Appendix 3.6

Chicken Farm Odour Assessment Methodology and Report

1 INTRODUCTION

1.1 Background

1.1.1 The Hung Shui Kiu New Development Area (HSK NDA) is located in the Tuen Mun – Yuen Long Corridor, bounded by Tin Ying Road, Kiu Hung Road on the east; Yuen Long Highway on the south; Lau Fau Shan Road, Deep Bay Road and hill slopes on the north; and Kong Sham Western Highway on the west. The boundary of the HSK NDA is shown in **Figure 1.1**.

1.1.2 The Study is to carry out planning, engineering and environmental impact assessments with a view to formulating a development proposal for the HSK NDA, confirming the feasibility of implementing the proposal for the HSK NDA to meet long-term housing, social, economic and environmental needs, and formulating the implementation strategies and programme for the NDA with the first population intake by the year of 2026 or earlier and for possible completion of the whole development by 2036 or earlier.

1.1.3 The planning and engineering study comprises an Environmental Impact Assessment (EIA) as the Study constitutes a designated project in accordance with item 1 of Schedule 3 of the Environmental Impact Assessment Ordinance (EIAO), which specifies that “Engineering feasibility study of urban development projects with a Study Area covering more than 20 ha or involving a total population of more than 100 000” is a designated project.

1.1.4 The Project might also comprise the following designated projects by virtue of items A.1, A.2, A.8, I.1 and F.3 of Schedule 2 of the EIAO that may be identified in the course of the Study:

(i) Primary distributor roads and district distributor roads [item A.1];

(ii) Proposed railway and/or railway stations, if required, for serving the HSK NDA [item A.2];

(iii) Road bridges of more than 100m in length between abutments [item A.8];

(iv) Construction of Drainage Works [item I.1]; and

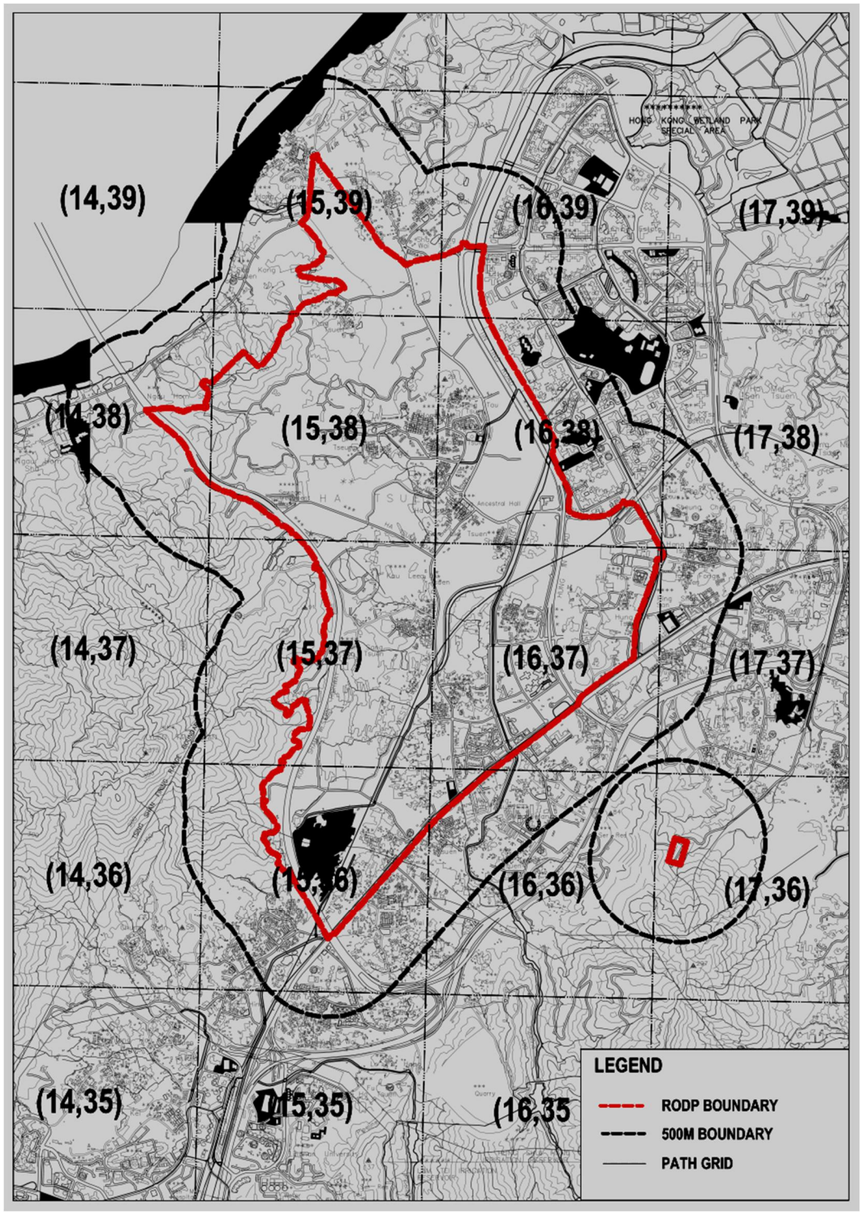
(v) Construction of Sewage Pumping Stations [item F.3].

1.2 Scope of Air Quality Impact Assessment

1.2.1 The exact scope for air quality assessment is detailed in Section 3.4.4 of the Environmental Protection Department’s (EPD) Environmental Study Brief (ESB)-221/2011, which includes both construction and operational phases air quality impacts.

1.2.2 In principle, the assessment shall follow the criteria and guidelines for evaluating and assessing air quality impacts as stated in Section 1 of Annex 4 and Annex 12 of the EIAO-TM. The air pollutant concentrations with reference to “Guidelines for Local-Scale Air Quality Assessment Using Models” shall be adopted for the evaluation. In particular, odour is one of the concerns in the area since existing chicken farm is located in the vicinity of the future developments.

