 38/0.1-0.2, 41/0.1-0.2 and 42/0.1-0.2 which exceeding the ESL for benzo (a) pyrene;
- Sample 62/0.1-0.2 which exceeded the ESL for benzo (a) pyrene and HSL for benzo (a) pyrene TEQ; and
- Sample 67/0.1-0.2 exceeded the ESL for F2.

All exceedances were within shallow filling adjacent to the access tracks within the site, with the exception of Pit 40.

One asbestos fragment was identified on the ground surface approximately 5 m north of Pit 43 and one asbestos pipe section was observed and its location is shown on Drawing 2, Appendix B. No other asbestos fragments were observed during the investigation.

All samples collected and tested from the stockpiles returned analytical results below their respective laboratory limits of detection or below the SAC. It is therefore considered that no further investigation is required for the stockpiles, however significant anthropogenic materials should be removed and reused/recycled or disposed of to a licensed landfill.

Two surface water samples were collected from the two dams. All results were below PQL or below the SAC, with the exception of copper. Copper levels were elevated above the guideline, however, this is anticipated to reflect natural background concentrations for waters from the western Sydney region with a dominant shale geology. No significant elevated copper concentrations were detected in the soil. In general, no significant contamination was found within the surface water sampled.

As only minor soil contamination was detected, groundwater monitoring is not considered necessary on the site. It is further noted that the soils have a low hydraulic conductivity which would limit the transfer of contamination to the groundwater.

Based on the investigation findings, additional investigation is required within the following identified areas. The following additional investigations are considered warranted:

- Step out test pits will be required at Pit 62 to determine the extent of the benzo (a) pyrene TEQ impacted soils. The impacted material will require excavation and off-site disposal at a licensed landfill. The resulting excavation surface will require validation testing to confirm complete removal of the impacted soils;
- Re-evaluation of the surface material in all areas of the site that exceeded the EIL or ESL prior to reuse in landscaped areas of the proposed development.

Additionally, the following will need to be undertaken for the site to be suitable for the proposed land use:

- Removal and disposal of all chemicals, paints, oils and lubricants at the site; and
- Removal of the asbestos pipe and validation of the removal process to ensure it complies with NSW WorkCover code of practice for removal of asbestos.

Based on the field observations and laboratory results, no signs of unacceptable, broad scale contamination impacts were found. Whilst the potential for isolated contamination pockets cannot be ruled out, these can be removed and managed at the time of site development with the implementation of standard operational protocols. Also, as an asbestos pipe was identified within the site, DP cannot rule out the possibility that additional asbestos pipes may be found. Therefore an Unexpected Finds Protocol should be implemented setting out the standard procedures for inspecting and managing any unexpected, potential contamination issues encountered during development works.

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Report on Detailed Site Investigation
Foti Fireworks, 51 St Andrews Road
Leppington

1. Introduction

This report presents the methodology and results of a Detailed Site Investigation conducted by Douglas Partners Pty Ltd (DP) for the Foti Fireworks Site located at 51 St Andrews Road, Leppington. The site covers an area of approximately 13 hectares and is referred to herein as "the site". The work was commissioned by Mr Paul Parfenow of SMEC Urban Pty Ltd on behalf of Cornish Group Pty Ltd.

It is understood that this assessment is required for pre-purchase due diligence purposes. It is also understood that this assessment will be required to support a development application for a future residential subdivision.

A six hectare portion of the site has been used for manufacturing fireworks and the residual portion of the site is vacant land.

The objectives of the investigation are to:

- assess the potential for contamination at the site based on past and present site use;
- determine the contaminants of concern;
- identify potential areas of environmental concern (AEC);
- identify potential human and ecological receptors;
- comment on the suitability of the site for the proposed residential subdivision, from a contamination standpoint, or identify the need for further investigation and/or management (if required).

2. Scope of Works

The site has been divided into two sections based upon a potential for contamination. The six hectare portion of land surrounding the sheds and other buildings associated with the manufacturing of fireworks underwent full density intrusive sampling at a rate of 11 test pits per hectare and the surrounding seven hectares, which is mostly undisturbed vacant land, underwent limited intrusive sampling at a density of two test pits per hectare.

