REPORT

SOIL VALIDATION PROTOCOL

COCKLE CREEK SITE REDEVELOPMENT

BOOLAROO, NSW

18 MARCH 2010

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REVISION 0

FOR

INCITEC FERTILIZERS LIMITED

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EXECUTIVE SUMMARY

Soil and Groundwater Consulting (S&G) has developed this Soil Validation Protocol for the remediation phase of the Incitec Fertilizers Limited (IFL) Cockle Creek site.

The Soil Validation Protocol has been developed to provide a consistent approach of the validation of the post-remediation surface of the site to verify objectively that the contamination status of the residual soils is suitable for the intended future uses of the site.

The appropriate implementation of the Soil Validation Protocol will provide a reliable and valid data set for the verification of the condition of the site surface following remediation.

The Soil Validation Protocol should be implemented within the overall site safety plan development for the remediation phase of the site to ensure the safety of staff involved in these works.

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DOCUMENT INFORMATION

Rev.	Status	Date	Company	Name
1	Draft	18 March 2010	Incitec Fertilizers Limited	Mr Mark Shelley
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1. INTRODUCTION

The Incitec Fertilizers Limited (IFL) Cockle Creek manufacturing and distribution site located on Main Road, Boolaroo, New South Wales is to undergo remediation to remove the contaminated fill materials from across the site and retain these within an engineered containment cell to be constructed at the northern end of the site.

The contaminated fill was the result of mixing of smelter wastes and slag with site soil to provide a suitable surface for the former fertiliser manufacturing and distribution centre. The manufacturing works have now ceased at the site and the distribution works will be completed in the near future and before any soil remediation activities commence.

Whilst the soil remediation program is to occur in three main phases, the site will eventually be divided into two sections:

- a northern section housing the containment cell and buffer zones; and
- a southern area suitable for residential uses.

1.1 Objective

The objective of the soil validation protocol is to ensure that the site is suitable for its intended future uses.

In the northern area of the site, the cell area is to be remediated to a point at which it is suitable for the placement of the containment cell and have only appropriate levels of contaminants beneath the cell which pose an acceptable risk to the environment. The surrounding buffer zone will be validated as being suitable for public open space. The final capping, and hence the entire exposed surface of the northern area holding the cell, will be validated as being suitable for public open space.

The southern area will be validated as being suitable for low density residential use with emphasis placed on the final surface meeting nationally approved human health based screening level criteria.

The surface validation will occur using a combination of NATA certified laboratory based analytical program and real-time guidance validation of heavy metal concentrations using a field portable X-ray fluorescence (XRF) meter. The use of an XRF meter as part of the validation protocol is considered appropriate in this case since the primary contaminants of concern are heavy metals and principally, these contaminants are lead and zinc. These contaminants are likely to represent markers of fill contamination and as such, their removal to acceptable levels is expected to result in a surface where the slag impacted fill materials have been suitably removed and in doing so, the excavation will have removed any other potentially contaminated fill materials. This will be verified by lower density NATA certified laboratory based analysis.

The NATA certified laboratory based analytical program will also include other potential contaminants and verify that these also occur at concentrations below the acceptance criteria.

These additional contaminants will include nutrients, fluoride, petroleum hydrocarbons, a broad range of industrial organic contaminants, a wider range of heavy metals, pH, sulphate, salinity (as electrical conductivity) and asbestos.

2. DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) have been developed for the validation task, as discussed in the following sections.

2.1.1 State the Problem

Previous investigations have identified widespread fill / soil contamination with heavy metals likely to have originated from the historical operation of the neighbouring smelter and filling of the site. The contaminated fill is to be removed to a containment cell. The residual surface must be suitable for its intended purposes. The validation protocol provides objective evidence that this has been achieved.

2.1.2 Identify the Decision

The validation protocol must demonstrate that the site is suitable for its intended purposes through comparison of analytical data to adopted guideline values which are inferred to indicate that the site is suitable for its intended use based on the soil exposure assumption inherent in the development of those criteria.

2.1.3 Identify Inputs to the Decision

Analytical data and its comparison to the adopted assessment criteria are the key inputs to the decision making process. Thus the key items are the collection of appropriate analytical data at an acceptable density to provide a suitable level of reliance on the outcome and, the agreement on the applicable criteria to be applied for each use of the land.

2.1.4 Define the Study Boundaries

The study area boundary is defined as the IFL site boundary as shown in Figure 1. The site will be dividend into three phases for the site remediation program and eventually the site will be divided into two broad areas:

- one in the north containing the engineered containment cell; and
- the second in the south providing an area suitable for residential use.