Figure 1.1 HSK NDA Boundary under RODP (demarked in red-dotted line)



1.3 Purpose of this Odour Assessment Report

1.3.1 The purpose of this report is to present the details of the odour impact assessment approaches for chicken farm, outline the scope and modeling strategy and the preliminary odour impact assessment results. **Figure 1.1** shows the Study Area which is being refined and developed under the Recommended Outline Development Plan (RODP) exercise.

2 ENVIRONMENTAL LEGISLATION, POLICIES, PLANS, STANDARDS AND CRITERIA

2.1.1 The criteria and guidelines for air quality assessment are laid down in Annex 4 and Annex 12 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM). In addition, specific requirements on air quality assessment for this Project are stipulated in Clause 3.4.4 of the EIA Study Brief (No. ESB-221/2011).

2.1.2 In accordance with the EIAO-TM, odour level at an air sensitive receiver should meet 5 odour units based on an averaging time of 5 seconds for odour prediction assessment.

3 BASELINE CONDITIONS

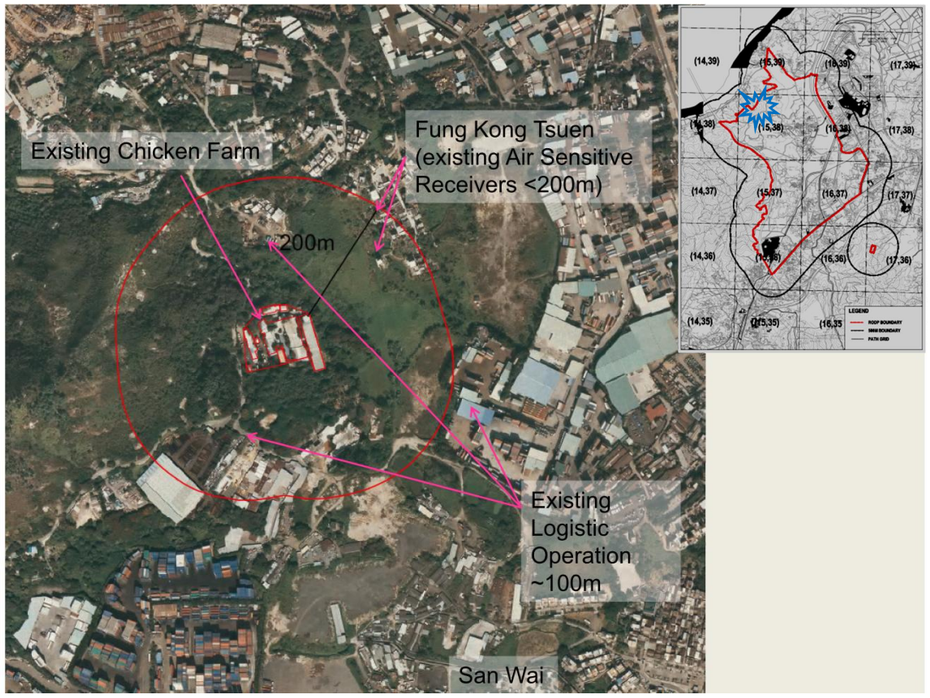
3.1 Local Air Quality and Environ

3.1.1 The proposed Project is predominantly rural with low population density and located next to the existing Tin Shui Wai and Tuen Mun New Towns. The local air quality is dominated by vehicular exhaust emissions from the Yuen Long Highway, Kong Sham Western Highway and Castle Peak Road as well as the scattered industrial emissions within the area.

3.1.2 As the proposed Project is within the vicinity of Shenzhen as well as Guangdong Province, the existing air quality in the assessment area is seasonally affected by the industrial emissions from the Guangdong Province as well.

3.1.3 In accordance with the RODP, it is proposed that the current chicken farm at the Fung Kong Tsuen shall be stayed and some new special-design logistics developments (to be operated by Government) would be built in the vicinity of the chicken farm.

Figure 3.1 Chicken Farm Location



3.2 Local Wind Condition

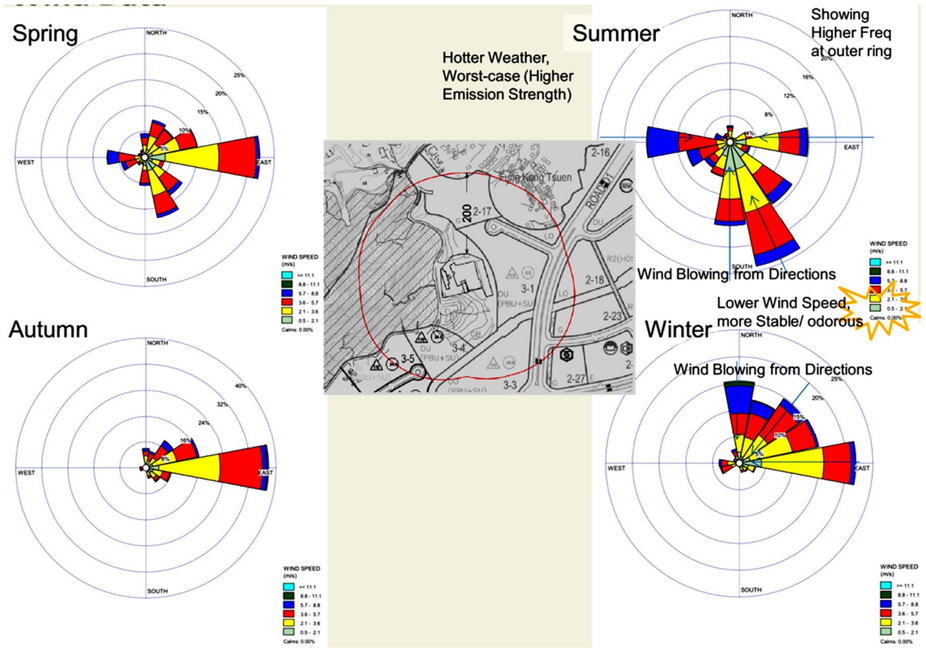
3.2.1 In terms of local temperature, **Table 3.1** shows the monthly variation/profile for 2012/2013 from Lau Fau Shan Weather Station. It is illustrated that the maximum yearly temperature would be in the order of 35 deg C. The hottest weather would be occurred from Jun to Aug (up to 35 deg C). The temperature in Sept is still very high but just slightly less by approximately 1 deg C from the yearly maximum.