The scope of works included:

- Undertake a site history investigation to determine potential areas of environmental concern (PAEC) for the site including:
    - Current and historic titles and Deposited Plans to identify previous owners that may indicate a potentially contaminating activity;

- Review historic aerial photos to identify land uses and changes in the land that may indicate potential for contamination;
- Search on the Contaminated Land Register for Notices issued under the *Contaminated Land Management Act* 1997;
- WorkCover search for dangerous goods stored or previously stored on site;
- Readily available Council records and section 149 (2 and 5) planning certificate;
- A search of the NSW Office of Water groundwater bore database;
- Interviews with persons identified by the client as having knowledge of the site conditions and previous site use;

- A brief description of the following local features:
  - Geology;
  - Soil types;
  - Topography;
- Walkover of the site to identify signs of concern with respect to contamination;
- Based on the site history assessment, preparation of a Conceptual Site Model (CSM);
- Full density intrusive sampling within the six hectares of the site which contains sheds and other buildings at a sample density of 11 sample locations per hectare. Test pits were excavated with a backhoe to a maximum depth of 1.0 m;
- Limited density intrusive sampling within seven hectares of the site which is vacant undisturbed land at a sample density of two sample locations per hectare. Test pits were excavated with a backhoe to a maximum depth of 1.0 m;
- Collection of undisturbed and disturbed samples from approximate depth ranges of 0 – 0.2 m, 0.2 – 0.5 m and, if filling is encountered, from regular depth intervals based on field observation;
- Collection of three surface water samples from the dam;
- Laboratory analysis of selected samples and interpretation of results in accordance with current NSW EPA guidelines and the National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM, 1999 – amended 2013) [NEPM, 2013]; and
- Provision of a report detailing the methodology and results of the assessment and assessing the suitability of the site for the proposed land use.

3. Previous Investigations

A previous investigation for the site was undertaken by Aargus Pty Ltd (Aargus) in *Report on Environmental Site Assessment, 51 St Andrews Road, Leppington NSW*, 27 September 2006, Ref: E1522, [Aargus 2006].

Aargus (2006) assessment included a review of site history and sampling for environmental purposes. The historical information from Aargus (2006) found that prior to the site's current land use, as an operational pyrotechnics laboratory and manufacturing facility, the site appeared to be mainly used for farming (grazing).

Based on the site history and site walkover, the areas of environmental concern and associated chemicals of concern were identified. These are summarised in Table 1 below.

Table 1: Potential Areas of Environmental Concern (Aargus 2006)

Potential AEC	Description	CoC	Likelihood of contamination
Area Surrounding Waste Storage Area	Storage of waste products used in the manufacturing of pyrotechnics	Metals, Potassium, PAH	Medium
Whole Site	Migration of chemicals to the site through surface water	Metals, TPH, BTEX	Low
Area Surrounding Dam	Testing of pyrotechnics occurs within close vicinity of the dam located on site	Metals, TPH, BTEX, PAH	Medium
Laboratory Sheds	Chemicals used in manufacturing of pyrotechnics stored and used within the sheds	Metals, PAH, TPH, BTEX, Potassium	Low

A total of 23 bore holes were drilled within the site for contamination purposes. A total of 24 samples were taken from the surface topsoil and underlying natural material. All results were found to be below the health-based investigation levels (HIL) for residential use with gardens and accessible soils (HIL A) and the 95% Upper Confidence Limit (UCL) for the arithmetic mean of concentrations was also below the HIL A.

Based on the above investigations, Aargus (2006) concluded that the site was suitable for residential, commercial and industrial land uses.

4. Site Information

4.1 Site Identification

The site is located at 51 St Andrews Road, Leppington (Lot 72 in Deposited Plan 706546) and is currently used for the production of fireworks. The site has an irregular shape and covers an area of approximately 13 ha. The site location and boundaries are shown on Drawing 1, Appendix B.

4.2 Regional Geology, Soils and Hydrogeology

Reference to the Penrith 1:100 000 Geological Series Sheet indicates that the site is underlain by Bringelly Shale (mapping unit Rwb) of the Wianamatta Group of Triassic age. This formation typically comprises shale, carbonaceous claystone, laminite and some minor coaly bands which weather to form clays of high plasticity. The results of the investigation were consistent with the geological mapping, with siltstone encountered in the pits that intersected rock.

The Penrith 1:100,000 Soils Landscape Sheet indicates that the majority of the site is within the Blacktown soil landscape group (mapping unit bt), which is associated with residual soils with moderately reactive, highly plastic subsoil, low soil fertility and poor soil drainage.