The final two areas of the site are the areas of inertest for the development of the validation protocol as this defines the landuse options in each of the two areas.

2.1.5 Develop a Decision Rule

The decision rule will be based on the statistical evaluation of the analytical validation data and comparison against the adopted land use criteria relevant to each area of the site. A high degree of reliance is required, particularly for the residential area, so in the first instance the preferred approach would be to have all analytical results below the adopted land use criteria in the residential area.

A higher level of contamination is likely to be acceptable beneath the cell as no human exposure to these soils will be possible once the cell is constructed. The acceptance criteria will therefore be based on health risks to workers and on potential leaching of contaminants to the groundwater environment.

In the residential area, the much lower levels of contamination which will be acceptable based on human health consideration would in all likelihood be protective of the groundwater environment and no specific leach based assessments are proposed as the validation of this area.

2.1.6 Specify Limits of Decision Error

Data quality indicators (DQIs) have been determined for completeness, comparability, representativeness, precision and accuracy of both field and laboratory data. The DQIs are presented in Section 2.2.

2.1.7 Optimise the Design for Obtaining Data

The proposed sampling program is based on the minimum requirements for characterisation of a site included in AS4482.1 *Guide to the sampling and investigation of potentially contaminated soil – Part 1: Non-volatile and semi-volatile compounds* (2005). This guideline identifies the diameter of round hot spot that would be detected at a 95% level of confidence using a square grid with a nominated sampling density.

In the residential area, small residential block sizes are considered likely and as a result it is proposed to conduct sampling at the higher density consistent with a small residential block assessment. This is based on sampling density of 100 points per hectare. The proposed density would identify an approximately 12 m diameter hot spot with a 95% level of confidence.

For the cell and buffer area which forms a large section of the site, a lower sampling density is considered appropriate as the risk associated with undetected hot spots is much lower due to the lower exposure risks. Despite the area being larger, an intermediate level sampling density has been proposed to provide a suitable level of reliance. This level is based on a sampling density of 15 points per hectare, or equivalent to the density recommended for a 2 ha site with a 95% confidence level of indentifying an approximately 30 m diameter hot spot.

It is considered that the proposed sampling density strikes the appropriate balance between a suitably high level of confidence in the outcome, particularly for the proposed residential area, and the cost of obtaining the required data.

2.2 Data Quality Indicators

The pre-determined Data Quality Indicators (DQIs) for the project are discussed below in relation to precision, accuracy, representativeness, comparability and completeness, and are shown in Table 1.

- Completeness – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.

- Comparability - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples, ensuring analysing laboratories use consistent analysis techniques and reporting methods.

- Representativeness –expresses the degree which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and by using an adequate number of sample locations to characterise the site to the required accuracy.

- Precision - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD) of duplicate samples.

- Accuracy - measures the bias in a measurement system. The accuracy of the laboratory data that is generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards.

Table 1 – Data Quality Indicators

Completeness
All field work to be completed in accordance with the Validation Protocol and the Project Safety Plan (PSP)
Samples to be tested or collected at nominated grid based locations
Field engineer / scientist to have appropriate field experience in soil sampling and with the required XRF equipment
All field sampling sheets to be completed fully including location, GPS coordinates, observations, samples taken
100% of samples to be analysed by laboratory within laboratory specified holding times by a NATA accredited laboratory
NATA accredited laboratories and NATA accredited analytical methodologies to be adopted for laboratory sample analysis
Comparability
All field work to be completed in accordance with the protocol and the PSP
Field engineer / scientist to have appropriate field experience in soil sampling and with the required XRF equipment
Climatic conditions to be recorded on site inspection checklist and recorded on file
All soil samples to be collected using same method across the site and at each validation event
Samples for laboratory analysis to be stored in laboratory supplied containers, in a chilled cool box and transported to laboratory under chain of custody documentation within specified holding times
Comparison of XRF and analytical data to verify the field based XRF method is comparable to the laboratory based analytical program