Table 3.1 Temperature Profile (LFS 2012 and 2013 data)

Month	Min Temp (deg C)	Max Temp (deg C)	Average Temp (deg C)
Jan	6	26	15
Feb	8	28	17
Mar	11	30	20
Apr	14	32	23
May	16	33	27
Jun	22	35	28
Jul	24	35	28
Aug	24	35	28
Sep	22	34	27
Oct	17	32	25
Nov	11	31	21
Dec	5	26	16
Overall	**5**	**35**	**23**

3.2.2 The Wind Roses of Lau Fau Shan Weather Station 2012 are presented in **Figure 3.2**. It is shown that there is a high probability that wind is blowing from East to West or North-east to South-west (towards existing hill-side) during Spring or Autumn periods. Similarly, wind is most commonly found from North or Nort-east during Winter. Whereas, during hot Summer, wind would be blowing from South, South-east or South-west towards to the future logistic developments.

Figure 3.2 Wind Rose Condition at Lau Fau Shan Weather Station 2012



3.3 Existing Chicken Farm Layout and Condition

3.3.1 Site visits were made in end 2014 and Jul 2015, and a brief interview and site walk have been made with the owner of the chicken farm. Each chicken house could house about 5,000 – 10,000 numbers of chicken depending on its size. As a common practice in the trade that once the chicken are sold, the whole chicken house would then be cleansed and sterilized, and leave it vacant for about 10 days in order to prevent infection of disease.

3.3.2 Natural ventilation with the aid of fans is generally adopted in chicken houses to ensure the fresh air supply. As a common practice, medium and large chickens would be caged in the form of “A-shaped” on top of a purposely built channel to collect the excrements from chickens. In general, accumulated excrements along the channels will gather from the end of channel to the temporary storage tank manually once per day (at around 2:00pm). The excrements will then transfer into enclosed rubbish bins, which will be collected by licensed waste collector few times a week.

3.3.3 In terms of small chickens, they are kept separately from other mature chickens to avoid cross-infection. Excrements would be retained on papers underneath for ultimate disposal into rubbish bins.

3.3.4 There are also on-site covered septic tanks for treatment of domestic effluent. Based on the site observation, there is no “noticeable smell” identified. As told by the operator, the septic tank will only be cleaned /maintained once every few years. During the cleansing/maintenance period, a very short-term transient smell might be detected.

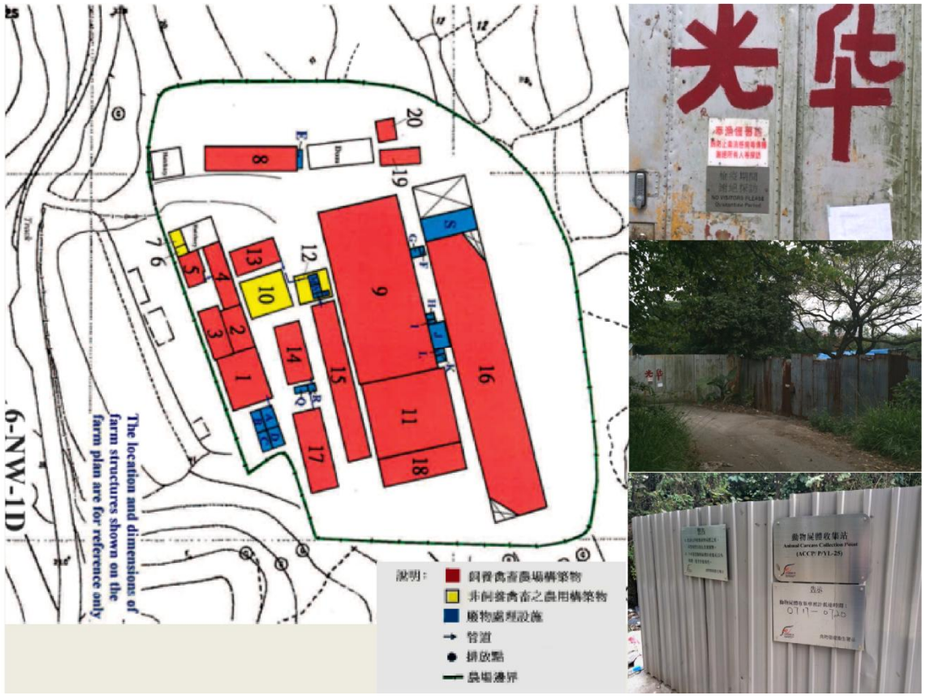
3.3.5 The number of chickens kept within the chicken farm would be varied, and such variation is very much affected by demand and supply from the market. In general, several high-demand periods would occur right before Chinese Festivals, such as Lunar New Year, Dragon Boat Festival, Mid-Autumn Festival and Winter Solstice.