The McNally, G. 2005, Investigation of Urban Salinity – Case Studies from Western Sydney, Urban Salt 2005 Conference Paper, Parramatta (McNally 2005) describes some general features of the hydrogeology of Western Sydney which are relevant to this site. The shale terrain of much of Western Sydney is known for saline groundwater, resulting either from the release of connate salt in shales of marine origin or from the accumulation of windblown sea salt. Seasonal groundwater level changes of 1 – 2 m can occur in a shallow regolith aquifer or a deeper shale aquifer due to natural influences.

Groundwater investigations undertaken by DP in the Camden area and previous studies of areas underlain by the Wianamatta Group and Quaternary river alluvium indicate that:

- the shales have a very low intrinsic permeability, hence groundwater flow is likely to be dominated by fracture flow with resultant low yields (typically < 1 L/s) in bores; and
- the groundwater in the Wianamatta Group is typically brackish to saline with total dissolved solids (TDS) in the range 4000 – 5000 mg/L (but with cases of TDS up to 31750 mg/L being reported). The dominant ions are typically sodium and chloride and the water being generally unsuitable for livestock or irrigation.

4.3 Site Condition

At the time of undertaking this assessment, the site was still used for the manufacturing of fireworks but was in the process of being decommissioned. The northern portion of the site consisted of brick and corrugated buildings associated with the production of pyrotechnics. Various shipping containers were located within the site, as well as other storage sheds. Access tracks were located within the site. Some consisted of asphalt and others were dirt tracks. The southern portion of the site consisted of grass-covered land to the west and tree covered in the south-east. Two dams were located within the site, one was located within the fireworks manufacturing area and the second was located down gradient within the southern portion of the site.

Fill mounds consisting of reworked natural material were observed in the northern portion of the site and anecdotal evidence indicates that the material was sourced from the construction of St Andrews Road.

5. Review of Site History Information

The site history investigation was undertaken to identify potential areas of environmental concern which may have arisen from previous uses (ie: storage of dangerous goods, raw and waste products etc), the presence of demolished or partly demolished buildings, soil stockpiles, land filling, waste disposal or other potentially contaminating activities.

The following sections detail the results of the investigations undertaken, with results discussed in Section 11.

5.1 Council Records

A search of Liverpool Council's records for the site was conducted by Council staff and the results of the search were discussed with DP on 10 July 2013. In summary, no files pertaining to contamination were identified.

5.2 Section 149(2) and (5) Certificate

Section 149 Planning Certificate was obtained for the site (dated 02 July 2013, copy provided in Appendix C). The site is currently zoned as R2 – Low density residential. There are no matters listed under the Section 59(2) of the *Contaminated Land Management Act* 1997 which should be specified on the certificate. Section 59(2) concerns matters that must be included within a Section 149 Planning Certificate in relation to the land being significantly contaminated, regulatory orders applying and the existence of a site audit statement or site audit report pertaining to the property.

Information in the Section 149(5) Planning Certificate states that Council has no records to indicate whether the site has been filled or partially filled.

5.3 NSW EPA Public Registers

A search on 22 July 2013 for Statutory Notices issued under the *Contaminated Land Management Act 1997* and *Protection of the Environment Operation Act 1997* (POEO), available on the EPA website, showed that no notices have been issued on the subject site.

5.4 WorkCover Search

The results for a WorkCover search for licences to keep dangerous goods at the site were received on 17 July 2013. A copy of the WorkCover search documents is provided in Appendix C.

The dangerous goods that have been stored on the site are summarised Table 2 below:

Table 2: Dangerous Good Stored on the Site

Dangerous Goods
Pyrotechnic Articles
Ammonium Perchlorate
Potassium Nitrate
Potassium Perchlorate
Sodium Nitrite
Barium Oxide
Sulfur
Uncoated Aluminum Powder
Calcium Silicide
Magnesium Powder
Dry Titanium Powder
Fireworks
Black Powder (Gunpowder)
Flash Powder
Guanyl Nitrosaminoguanyltetrazene (Tetrazene)

5.5 Groundwater Bore Database

A search of the groundwater bore database administered by the NSW Office of Water indicated that there are no bores located within a 1 km radius of the site. The closest bore is located approximately 1.5 kilometres south-east of the site which is considered too distant to be relevant.

5.6 Historical Aerial Photography

Aerial photographs were examined with a view to identifying potentially contaminating land uses or significant environmental features and changes to the site. Five aerial photographs were examined from the years 1947, 1961, 1975, 1994 and 2002 and copies are included in Appendix B. A summary of the findings are given below:

1947: The site was vacant, predominantly bushland covered with some cleared land in the northern section of the site. Structures were not present within the site. The area of land appeared to be surrounded by cleared (possibly) agricultural properties located on the northern, eastern and western boundaries of the site. Vacant bushland and a Sydney Water canal system is observed to the south east of the site.