Representativeness
Soil samples to be assessed and sampled using methodologies as specified in the protocol
Soil samples for laboratory analysis to be collected in accordance with prevailing guidelines in clean / preserved jars provided by the laboratory and stored in chilled cool box for transport to the laboratory
Laboratory prepared trip blanks to be analysed at a rate of one sample per validation event
Rinsate blanks are to be collected and analysed at a rate of one per day of investigations / validation to demonstrate lack of cross contamination
Precision
All field work to be completed in accordance with the protocol and the PSP
Appropriate calibration and operation of the field XRF meter
All laboratories to be National Association of Testing Authorities (NATA) accredited for the analyses performed
Field duplicates (intra-laboratory) to be collected at a frequency of 5% and analysed for the same range of analytes as the primary laboratory samples.
Relative Percent Differences (RPDs) to be calculated for intra-laboratory duplicates, with the objective of all RPD's calculated being: o 0-30% for inorganics; and o 0-50% for organics.
Laboratory prepared trip blanks to be analysed at a rate of one sample per validation event
Rinsate blanks are to be collected and analysed at a rate of one per day of investigations / validation to demonstrate lack of cross contamination
Laboratory internal QC to include duplicate samples for each analyte and will conform with the following: ▪ Surrogate spike recoveries to be between 70% and 130%; ▪ Matrix spike recoveries to be between 70% and 130%; ▪ Contaminants below detection limits for method blank samples; ▪ Matrix duplicate/laboratory duplicate RPDs to be less than 50%.
Laboratory internal QC to include as outlined in NEPM Schedule B(3) and in accordance Table 3 and with NATA requirements: ▪ reagent blanks ▪ method blanks ▪ matrix spikes ▪ matrix spike duplicates ▪ surrogate spikes ▪ reference materials ▪ laboratory control samples
Comparison of XRF and analytical data to verify field method precision
Accuracy
All field work to be completed in accordance with the protocol and the PSP.
Appropriate calibration and operation of the field XRF meter
All laboratories to be National Association of Testing Authorities (NATA) accredited for the analyses performed
Field duplicates (inter-laboratory) to be collected at a frequency of 5% and analysed for the same range of analytes as the primary samples
Relative Percent Differences (RPDs) to be calculated for inter-laboratory duplicates, with the objective of all RPD's calculated being: o 0-30% for inorganics; and o 0-50% for organics.
Secondary laboratory internal QC to include duplicate samples for each analyte and will conform with the following:

▪ Surrogate spike recoveries to be between 70% and 130%; ▪ Matrix spike recoveries to be between 70% and 130%; ▪ Contaminants below detection limits for method blank samples; ▪ Matrix duplicate/laboratory duplicate RPDs to be less than 50%.
Laboratory internal QC to include as outlined in NEPM Schedule B(3) and in accordance Table 3 and with NATA requirements: ▪ reagent blanks ▪ method blanks ▪ matrix spikes ▪ matrix spike duplicates ▪ surrogate spikes ▪ reference materials ▪ laboratory control samples
Comparison of XRF and analytical data to verify field method accuracy

3. VALIDATION ACCEPTANCE LEVELS

The overall validation program has been developed with consideration of the *Guidelines for Consultants Reporting on Contaminated Sites* (EPA, 1997).

As noted above, the site is essentially divided into two areas:

- the northern area containing the contaminated fill containment cell; and
- a southern area designated for low density residential use.

Different criteria are applicable to each area. In the absence of a detailed site specific risk assessment and with the express purpose of providing a high reliability result, screening level criteria published in the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM, 1999) for relevant land use scenarios have been adopted as the remediation criteria at this site.

Section 105 of the CLM Act allows DECCW to "make or approve" guidelines for any purpose related to the objects of the Act. The *Guidelines for the NSW Site Auditor Scheme (2nd edition)* indicates that the appropriate soil investigation levels (SILs) for the assessment of the suitability of the site are as follows.

3.1 Potential Human Health Risks

The human health-based investigation levels (HILs) and the exposure scenarios on which they are based are published in the NEPM and also in the *enHealth Monographs—Soil Series*.

The HILs are based on generally conservative assumptions for the estimated exposure of site occupants in the above land use scenario. The NEPM states that:

> *"An* ***investigation level*** *is the concentration of a contaminant above which further appropriate investigation and evaluation will be required (ANZECC/NHMRC Guidelines 1992)".*

An exceedance of an investigation level does not indicate that there is a definite risk to human health, but rather that further site-specific assessment is required to quantify the potential risk to human health.

Where the NEPM investigation levels are silent, other health based guidelines, including the NSW EPA *Guidelines for Assessing Service Station Sites* (EPA, 1994) may be appropriate. It is recognised that the soil criteria provided in the *Guidelines for Assessing Service Station Sites* are provided for sensitive land use and as such, are likely to be conservative criteria for uses other than sensitive uses.

Where appropriate health based criteria are not available in the listed publications then alternative national / international criteria will be considered. This will include contaminants such as fluoride, asbestos and nutrients. The proposed criteria will be discussed and agreed with the Site Auditor /

DECCW. Where no appropriate criteria are identified, then the Site Auditor / DECCW will be contacted for advice on assessment criteria for these contaminants.