3.3.6 For this specific site, owner of the chicken farm is not the land owner. About 50,000 chickens are kept within the farm in Dec 2014, and a maximum of about 102,000 chickens can be kept under the licence. As shown in **Figure 3.3**, there are two major odour emission sources as spotted during the site visit:

- 1) Refuse/ Manure Collection (in blue)
- 2) Chicken cages (in red)

3.3.7 Based on the current information from EPD, there is no complaint on odour received from the existing/adjoining villages in the past 10 years. With the proper operation conditions/ maintenance procedures required under AFCD licence, adverse odour impact is not expected in the past.

Figure 3.3 Existing Chicken Farm Layout



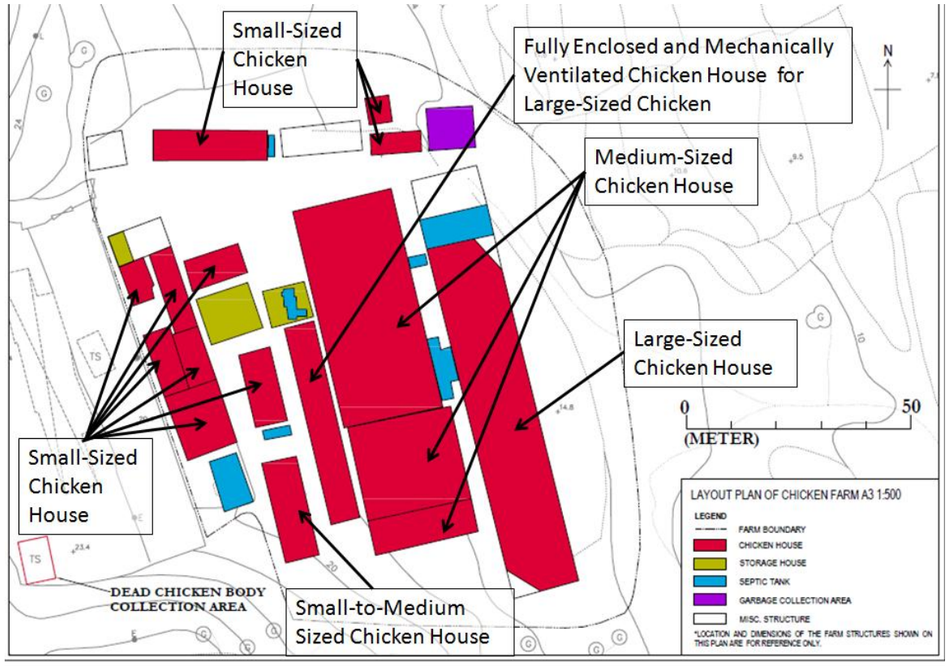
4 AT-SOURCE ODOUR SAMPLING

4.1.1 Site visit to the chicken farm was held in end July 2015 with the photo records in **Appendix A**. A farm layout plan is shown in **Figure 4.1**. Based on the observation during the site visit, potential odour emission sources within the chicken farm are identified as below.

· Chicken Houses for small, medium or large sized chicken; and

· Garbage Collection Area.

Figure 4.1 Chicken Farm Layout Plan



4.1.2 At-source odour sampling locations (for determination of emission strength) and ambient odour concentration sampling locations are selected based on the site visit observation, as shown in **Figure 4.2** and **Figure 4.3**, respectively. A total of 12 odour at-source samples using flux hood and 20 direct ambient odour concentration samples using air-bags are proposed to be taken.

Figure 4.2 At-source Odour Sampling Locations

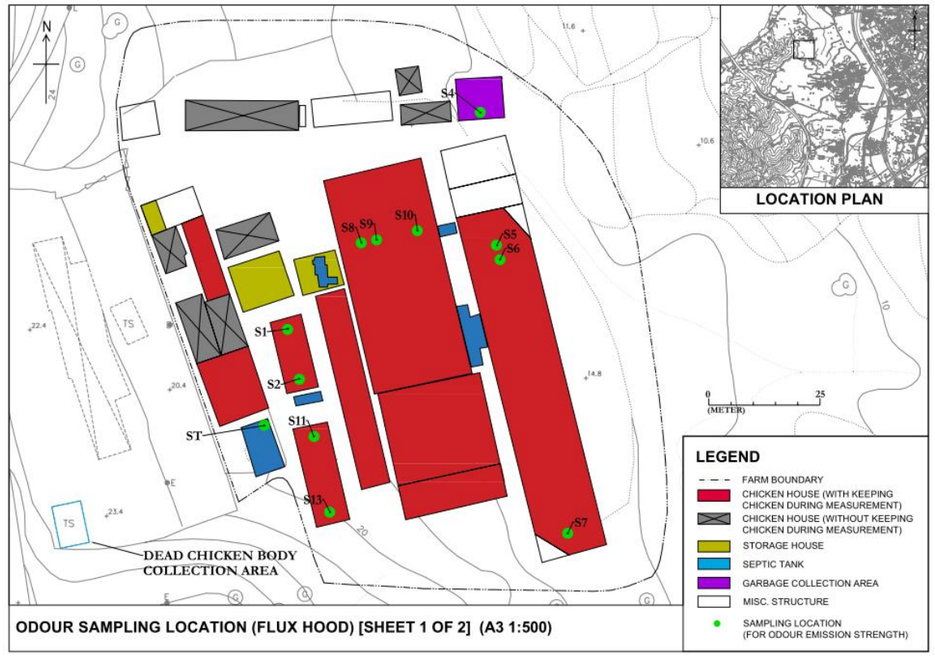
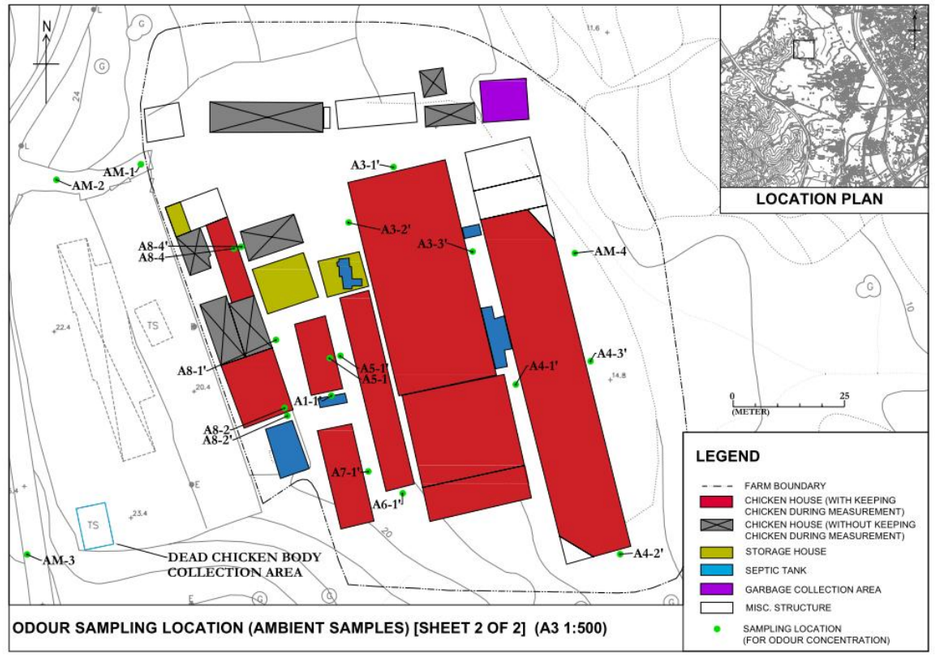