1961: The site remained predominantly vacant and bushland covered, however, vegetation clearing was observed in isolated pockets located throughout sections of the site.

1975: The site remained vacant, with an increase in bushland vegetation of previously cleared areas within the southern and central sections of the site. Structures were still not present within the site. Cleared (possibly) agricultural land located to the north of the site appears now to contain a market garden. Ground disturbance and a possible motor vehicle dirt track were observed to the south east beyond the property boundary.

1994: The site contained numerous structures, predominantly located in the northern section of the property; a large dam is located in the south west corner of the site. A large cleared vacant section of land was observed in the north-west corner near the property entrance. To the eastern and southern boundary of the site adjoining land is relatively unchanged and remains heavily vegetated with bushland. The aerial photograph was of poor quality.

2005: The site contained additional structures predominately situated in the north-east and central sections of the property. Bushland had been further cleared from the property to make way for numerous small structures, possibly sheds and shipping containers used for storage. The southern corner of the site remained heavily vegetated.

Summary:
The aerial photograph review indicates that the site has gradually changed since 1947. Structures first appeared on the property in the 1994 aerial photograph. However, land clearing in isolated pockets was observed throughout the property since 1947. The area surrounding the site to the north, south-west and north-west remained relatively unchanged and appears to have been used for agricultural purposes with a market garden observed to the north of the site in the 1975 photograph.

5.7 Previous Site Ownership

A title deeds search was conducted by Service First Registration Pty Ltd, Legal Agents. The title information can assist in the identification of previous land uses through the recorded occupation of individual land owners or by a descriptive company name. This may, therefore, establish potentially contaminating activities occurring at the site. A summary of the results of the site history and title deeds search are shown in the following tables. The full results of the searches are given in Appendix C.

Table 3: Previous Site Ownership for Lot 72 in Deposited Plan 706546

Date of Acquisition	Owner and Occupation	Inferred Land use
24.10.1857 (1857 to 1929)	Robert Thomson (& His Deceased Estate)	Possibly Agricultural / Vacant
23.10.1929 (1929 to 1947)	Peter Thomson (Farmer)	Possibly Agricultural / Vacant
09.12.1947 (1947 to 1953)	Robert Stanley Thomson (Dairy Farmer)	Possibly Agricultural / Vacant
07.07.1953 (1953 to 1972)	Edward Morris Philpott (Provision Merchant) Ivy Mahala Philpott (Married Woman)	Vacant
14.06.1972 (1972 to 1984)	Campbelltown City Council	Vacant
11.10.1984 (1984 to 2012)	Salvatore Foti (Company Director) Carmela Maria Foti (Married Woman)	Firework Manufacturing / Industrial Commercial
30.03.2012 (2012 to Date)	# Salvatore Foti (Company Director)	Firework Manufacturing / Industrial Commercial

# Denotes current registered proprietor

In establishing the inferred use of the site, information has also been drawn from other sources, such as aerial photographs.

6. Site Walkover

A site walkover was undertaken by an engineer from DP on the 1 July 2013. During the inspection the following were noted within the site:

- The southern portion of the site was predominantly covered with grass and trees with a cleared section in the south-west.
- At the time of the investigation, the site was in the process of being relocated to another site, with most shipping containers and buildings being cleared of product and equipment.
- Multiple sheds, buildings and shipping containers were observed within the northern portion of the site (Pyrotechnic manufacturing and storage area). The sheds, buildings and shipping containers were used for the manufacturing of pyrotechnics, storage of associated pyrotechnic equipment, manufacturing equipment, storage of raw products and/or final products.
- The sheds were constructed from either bricks or corrugated sheeting.
- Roadbase and dirt access roads were observed leading to the buildings, sheds, and shipping containers.
- Two dams were located within the site. One is located within the manufacturing and storage area and the other down gradient. Dams were used to collect and store surface water run-off.
- Soil stockpiles were located within the northern portion of the site.
- The site generally sloped from the north to the south, with surface water expected to flow to the two on-site dams.
- The chemical/flammable storage area (a converted shipping container) contained numerous chemical containers. The chemicals included fuel, oils, paints, hydraulic liquids and various other chemicals. The storage area was an enclosed shipping container with a lockable gate (refer Photo 12) which appeared in reasonable condition, with all chemicals stored off the ground with a grate on the base of the shipping container and shelving at the rear. Some minor evidence of spillages could be observed on the floor of the shipping container. A test pit was positioned directly down gradient from the chemical storage area.
- 44 gallon drums of liquid hydrocarbon were located adjacent to one of the buildings on a concrete slab (refer Photographs 6 and 7). No staining was observed on the concrete slab in the vicinity of the stored chemicals. A test pit was positioned adjacent to the stored drums.
- An exposed pipe (approximately 1 m exposed), which is presumed to be asbestos, was observed running under a building (location of pipe shown on Drawing 2, Appendix B).
- No visible surface staining was observed within the site, however the recent rainfall meant the surface of the site was saturated during the inspection.