3.2 Potential Ecological Risks

The NEPM Interim Urban Ecological Intervention Levels (EILs) provide indicative screening level assessment of the ecological impact of contamination based on phytotoxicity.

The EILs aim to protect ecological values (eg. flora, fauna) in developed areas. The EILs are based on considerations of phytotoxicity (copper, chromium, lead) and soil survey data (barium, phosphorous, sulphur) from four Australian capital cities.

Where no EILs are nominated in the NEPM, reference has been made to the "B" values given in the *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites* (ANZECC/NHMRC 1992).

In the absence of NEPM guidelines, the NSW EPA (1994) *Guidelines for Assessing Service Station Sites*, sensitive land use criteria including terrestrial values where provided, have been adopted as environmental screening criteria for the assessment of TPH and BTEX contamination.

Where appropriate ecological based criteria are not available in the listed publications then alternative national / international criteria will be considered. This will include contaminants such as fluoride and nutrients. The proposed criteria will be discussed and agreed with the Site Auditor / DECCW. Where no appropriate criteria are identified, then the Site Auditor / DECCW will be contacted for advice on assessment criteria for these contaminants.

3.3 Leachability

Residual contaminants may occur in soils that fall below relevant health or ecological based criteria. In most cases these levels are likely to be sufficient to ensure that the contaminants do not pose a significant risk to the quality of the groundwater system. However the leachability of any residual soil contaminants will be tested to verify that such contaminants are not leachable at concentrations that are likely to result in contamination of groundwater at levels that would preclude relevant uses.

This is particularly relevant in the northern area beneath the cell where it is proposed to use HIL F criteria. In this area both the HIL F values and the TCLP results obtained on residual soils will be used to validate the surface as being suitable for the cell construction area. The site groundwater dispersion model will be used to develop appropriate TCLP compliance criteria for the containment cell area. These criteria will be established before the remediation works commence and will be agreed with the Site Auditor.

If the TCLP is found not to be a limiting factor, then it will be proposed for subsequent stages of the cell area construction that only the HIL F values be adopted for validation purposes, thus simplifying the validation process.

3.4 Aesthetics

Accessible soils will be remediated such that they do not present aesthetic contamination. It is noted that the Schedule B(1) of the NEPM (1999) that states that *"there are no numeric Aesthetic Guidelines but the fundamental principle is that the soils should not be discoloured, malodorous (including when dug over or wet) nor of abnormal consistency. The natural state of the soil should be considered".* Additionally, aesthetic considerations are also noted in the DECCW *Site Auditor Guidelines* 2nd Edition. This is considered the relevant guideline for the site on this issue.

The assessment of the soils to date indicates a low probability that they will be odorous and that this will be relevant to the assessment of aesthetics at this site. There is potential for soils to be discoloured (predominantly as a result of slag or other waste) however such materials are likely to result in elevated soil concentrations and thus would typically require removal in any case to meet the relevant health or ecological based criteria. Nonetheless, the aesthetic criteria or olfactory or visual impact will form part of the assessment of compliance of the remediation program within areas where residual soils will be accessible.

3.5 Building and Structures

As the remediated section of the site is intended for low density residential use it is expected that only light structures requiring shallow foundations will be developed at the site. As the soils are expected to be remediated to remove the fill materials and the upper natural soils in this area, it is considered likely that the remediated soils will not pose an unacceptable risk to the durability of concrete structures installed in the site soils as the residual sulphate concentrations will be protective of concrete structures. It is noted that common residential building slab construction includes a plastic moisture barrier in any case and this would likely provide some protection to the concrete from these potential contaminants.

Nonetheless, the validation program instituted at the site will be sufficiently broad to ensure that the soils do not pose a risk to the durability of structures built at the site. This will include the assessment of soil pH, sulphate, redox potential, salinity and any other potential contaminants of concern which may influence the integrity of buildings or other structures as discussed and agreed with the Site Auditor.

3.6 Soil Validation Criteria Summary

The following tables summarise the validation criteria proposed to be adopted for the remediation of the Cockle Creek site.

A higher level of contamination is considered acceptable beneath the cell as no human exposure to these soils will be possible once the cell is constructed. The validation criteria will therefore be based primarily on health risks to workers (assuming NEPM HIL F criteria are applicable for screening proposes) and on potential leaching of contaminants to the groundwater environment using dispersion model based criteria which are yet to be developed.

On completion of the engineered cell, the northern area is proposed to be used for controlled recreational or open space purposes, therefore the surface soils remaining across this area (including the cell cap and buffer areas) will be validated to ensure that the final surface soils meet the NEPM HIL E screening values and therefore the surface soils will not pose a potential risk to future users of the site.