Figure 4.3 Ambient Odour Concentration Sampling Locations



At-Source Odour Sampling using Flux Hoods

4.1.3 As observed, operational practices of all size of chicken houses (small, medium or large-sized chicken house) are similar, except for 1 fully enclosed and mechanically-ventilated chicken house. At-source samples, as shown in **Figure 4.2**, were taken at one typical chicken house of each size (small, medium or large sized chicken) to represent its typical odour strength. Samples were taken at the front and the end of 1 typical excretion collection channel of each size and at middle if possible:

- Excretion Collection channel in small-sized chicken house (S1 and S2);
- Excretion Collection channel in small-to-medium-sized chicken house (S11 and S13);
- Excretion Collection channel in medium-sized chicken house (S8, S9 and S10); and
- Excretion Collection channel in large-sized chicken house (S5, S6 and S7).

4.1.4 One at-source odour sample (S4) was taken at the garbage collection. In addition, one odour sample (ST) was taken at the septic tanks for chicken's excretion storage.

4.1.5 A dead chicken body collection area is also identified as a potential odour emission source just outside the chicken farm. However, the operator would only dispose of dead chicken bodies in the afternoon at around 3 – 4pm right before collection by FEHD, i.e. dead chicken bodies are kept at the collection area for minimum of time. Therefore, no sampling was taken at the collection area as no dead chicken bodies could be found at the sampling time.

4.1.6 Owing to the fact that excrements and premises are washed and cleansed after 2:00pm, all the samples were taken before 2:00pm. In order to obtain samples during hot temperature, the sampling was conducted in the period between 10:00am to 2:00pm and the ambient temperature was at least 30 degree Celsius during sampling.

4.1.7 **Table 4.1** summarizes the sampling locations and number of samples to be taken. The flow rates of the odour-free gas (e.g. nitrogen gas) for the flux hood sampling are clearly stated and recorded during sampling.

4.1.8 In-situ meteorological conditions, including 3-min average wind speed (at height at flux-hood mid-point level), wind direction (state if not measurable), peak temperature and relative humidity were also collected.

4.1.9 On top of the sampling, the following information were collected:

- Number of chickens (small, medium or large sized chicken) being kept in each chicken house
- Number of excretion collection channels are in active use (with excrement)
- During the maximum capacity period (~ 102,000 chickens), how would be the chicken allocated (more crowded within the cage or provided with additional cages within the house)

Ambient Odour Sampling

4.1.10 20 sets of samples were also collected as depicted in **Figure 4.3** and **Table 4.1** at accessible locations within or in the vicinity of the site in order to identify the odour concentration. In-situ meteorological conditions, including 3-min average wind speed, wind direction, peak temperature and relative humidity were collected. In order to determine the wind flux across openings, these meteorological data shall be recorded for every sampling location. The sampling height shall be set at 1.5m above ground

(breathing height) or the mid of the opening area. The lowest detection limit of wind speed measurement device was down to 0.4m/s.

4.1.11 In order to collect "more synchronize" samples between flux hood data and air bags data, this exercise was conducted by two separate teams. This practice can also avoid cross-contamination of equipments (surface) of the ambient samples by excrement (reducing the extensive cleansing and flushing).