Site photographs are provided in Appendix H.

Mr Tino Foti was informally interviewed during the site walkover. The interview provided information on the historical (where known) and current activities of the property.

The following information was obtained from the interview:

- No waste was buried within the site.
- The fireworks testing area is located to the north of the large dam.
- The soil stockpiles located within the rear of the site were sourced from excess soil from the construction of St Andrews Road.
- The water pipes located within the site were either constructed from plastic, PVC or copper pipes.
- The chemical storage area was identified.
- Shipping containers in the rear of the site were used for the storage of fireworks.
- The brick buildings in the north of the site were the laboratories where chemicals were mixed and used, but at the time of the investigation were all empty, except one.
- The concrete bunker at the rear of the site was the black powder storage for the site and holds 500 kg of black powder.

7. Conceptual Site Model

In the course of the site history investigations and site walkover, the entire northern portion of the site (the area used for the manufacture of fireworks) was identified as an Area of Environmental Concern (AEC).

A 'source–pathway–receptor' approach has been used to assess the potential risks to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the sources and receptors are provided in Table 4 below.

Table 4: Conceptual Site Model

Source	Secondary Source	Transport Pathways	Receptors
The Production and Manufacturing of Fireworks and associated: - Buildings and infrastructure - Storage areas for fireworks and materials (including chemicals) - Fireworks Testing Areas Imported filling for roadways and within stockpiles	Impacted superficial soils Impacted surface water	P1 - Direct Contact with soil P2 - Inhalation of dust P3 - Inhalation of vapours	R1 - current users R2 - future users (Residential) R3 - construction and maintenance workers
		P2 - Inhalation of dust P3 - Inhalation of vapours	R4 - Adjacent users (Residential)
		P4 - surface water Runoff	R5 - Downstream water course and dam

A list of potential contaminants have also been developed for the contaminant sources and are provided in Table 5.

Table 5: Potential Contaminants

Source	Issues/ substances of Concern	Target Analytes
The Production and Manufacturing of Fireworks	Storage areas for fireworks and materials (including chemicals) (TPH, PAH, metals) Spills (TPH, BTEX, PAH and Metals) Pyrotechnic testing areas (Explosives, heavy metals)	TPH, BTEX, PAH, explosives and metals
Imported filling for roadways and within stockpiles	Contaminants dependent on source of filling, which is often unknown. Common contaminants comprise asbestos, heavy metals, PAH, petroleum compounds, pesticides, PCB.	Asbestos, heavy metals, PAH, TPH, BTEX, OCP, OPP, PCB, phenols

8. Data Quality Objectives (DQO)

The overall objective of the Detailed Site Investigation is to investigate the site to assess whether it is suitable, from a contamination standpoint, for the proposed land use.

To confirm the quality of the assessment data, the 7-step data quality objective process has been completed with reference to the Australian Standard *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil Part 1: Non-volatile and Semi-volatile Compounds* (AS 4482.1 – 2005).

8.1 State the Problem

The site is to be developed for a residential subdivision. At the time of preparation of this report, the site was used for the manufacturing of fireworks in the northern portion of the site and vacant land in the south with either grass or remnant native vegetation being present.

The "problem" under consideration is the characterisation of the type, extent and nature of contamination that may exist at the site, if any, and the suitability of the site for the proposed subdivision and residential use.

8.2 Identify the Decision

The primary decisions to be made in completing the assessment are as follows:

- Does the site, or is the site, likely to present a risk to human health or the environment under the proposed land use?
- Is the site currently suitable for the proposed end use?
- Is there any potential for groundwater contamination?
- Are there any off-site migration issues to be considered?
- Is further investigation required to adequately address the abovementioned decisions?
- Is further investigation required to delineate the extent of any contamination identified?
- Does the site require remediation to ensure suitability for the proposed end use?