In the residential area, the much lower levels of contamination which will be acceptable based on human health consideration would in all likelihood be protective of the groundwater environment and no specific leach based assessments are proposed as the validation of this area. Given the proposed low density residential use of this area, the final surface soils will meet the NEPM HIL A screening values and therefore the surface soils will not pose a potential risk to future users of the residential portion of the site.

The proposed assessment criteria for the final surface soils of the engineered cell are provided in Table 2 below. The applicable criteria for any additional contaminants determined as relevant during the remediation program will be discussed and agreed with the Site Auditor.

Table 2 – Adopted Soil Validation Criteria (mg/kg)

Parameter	Ecological Screening Value	Human Health Screening Value Construction Surface [1]	Human Health Screening Value Cell Cap & Buffer Zone	Human Health Screening Value Residential Soils
Heavy Metals				
Antimony	0.66(h)	40(e)	20(d)	31(i)
Arsenic	20	500	200	100
Barium	300(h)	2000(g)	500(f)	15,000(i)
Beryllium	5.8(h)	100	40	20
Cadmium	3	100	40	20
Chromium (Total)	400	60,000	24,000	12,000
Chromium (IV)	1	500	200	100
Cobalt	0.49(h)	500	200	100
Copper	100	5,000	2,000	1,000
Lead	600	1,500	600	300
Mercury	1	50	30	15
Molybdenum	3.7(h)	40(g)	10(f)	390(i)
Nickel	60	3,000	600	600
Silver	1.6(e)	5,130(i)	390(i)	390(i)
Tin	50(a)	300(g)	50(f)	47,000(i)
Zinc	200	35,000	14,000	7,000
Organics				
TPH C_{10}-C_{36}	1,000(b)	1,000(b)	1,000(b)	1,000(b)
TPH C_{16}-C_{35} Aromatics	-	450	180	90

Parameter	Ecological Screening Value	Human Health Screening Value Construction Surface [1]	Human Health Screening Value Cell Cap & Buffer Zone	Human Health Screening Value Residential Soils
TPH C_{16}-C_{35} Aliphatics	-	28,000	11,200	5,600
>C_{35} Aliphatics		28,000	11,200	56,000
Benzene		5.4(i)	1(b)	1.1(i)
Toluene	1.4(c)	45,000(i)	130(b)	130(b)
Aldrin + Dieldrin	0.2(a)	50	20	10
Chlordane	1.6(h)	250	100	50
DDT+DDD+DDE	0.047 to 0.067(h)	1000	400	200
Heptachlor	0.0012(h)	50	20	10
Polycyclic Aromatic Hydrocarbons (Total)		100	40	20
Benzo(a)pyrene		5	2	1
Phenol	6.3(h)	42,500	17,000	8,500
Polychlorinated Biphenyls	1(a)	50	20	10
Nutrients				
Fluoride		41,000(i)	3,100(d)	3,100(i)
Total Phosphorus (P)	2,000			
Reactive Phosphorus	0.0027(h)	2.0(i)	1.6(d)	1.6(i)
Sulfur (S)	600			
Sulphate	2,000			
Nitrate		1,600,000(i)	130,000(d)	130,000(i)

Notes:

1. Subject to verification of TCLP compliance

a) ANZECC / NHMRC (1992) Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites Environmental Investigation 'B' level

b) NSW EPA (1994) Guidelines for Assessing Service Station Sites, Threshold Concentration for Sensitive Land Use – Soils

c) NSW EPA (1994) Guidelines for Assessing Service Station Sites, Threshold Concentration for Sensitive Land Use – Soils (Protection of terrestrial organisms in soil)

d) CCME (2007) Canadian Soil Quality Guidelines – Interim Remediation Criteria for Soil (Parkland Use)

e) CCME (2007) Canadian Soil Quality Guidelines – Interim Remediation Criteria for Soil (Industrial Use)

f) CCME (2007) Canadian Soil Quality Guidelines for Parkland Use

g) CCME (2007) Canadian Soil Quality Guidelines for Industrial Use

h) USEPA (August 2003) Region 5, RCRA, Ecological Screening Levels for Soil

i) USEPA (December 2009) Region 9, Regional Screening Levels for Industrial Use

3.7 Statistically based Compliance Decision Methodology

In the first instance the preference would be for all values to fall below the nominated validation criteria provided in Table 2. Where this is not possible then the 95% Upper Confidence Level of the Mean (95% UCL) will be adopted as guideline value for comparison against the criteria for each parameter.