Table 4.1 Proposed Odour Sampling Locations

Sample ID	Location	Number of Sample	Purpose
Set 1			
Collected odour samples using direct air bags (Ambient Air Sampling)			
A1-1', A5-1, A5-1', A8-2, A8-4, A8-1', A8-2' and A8-4' [1]	Small-sized Chicken House	1 per each location	Determination of Odour Concentration and associate dilution factor
A7-1' [1]	Small-to-medium-sized chicken house	1 per each	Determination of Odour Concentration and associate dilution factor
AM-1 [2]	Outside the Farm Entrance Gate	1 per each location	Determination of Odour Concentration
AM-2 [2]	Access road to the Farm	1 per each location	Determination of Odour Concentration
Collected odour samples using flux hood (from less strength to high strength avoiding cross contamination)			
S1	Small-sized Chicken House	1	Determination of Odour Emission Strength
S2	Small-sized Chicken House	1	Determination of Odour Emission Strength
S11	Excretion Collection channels in small-to-medium-sized chicken house	1	Determination of Odour Emission Strength
S13	Excretion Collection channels in small-to-medium-sized chicken house	1	Determination of Odour Emission Strength
Set 2			
Collected odour samples using direct air bags (Ambient Air Sampling)			
A4-1', A4-2', A4-3' [1]	Large-sized chicken house	1 per each location	Determination of Odour Concentration and associate dilution factor
AM-4 [2]	Area as shown outside the large-sized chicken house	1 per each location	Determination of Odour Concentration
Collected odour samples using flux hood (from less strength to high strength)			
S4	Garbage Collection Area	1	Determination of Odour Emission Strength
S5	Excretion Collection channels in large-sized chicken house	1	Determination of Odour Emission Strength

Sample ID	Location	Number of Sample	Purpose
S6	Excretion Collection channels in large-sized chicken house	1	Determination of Odour Emission Strength
S7	Excretion Collection channels in large-sized chicken house	1	Determination of Odour Emission Strength
Set 3			
Collected odour samples using direct air bags (Ambient Air Sampling)			
A3-1', A3-2', A3-3' [1]			
A6-1' [1]	Fully enclosed and mechanically-ventilated chicken house	1 per each location	Determination of Odour Concentration and associate dilution factor
AM-3 [2]	Area near the dead chicken body collection area	1 per each location	Determination of Odour Concentration
Collected odour samples using flux hood (from less strength to high strength)			
S8	Excretion Collection channels in medium-sized chicken house	1	Determination of Odour Emission Strength
S9	Excretion Collection channels in medium-sized chicken house	1	Determination of Odour Emission Strength
S10	Excretion Collection channels in medium-sized chicken house	1	Determination of Odour Emission Strength
ST	Septic Tank	1	Determination of Odour Emission Strength

Note:
[1] All outdoor ambient odour samples were taken under downwind condition from farm. Actual sampling location for these samples will be determined on site subject to wind condition.
[2] Since ambient odour sample at AM-1, AM-2, AM-3 & AM-4 were taken under downwind condition from farm.

4.2 Odour Sampling Methodology

4.2.1 Gaseous odour sample was collected using an air bag. A pump with a known extraction rate was used. The typical air sampling procedures are listed as follows:

- Odour sampling was conducted by staff from approved odour laboratory.
- Odour samples were collected by odour bag through suction from air pump. The sample bag shall be made from PTFW, Tedlar.
- Odour samples were collected on the using flux hood method or other alternative method such as mini-wind tunnel. Odour-free gas (e.g. nitrogen gas) shall be used in order to simulate a parallel wind blowing on the main section of the sampling device.
- Meteorological conditions, including temperature, mean wind speed, wind direction and relative humidity were collected during sampling.
- After sampling, odour samples were transported to an approved odour laboratory within the same day
- Sample gas was tested by qualified odour panellists for olfactometry analysis within 24 hours.
- Exposure of odour bag to direct sunlight shall be avoided during sampling. If condensation is observed on the inner surface of the air bag, the sample shall be discarded.

4.3 Olfactometry Analysis

4.3.1 Odour concentration was determined by a Force-choice Olfactometer in accordance with the European Standard Method (EN 13725). The key points are listed as follows:

- Each odour testing session comprises at least five qualified panellists. The panellists shall be screened by using a certified n-butanol standard gas, with his detection thresholds of n-butanol stated in the EN 13725 standard;
- Panellists have not eaten or smoke during and prior to the testing session. Use of perfumes, shave-lotions or other fragment essences before the testing session is not allowed
- Panellists were in healthy conditions, without any influenza or any other health problems which would affect performance of the nose
- Regular calibration of the olfactometer shall be made for checking the accuracy and repeatability of its dilute settings
- The odour laboratory shall be ventilated to maintain an odour-free environment and to provide fresh air to the panellists.