8.3 Identify the Inputs to the Decision

The "inputs to the decision" comprise the data gathered as part of the current assessment and relevant guidelines and policies including the following documents/information:

- State Environmental Planning Policy No. 55 (SEPP 55) – Remediation of Land (commenced 28 August 1998);
- NSW EPA *Contaminated Sites: Sampling Design Guidelines* (1995);
- NSW EPA *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (1997); and

- NSW DEC *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme* 2nd edition (2006).
- National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM, 1999 – amended 2013) [NEPC, 2013].

The primary inputs in assessing the presence of contamination in soil are as follows:

- An assessment of site history;
- Site walkover;
- The areas of potential contamination and contaminants deriving from known historical and current site activities identified from the history review;
- Published soil guidelines appropriate to the proposed future land use (residential) and published guidelines for protection of the environment;
- Field investigation techniques to assess contamination as per DP's standard field procedures; and
- Field observations and analytical results.

8.4 Define the Boundaries of the Study

The boundaries of the site are the cadastral boundaries of Lot 72 in Deposited Plan 706546 as shown on Drawing 1 Appendix B.

8.5 Develop a Decision Rule

The information obtained through this assessment will be used to characterise the subject site in terms of contamination issues and risk to human health and the environment.

The site assessment criteria are provided in Section 11. Further investigation, remediation and/or management may be recommended if these criteria are not met.

Laboratory analytical results will be accepted and considered useable for this assessment under the following conditions:

- All laboratories used are accredited by NATA for the analyses undertaken;
- All practical quantitation limits (PQL) or limits of reporting (LOR) set by the laboratories fall below the assessment criteria adopted, or indicate across the board lack of detection (i.e. some of the water assessment criteria are difficult to achieve at PQL or LOR);
- The differences between the reported concentrations of analytes in the field replicate samples and the corresponding primary samples are within accepted limits;
- The reported trip spike recoveries are within accepted limits;
- The reported trip blank concentrations are less than PQL or LOR; and

- The quality assurance / quality control (QA/QC) protocols and results reported by the laboratories comply with the requirements of the National Environmental Protection Council (NEPC) *National Environmental Protection Measure (NEPM) Guideline on Laboratory Analysis of Potentially Contaminated Soils* (1999 – amended 2013) and Australian and New Zealand Environment and Conservation Council (ANZECC) *Guidelines for the Laboratory Analysis of Contaminated Soils* (1996).

8.6 Specify Tolerable Limits on Decision Errors

Specific limits for the Detailed Site Investigation will generally be in accordance with the appropriate guidelines from the NEPC (2013) for the collection of environmental samples. In order that the results obtained are accurate and reproducible, appropriate and adequate quality assurance and quality control (QA/QC) measures and evaluations were incorporated into the sampling and testing regime. These are summarised in Section 10.

8.7 Optimise the Design of Obtaining Data

Design for data collection was optimised by the development of a plan for sample collection, handling and analysis in accordance with pre-determined requirements based on the data needs for the assessment. These include undertaking quality assurance and quality control measures to allow assessment of the suitability of the data collected for use in the assessment.

Section 10 describes the data collection and optimisation methods adopted for the assessment.

9. Fieldwork, Sampling and Analysis

9.1 Sampling and Analysis Rationale

The sampling regime was devised with reference to the general principles outlined in NSW EPA *Contaminated Sites Sampling Design Guidelines* (1995) and Camden Council's *Management of Contaminated Lands* (Policy No. 3.12, 26 February 2008).

A total of 66 test pits were excavated within the six hectares portion of land surrounding the sheds and other buildings associated with the manufacturing of fireworks. The sampling density is in accordance with the NSW EPA *Contaminated Sites Sampling Design Guidelines* (1995) for a site of this size with a sample density of 11 test pits per hectare. The test pits were positioned across the site on an approximate square grid targeting roadways, buildings, chemical storages, observed filling, drainage lines and other site features.

A total of 14 background test pits were excavated within the surrounding seven hectares which is mostly undisturbed vacant land (sampling at a rate of two test pits per hectare). The test pits were positioned across the site with the majority providing background information, and one targeting a fireworks test area.

All test pits were extended into natural material. Samples were collected from the near surface horizon at a depth of 0.1 – 0.2 m or 0 – 0.1 m, with additional deeper samples collected from selected locations based on field observations made at each location and the expected variations in contamination potential with depth.

Stockpiles were observed within the northern portion of the site. Anecdotal evidence suggests that the material was sourced from the construction of St Andrews Road. Samples were collected from the stockpiles and from the underlying natural material.