It is noted that the NEPM indicates that the arithmetic mean of the results should be compared to the criteria. In this case, the values from each validation site or the 95% UCL will be used in preference to the arithmetic mean. In addition the data sets must meet the statistical compliance requirements included in the NEPM which are:

- The standard deviation of the result must be less than 50% of the validation criterion; and
- No result can be greater than 250% of the validation criterion.

The exception to this will be the identification of any volatile compounds or volatile petroleum hydrocarbons. The results obtained for these compounds must be below the respective criteria to ensure there are no localised volatile impacts to users of the site. Based on the available analytical data, the potential for significant volatile contamination to be identified at the site is considered to be very low.

4. VALIDATION SAMPLING PROGRAM

4.1 Validation Overview

The surface validation will occur using a combination of NATA certified laboratory based analytical program and real-time guidance validation of heavy metal concentrations using a field portable X-ray fluorescence (XRF) meter. In addition, the collected samples for laboratory analysis will be screened in the field using a photoionisation detector (PID) to assess the potential presence of volatile organic compounds. Any area identified by olfactory assessment of potentially being contaminated will also be screened with the PID.

The use of an XRF meter as part of the validation protocol is considered appropriate in this case since the primary contaminants of concern are heavy metals and principally, these contaminants are lead and zinc. These contaminants are likely to represent markers of fill contamination and as such, their removal to acceptable levels is expected to result in a surface where the slag impacted fill materials have been suitably removed and in doing so, the excavation will have removed any other potentially contaminated fill materials.

The XRF will be used to provide a screening level assessment of the excavation surface to assist in determining excavation extents. Following successful excavation, the XRF meter will be used to provide a rapid, high-density validation program to ensure compliance of each allotment or sub parcel with the adopted remediation criteria and provide adequate data for statistically based assessments.

The XRF and analytical validation sampling will be conducted in combination with a GPS unit to allow for accurate location of the sampling locations within the site and verify a suitable density of sampling across each residential allotment.

4.2 Validation Density

The validation density will be based on the proposed land use of each of the two main site areas.

4.2.1 Residential Southern Zone - XRF

In the residential area to the south small residential block sizes are considered likely and as a result it is proposed to conduct sampling at the higher density consistent with a small residential block assessment.

It is expected that slag materials will represent an aesthetic issue in this zone and any evidence of residual slag material should have been removed through the remediation program. Any zones of slag material or other aesthetically unacceptable material identified during the validation program should be removed from this area and placed within the cell. The final surface should represent only natural soil materials.

In the residential area, the validation density using XRF will be 100 points per hectare on a square grid basis.

The proposed density would identify an approximately 12 m diameter hot spot with a 95% level of confidence. This is consistent with the density recommended in AS4482.1 for site characterisation of a site comprising 0.05 ha (500 m^2).

4.2.2 Northern Cell Area - XRF

In the cell and open space buffer area in the north, a lower sampling density is considered appropriate as the risk associated with undetected hot spots is lower due to the lower exposure risks. An intermediate level sampling density has been proposed to provide a suitable level of reliance.

This validation density using XRF in the cell and open space buffer area will be 15 points per hectare.

The proposed density would identify an approximately 30 m diameter hot spot with a 95% level of confidence. This density is consistent with the density recommended in AS4482.1 for site characterisation of a site comprising 2 ha.

4.2.3 Laboratory Based Density

The XRF validation data will be verified and extended by the laboratory analytical program. Duplicate soil samples analysed by the XRF will be analysed routinely by the laboratory at the rate of 10% of the XRF sampling locations. This is greater than the minimum 5% recommended in US EPA Method 6200.

The locations for analytical assessment will be appropriately dispersed to provide a wide coverage of the site. These analytical assessment locations will also be assessed for a wider range of chemical and physical parameters and will provide a more detailed verification of the surface validation for low likelihood contaminants (ie those contaminates which are not expected to occur based on available data).

As noted previously, TCLP testing will be required to verify the suitability of NEPM HIL F as suitable criteria for the cell footprint area. The TCLP testing will initially be undertaken at the same density as the other laboratory testing programs. If the TCLP results are not found to be a limiting factor for validation, then it will be proposed for subsequent stages of the cell area construction that only the HIL F values be adopted for validation purposes, thus simplifying the validation process

Should the analytical program identify low likelihood contaminants at elevated concentrations, then further analytical testing would be undertaken. The analyte suite and density of this further sampling would be discussed and agreed with the Site Auditor.

4.3 Sample Collection

The location of the validation point will be confirmed using the GPS.