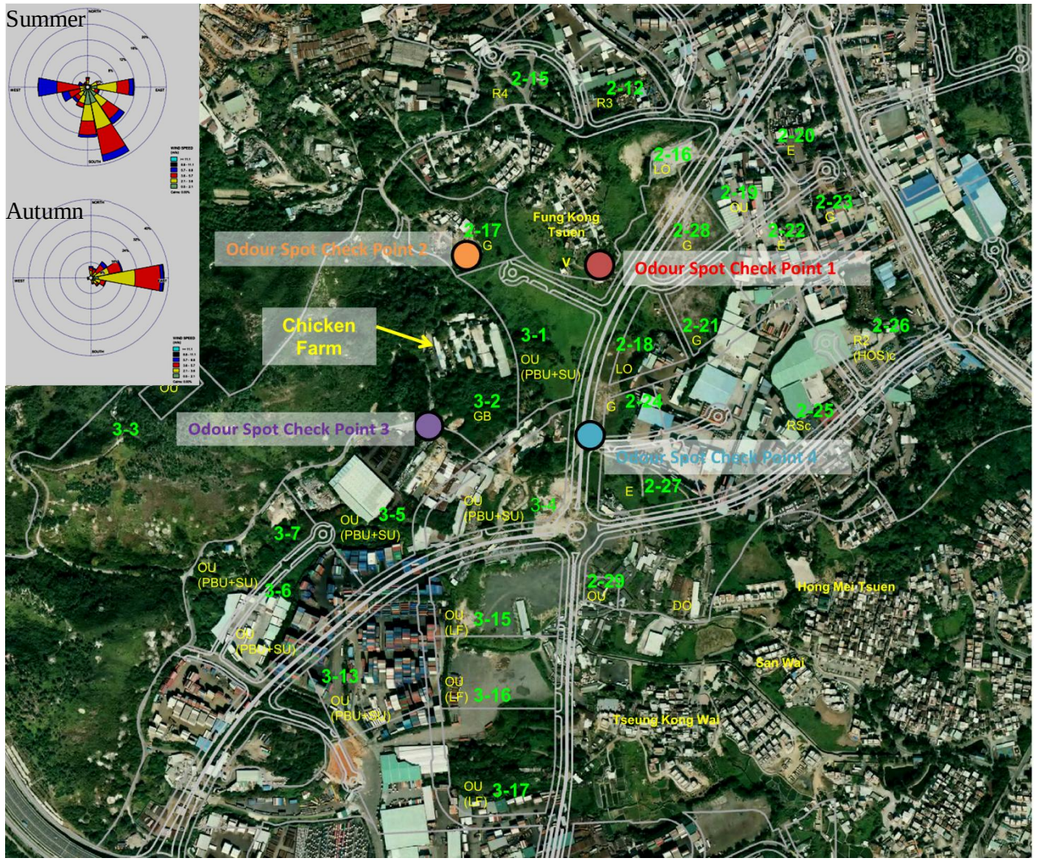
4.4 Data Analysis

4.4.1 The nitrogen gas cylinder inside the sample-collection system shall supply an odour-free gas to generate air inflow at defined velocities. The specific Odour Emission Rate (SOER) at each odour source were calculated based on the specified air flow velocity.

5 ODOUR PATROL/SPOT-CHECK SURVEY

5.1.1 In order to identify the odour impact induced from existing operation of chicken farm to the nearby ASRs, odour patrol/spot-check is conducted. **Figure 5.1** shows four proposed odour spot-check points at four different directions. The patrol was conducted from the less odour towards the strong odour side. These spot-check locations are accessible and located at the boundary of the existing and future developments, including Fung Kong Tsuen (also represent far side of Site 3-1), Site 2-17, Site 3-5 and Site 2-24/Site 2-27. The intention of taking patrol/spot-check survey is to estimate the prevailing effect for the ground-level ASRs (mostly affected) under actual operating condition (eliminating the uncertainty in modeling).

Figure 5.1 Four Odour Patrol/Spotted-check Points



5.1.2 In order to draw any meaningful conclusion, the odour patrol/spot-check exercise should aim to capture a reasonably worst impact situation (i.e. combination of relatively high chicken-holding capacity and hot weather conditions).

5.1.3 Specifically, the operation status of all the odour emitting sources within the chicken farm should also be determined to check whether or not the odour emitting process is underway during the odour patrol. As such, the odour patrol/spot-check were conducted at the same time frame as the in-situ odour sampling within the chicken farm as far as possible (“in order to synchronize the data at the same time/day”).

5.1.4 Before the survey, the qualified panelists have their individual n-butanol thresholds tested and confirmed to be within a required range of 20 to 80 ppb/v.

5.1.5 During the patrol/spot-check, relevant weather conditions such as ambient temperature, relative humidity, wind direction and wind speed were recorded on the site.

5.1.6 An odour patrol/spot-check shall be conducted by three qualified odour panel members from a qualified laboratory for each trip determining the odour intensity in the following scales (see **Table 5.1**).

Table 5.1 Rank of Odour Intensity

Rank	Description	Remarks
0	Not detected	No odour perceived or the odour was so weak that it cannot be easily characterized or described
1	Slight	Identifiable odour, slight
2	Moderate	Identifiable odour, moderate
3	Strong	Identifiable odour, strong
4	Extreme	Severe odour

5.1.7 The patrol was conducted in 4 sessions, during early morning (6am), afternoon (10am-2pm), evening (6pm) and night (8pm) to catch different wind conditions. During each session, odour intensity and concentration were checked at 4 spot-check points by the 3 qualified panelists. Samples were taken at 1.5m above local ground.

5.1.8 The nasal range field olfactometer was used so as to take odour concentration (5 second averaged) at the odour patrol/spot-check points.

5.1.9 For each spot-check location (at each session in each spot-check day), 5 samples in both intensity and concentration were recorded (each sample separated by 1 min interval).

6 ODOUR SAMPLING RESULTS

6.1 Odour Sampling

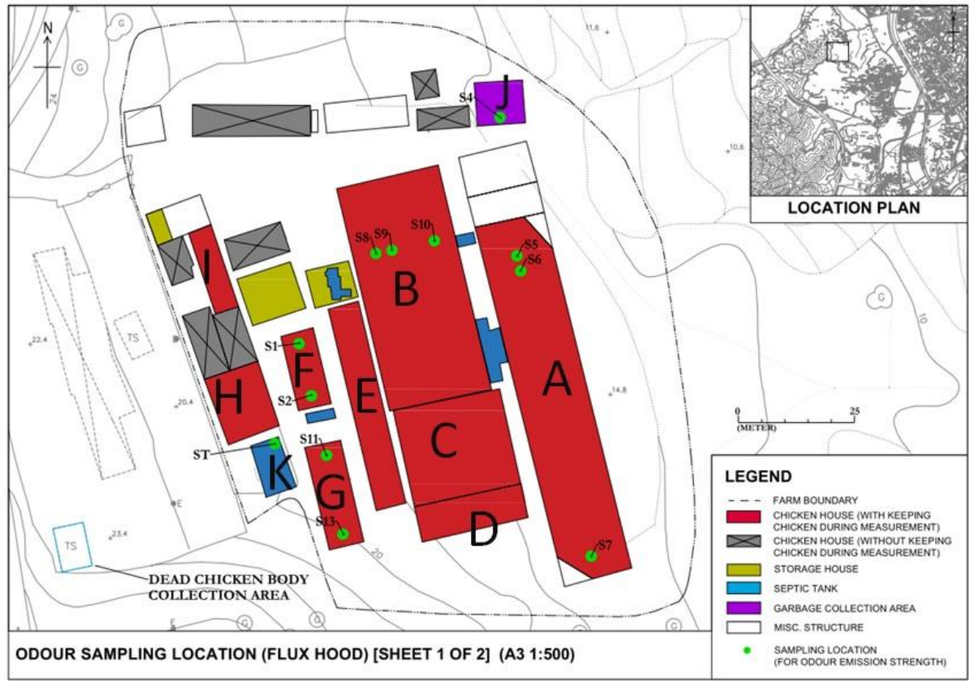
6.1.1 Three odour sampling sets were conducted as described above at identified odour sources and locations respectively on 18 19 and 24 August 2015 of a three non-rainy days with daytime's temperature greater than 30°C (during sampling period) at site. The sampling locations are illustrated in **Figure 4.3** and listed in **Table 4.1.** Detailed report of the odour survey for the Chicken Farm is presented in **Appendix B**.