Two surface water samples were collected directly from the two dams located within the site. Samples were collected with an extendable sampling pole.

Drawing 3, Appendix B, shows the test pit locations within the site. Table 6, provides a rationale for each location investigated and samples tested.

Table 6: Sampling Analysis Plan

Target / Description	Estimated Area (ha)	Number of Sample Locations	Number of Samples Tested	Primary Contaminants of Concern
Pyrotechnical manufacturing and storage area	6	66	71	HM, TRH, BTEX, PAH, OCP, OPP, PCB Explosive Suite and Asbestos
Background	7	14	14	HM, TRH, BTEX, PAH, OCP, OPP, PCB and Asbestos
Stockpiles	-	4	4	HM, TRH, BTEX, PAH, OCP, OPP, PCB and Asbestos
Surface Water / Dams	-	2	2	HM, TRH, BTEX, PAH, OCP, OPP, PCB

Notes:
HM = priority heavy metals viz: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn).
TPH = Total Petroleum Hydrocarbons.
BTEX = Benzene, Toluene, Ethylbenzene and Xylenes.
PAH = Polycyclic Aromatic Hydrocarbons.
OCP = Organochlorine pesticides
Asb = Asbestos.
OPP = Organophosphorous pesticides.
Explosive Suite = HMX, RDX, 1,3,5-Trinitrobenzene, 1,3-Dinitrobenzene, Tetryl, 2,4,6-Trinitrotoluene, 4-Amino-2,6-dinitrotoluene, 2-Amino-4,6-dinitrotoluene, 4-&2-AM-DNT(Isomeric Mixture), 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 2,4&2,6-DNT(Isomeric Mixture), Nitrobenzene, 2-Nitrotoluene, 3-Nitrotoluene, 4-Nitrotoluene, Nitroglycerine and PETN

9.2 Sample Collection and Handling

Test pits were excavated using a JCB 4CX backhoe with a 450 mm bucket. Samples were collected from exposed soils in the sidewalls (shallow samples) or from the centre of the bucket (deep samples) taking care to select soil which had not been in contact with the bucket.

Sample collection and handling were undertaken in accordance with DP's standard operating procedures. The general sampling, handling, transport and tracking procedures comprised:

- Provision of logs for all sample locations. Records include GPS coordinates of the locations, description of the conditions encountered, the depth of samples collected, the name of the person logging and the equipment used;
- The use of disposable sampling equipment (nitrile gloves);
- Transfer of the sample for chemical analysis using new glass jars supplied by the NATA accredited laboratory and sealed with a Teflon lined lid to eliminate cross contamination during transportation to the laboratory;
- Transfer of sample for asbestos analysis using new, sealable, plastic bags;
- Labelling of the sample containers with individual and unique identification including project number, test location identification and depth;
- Placement of the containers into a chilled, enclosed and secure container for transport to the laboratory; and
- Use of chain-of-custody documentation to enable sample tracking and custody to be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory.

9.3 Laboratory Analysis and Methodology

Envirolab Services conducted analysis of the primary samples and intra-laboratory replicate samples while ALS Group conducted the inter-laboratory replicate samples. Both laboratories are accredited by the National Association of Testing Authorities (NATA) and are required to conduct in-house QA/QC procedures. These are normally incorporated into every analytical run and include assessment of reagent blanks, spike recovery, surrogate recovery and laboratory duplicates.

The analytical methods used are summarised in the Laboratory Reports, included in Appendix E.

9.4 Field Quality Assurance

Quality assurance (QA) and quality control (QC) procedures were adopted throughout the field sampling programme to ensure sampling precision and accuracy and prevent cross contamination.

A 10% field duplicate (5% intra-laboratory and 5% inter-laboratory) samples were collected and analysed in accordance with AS 4482.1 – 2005 *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soils*. Duplicates were collected and analysed for the same analytical suite as the primary sample. Relative percentage differences (RPD) were calculated and compared to the typical variations provided in AS 4482.1 (ie: typically ± 30 – 50% or greater for low concentrations).
Trip blank and trip spike samples were prepared and transported with the collected samples at a rate of one sample of each per day for volatile compounds. Trip blank and trip spike samples were analysed for BTEX.

10. Site Assessment Criteria

This investigation is undertaken for pre-purchase due diligence purposes. It is also understood that this assessment will be required to support a development application for a future residential subdivision. Six hectares of the site at the time of this investigation is being used for the manufacturing and production of fireworks. The remaining seven hectares of the site is mostly undisturbed vacant land.