Only a suitably calibrated XRF meter will be used for validation. XRF analyses will be conducted in accordance with the meter manufacturer's operational instructions. This typically requires a

uniform surface be prepared and the then the meter targeted to this area. The XRF measures the contaminants contained in the surface materials and does not penetrate the sample area.

The data reported by the XRF, together with the location identifier, a material description and the spatial location data will be recorded on a validation field sheet.

All sample locations will be checked for potential volatile contaminants using a calibrated PID. This will require collection of a sample, placement in a sealed bag or jar and then after a suitable stabilisation period, assessment of the soil headspace using a calibrated PID meter. The PID will be calibrated to a standard isobutylene gas on at least a daily basis during validation. If a highly elevated result is obtained, the PID will be recalibrated. The PID calibration records will be maintained and available for review as required. They will be provided with the validation report.

The residual soils must also meet the criteria for aesthetic considerations regarding the use of the site for residential or open space purposes. Aesthetic issues include the generation of odours from the site and any discolouration of the soil as a result of contamination. The discoloration criterion would also include the presence of slag materials. As noted previously, the generation of odours is considered to be a low risk at this site due to the absence of any significant concentrations of volatile or other organic contaminants.

The PID data and all field observations will be recorded on the validation field sheet.

Samples for laboratory analysis will be collected from the near surface soils at the appropriate locations using standard environmental sampling procedures. The location should correspond exactly with the location of the XRF analysis.

Clean disposal gloves and a decontaminated trowel will be used at each sampling location. The collected sampled will be placed directly in a clean sample jar provided by the laboratory. Duplicate soil samples will be collected for PID analysis as noted above. All samples are to be marked appropriately and paced in a cooler box for storage and transport. All samples should be returned to the appropriate laboratories under Chain of Custody documentation. Duplicate and blank samples shall be collected in accordance with the DQO's.

The sample description and any other observations noted during sampling will be recorded on the validation field sheet

4.4 XRF Verification

The XRF assessment method provides a field based assessment of the metal status of the shallow soils. Whilst the meter is calibrated it is imperative that consistency between the XRF data and the laboratory analytical data is established to verify the accuracy of the XRF data as being suitable for validation purposes.

Prior to or at the commencement of the validation program a selected group of at least 10 sample locations will be tested using both the XRF and laboratory sampling methods. The two data sets will be compared to assess the accuracy of the XRF relative to the laboratory data and establish if the data sets are suitably consistent to allow the XRF meter to be used for validation purposes.

If there is unacceptable discrepancy between the two data sets and the XRF does not provide a consistently conservative result relative to the analytical data, then the XRF sampling method will be reconsidered. As noted previously the XRF only samples the surface material whilst the laboratory sample comprises a discrete soil sample extracted over a small depth interval. It may be possible to undertake screening using the XRF at multiple depths, following a surface scrape, to obtain an averaged result over the interval utilised for analytical sample collection.

Additionally it may be possible to take multiple XRF readings at each sampling level to provide a more comprehensive data set for averaging purposes and thus more representative of the material included in the analytical soil sample. Any modifications will be discussed and agreed with the Site Auditor.

After the initial verification phase, the XRF accuracy will be checked at 10% of the sampling locations. A constant revision of the accuracy of the XRF relative the laboratory data will be required to verify the ongoing suitability of the data generated by the XRF.

If there is any concern regarding the validity of the XRF data based on the analytical results then the area will be re-validated. If required the XRF sampling method may be modified. Any modifications will be discussed and agreed with the Site Auditor.

4.5 XRF Meter Calibration

The XRF meter will be calibrate in accordance with the manufacturer's operational instructions. Calibration will occur at least at the frequency indicated by the XRF manufacturer.

The meter calibration records will be maintained and available for review as required. They will be provided with the validation report.

4.6 Analytical Program

The laboratory analytical program will be conducted at 10% of the grid based validation locations.

The analyses will include a range of organic and inorganic contaminants to verify the suitability of the site soils for the proposed uses. The analytical data will be compared to the screening level criteria included in Table 2 for the respective land uses. The following analytical suite will be undertaken:

- Victorian 'EPA Screen' parameters
- Ammonia
- Nitrate
- Phosphate
- Fluoride
- Soil pH
- Sulphate
- Electrical Conductivity
- Asbestos

The data will be compared to the criteria and exceedances assessed.

4.7 Validation Failure

If the results exceed the nominated criteria through application of the data assessment protocol discussed in Section 3.7, then the area comprising the exceedances will require further excavation and validation until such time as the surface complies.

It is expected that residual contamination identified through the validation program will be the result of impacts derived from the previously overlying fill materials. Evidence to date suggests that deeper soil are less contaminated than the shallow soils and so further excavation would be expected to remove the non compliant material.

The excavation should be extended to at least half the distance to the nearest validation data points. The excavated material should be removed to the containment cell.

The area should be revalidated following excavation. In the event that the exceedance is the result of metal contamination, the frequency of XRF validation points should be suitable to provide a thorough assessment of the excavated area. An additional analytical sample should also be collected and analysed for the exceeding metal(s). If the exceedance is the result of a low likelihood contaminant, then further analytical testing for the exceeding contaminant(s) will be required to validate the area. Again, this testing should occur at a density that provides a thorough assessment of the excavated area.

4.8 Validation Contingency

The XRF approach to a large portion of the validation program may not be valid if the XRF data cannot be verified by the laboratory data and various modifications to the XRF sampling approach do not resolve this discrepancy. As noted above, this will be more of a concern where the XRF does not consistently provide higher results than that reported by the laboratory. If The XRF reports consistently reports higher result then the XRF data would result in a relatively conservative validation of the surface.

In the event that the XRF validation process cannot be applied, the default position will be to replace the XRF sampling locations with laboratory samples for the standard eight heavy metals. This will provide a similar level of validation that would occur with the XRF but using the same methodology as would be considered standard in environmental assessments. If this was the case, the quality control samples would be complete in accordance with the DQO's.

4.9 Validation Reporting

A validation report will be prepared at the completion of each phase of the remediation program. This will compile all the relevant information and provide definitive evidence that the site has been remediated to the required level. The progressive reporting of the validation data will allow for any progressive amendments to the validation program following review of the validation results by the Site Auditor.

Two final site validation reports will be prepared at the completion of the remediation program and will consolidate the available data into separate reports for each of the two main sections of the site. These reports will clearly demonstrate that the areas of the suite are suitable for their intended purpose.

5. CLOSURE

Soil and Groundwater Consulting (S&G) has developed this Soil Validation Protocol for the remediation phase of the Incitec Fertilizers Limited (IFL) Cockle Creek site.

The Soil Validation Protocol has been developed to provide a consistent approach of the validation of the post-remediation surface of the site to verify objectively that the contamination status of the residual soils is suitable for the intended future uses of the site.

The appropriate implementation of the Soil Validation Protocol will provide a reliable and valid data set for the verification of the condition of the site surface following remediation.

The Soil Validation Protocol should be implemented within the overall site safety plan development for the remediation phase of the site to ensure the safety of staff involved in these works.

6. LIMITATIONS

Purpose

1. This report was prepared by Soil & Groundwater Consulting ('S&G') for the sole use of the client identified in the body of the report ('**Client**'), in relation to the property identified in the body of the report ('**Site**') and in accordance with the scope of work agreed between S&G and the Client.

Standard

2. This report was prepared by S&G generally in accordance with the usual and accepted practices and standards for consultants at the time it was prepared. The data referred to in this report was obtained between the dates as set out in the body of the report ('Data Collection Period').

3. S&G is not responsible for any inaccuracies or omissions in this report outside the scope of work and purpose set out in the report. There was no indication to S&G during the data collection period that any information contained in this report was false.

4. Opinions and recommendations contained in this report are based on data provided by representatives of the Client, information gained during site inspection and fieldwork, employee interviews and information provided from government authorities' records and other third parties, to the extent to which such information has been sought and obtained.

Variation in Conditions

5. This report presents the results of an investigation and assessment program to determine the presence of a range of potential contaminants in soil or groundwater at the Site.

6. This report is based on the conditions encountered and information available during the Data Collection Period.

7. Subsurface conditions may vary significantly between sampling locations and depth intervals and at locations other than where data collection was performed. Contaminant concentrations may vary from day to day.

8. S&G does not accept any responsibility for any changes to the Site conditions that may have occurred after the Data Collection Period described in Clause 2 above, or for the impact of any such changes on this report.

Use of Report

9. This report must be read in its entirety.

10. This report may not be relied upon by any third party without the express written permission of S&G, which permission may be granted or withheld in S&G's absolute discretion.

11. No responsibility is accepted by S&G for use of this report, or any part of this report, in any context or for any purpose or for any party, other than the Client, and for the purpose identified in the body of the report.

12. The information in this report is considered to be accurate at the date of issue and is in accordance with conditions at the Site during the data collection period.

13. This report and the information contained in it should only be regarded as validly representing the Site conditions at the time of the data collection period unless otherwise explicitly stated in this report.

No third party warranties

14. No warranties, express or implied, are made to any third party in relation to the subject matter of this report, or the recommendations or conclusions expressed within it.