The analytical results from the laboratory testing have been assessed (as a Tier 1 assessment) against the investigation and screening levels in Schedule B1 of NEPC (2013). This guideline has been endorsed by the NSW EPA under the *Contaminated Land Management* (CLM) Act 1997. Schedule B1, NEPC (2013) provides investigation and screening levels for commonly encountered contaminants which are applicable to generic land uses and include consideration of, where relevant, the soil type and the depth of contamination.

The investigation and screening levels are not intended to be used as clean up levels. They establish concentrations above which further appropriate investigation (e.g. Tier 2) should be undertaken.

The proposed use of the Site is residential and as such, the adopted assessment criteria (SAC) comprised the:

- **Health Investigation Levels (HIL) A** – The health investigation levels (HILs) are scientifically based, generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential risks to human health from chronic exposure to contaminants. Given the proposed land use is residential, the HIL (A) guideline values have been adopted which are for sites that are residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry)), and also includes childcare centres, preschools and primary schools.
- **Health Screening Levels (HSL) A & B** (low – high density residential sites) – Health Screening Levels (HSLs) are used to assess selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact with affected soils and groundwater. The HSLs were developed by the Co-operative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) and were derived through the consideration of health effects only, with particular emphasis on the vapour exposure pathway. Other considerations such as ecological risk, aesthetics, the presence of free phase product and explosive / fire risk are not addressed by the HSLs. As such, the HSLs should be used similarly to the HILs, i.e. as a screening tool. Given the proposed land use is residential, the HSL A & B (low – high density residential sites) has been adopted for silt soil types;
- **Ecological Investigation Levels (EIL)** – Ecological Investigation Levels (EILs) have been developed and discussed in NEPC (2013) for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which essentially corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant using the following formula:

  EIL = ABC + ACL, where

  ABC = Ambient Background Concentration

  ACL = Added Contaminant Limit

The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions). The ABC was determined through the use of methods defined by Olszowy et al. (1995).

Given the proposed land use is residential, a worst case scenario has been adopted and the lowest (most conservative) ACL for Urban Residential /public open space has been adopted for a screening level.

- **Ecological Screening Levels (ESL)** – ESLs are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESLs apply to the top 2 m of the soil profile, which essentially corresponds to the root zone and habitation zone of many species. Given the proposed land use is residential, the ESLs for Urban Residential /public open space sites and for fine soil texture have been adopted.
- **Management Limits** – In addition to appropriate consideration and application of the HSLs and ESLs, there are additional considerations which reflect the nature and properties of petroleum hydrocarbons, including the formation of observable light non-aqueous phase liquids (LNAPL), fire and explosion hazards; and effects on buried infrastructure e.g. penetration of, or damage to, in-ground services. Management Limits to avoid or minimise these potential effects have been adopted in NEPC (2013) as interim Tier 1 guidance. Given the proposed land use is residential; the management limits for residential, parkland and public open spaces have been adopted.
- **Asbestos** – As no asbestos was identified in the test pits excavated and the site history indicates that there is a low potential for asbestos contamination, an asbestos screening criterion has been adopted in the first instance. The asbestos screening involved the collection of 50 g samples and a criterion of 'no asbestos detected at the reporting limit of 0.1 g/kg (0.01%)'.

10.1.1 Background Concentrations

Based on the relatively low sampling density for background areas which has been adopted due to the low risk of contamination, the preliminary screening levels for background results are the published background ranges for Australian soils. These include background ranges published in:

- NEPC (1999), National Environmental Protection (Assessment of Site Contamination) Measure Schedule B(1) *Guidelines on the Investigation Levels for Soil and Groundwater, Background Ranges.* It should be noted that the NEPC (1999) was amended in 2013 and as such is now superseded. However, as there are no new background ranges within the NEPC (2013) the NEPC (1999) background ranges are considered appropriate for this investigation; and
- Australian and New Zealand Environment and Conservation Council/National Health and Medical Research Council (ANZECC/NHMRC): *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites* (1992), Environmental Soil Quality Guidelines Column A Background (ANZECC A).

In areas where the field and laboratory results are within the expected background conditions, it will be considered that no signs of anthropogenic impacts are present and no further assessment will be considered necessary to confirm suitability for the proposed land use.

Any results found to significantly exceed the background ranges may trigger the requirement for further investigation around the test pit(s) of interest.