6.1.2 A specific odour emission rate (SOER) of each sample taken in chicken house, garage collection area and septic tank is determined in the odour survey. The SOER of each odour emission source is adopted to be the average SOER of samples taken in the structures and is summarized as below **Table 6.1**:

Table 6.1 Specific Odour Emission Rate of Odour Source in Chicken Farm

ID	Sample ID	Description	SOER (OU/m^2·s)
A	S5, S6, S7	Large-sized Chicken House	15.77
Exhaust of A	A4-2'	Large-sized Chicken House (Active Vent)	64 (odour conc., OU/m^3)
B	S8, S9, S10	Medium-sized Chicken House	2.19
C	S8, S9, S10 [1]	Medium-sized Chicken House	2.19
D	S8, S9, S10 [1]	Medium-sized Chicken House	2.19
E	A6-1'	Small-sized Chicken House (Active Vent)	22 (odour conc., OU/m^3)
F	S1, S2	Small-sized Chicken House	0.39
G	S11, S13	Small-to-Medium Chicken House	0.43
H	S1, S2 [1]	Small-sized Chicken House	0.39
I	S1, S2 [1]	Small-sized Chicken House	0.39
J	S4	Garbage Collection Area	0.48
K	ST	Septic Tank	4.55

Remark:
[1] Adopted as the same type of chicken house



6.2 Odour Patrol/Spot-check Survey

6.2.1 The odour patrol/spot-check at the four proposed odour spot-check points as shown in **Figure 5.1** were also conducted on 18, 19 and 24 August 2015 as described above simultaneously with the odour sampling in the chicken farm. Detailed report of the odour patrol/spot-check is also presented in **Appendix B**.

6.2.2 During the patrol, the perceived intensity of the odour was determined by their olfactory sense while the odour concentration (5-second averaged) was determined by using a field olfactometer (Nasal Ranger). The findings of the patrol at each spot-check points are summarized in below **Table 6.2**.

Table 6.2 Summary of Odour Patrol/Spot-check Survey

Spot-Check Point	Odour Intensity Rank	Rank Interpretation	Nasal Ranger Number
Point 1	0 – 1	No detected to Identifiable odour, slight	< 2
Point 2	0 – 1	No detected to Identifiable odour, slight	< 2
Point 3	0	No odour perceived or the odour was so weak that it cannot be easily characterized or described	< 2
Point 4	0	No odour perceived or the odour was so weak that it cannot be easily characterized or described	< 2

7 ODOUR EMISSION ESTIMATION FOR CHICKEN FARM ON FUTURE RODP DEVELOPMENTS

7.1 Estimation of Odour Emission Rate

7.1.1 With reference to the SOER determined by the odour sampling, the odour emission rate of each chicken house is determined according to the total area of the excretion collection channels inside each chicken house or the size of the exposed area. The odour emission rate of each structure derived from the measurements is summarized in below **Table 7.1**.

7.1.2 Owing to the short distance between each chicken house, odour emission by diffusion from the chicken houses would dominant while dispersion ambient wind is not effective. Therefore it is more appropriate to consider all chicken houses as one single emission source. Odour emission sources are then allocated around the chicken house, along the sides of the farm, namely north, east, south and west sides. Each side of the farm is further divided into a number of cubic volume sources. The total odour emission rate is obtained by summing up the rate of each individual house. In order to match with the ambient measurement results, different fraction of total odour emission rate is allocated to each side with 35% for each side on north and west and 15% for east and south sides.

7.1.3 For those chicken houses (A & E) with ventilation fans on during the sampling, their odour emission rates are determined by the measured odour concentration and flow velocity of exhaust and the area of ventilation opening. Chicken house E is covered in 3 sides with roof and has forced ventilation at the end of the house, thus a volume source is place at the end of the chicken house downstream of the ventilation fan blowing direction. Unlike chicken house E, there are opening with barded wires on sides of chicken house A. The volume source at the exhaust is assumed to have 86% of the odour emission of the chicken house A.

7.1.4 Sample point A4-2' is taken as a reference point to adjust the emission rates associated with the chicken houses. A scaling factor of 0.053 is obtained and adopted for the adjustments. The odour emission of chicken house are further adjusted to the one at maximum capacity by a factor of 1.3 (max. capacity / capacity during sampling = 102,000 / 78,000 = 1.3).

7.1.5 The exposed are of garbage collection Area (J) and septic tank (K) are modelled as area sources. Their odour emission rate are directly adopted from the SOER determined by the odour sampling.

Table 7.1 Effective Odour Emission Rate of Odour Source in Chicken Farm

ID	SOER ($OU/m^2 \cdot s$)	Total Exposed Area (m^2)	Odour Emission Rate by Measurement (OU/s)
A [1]	211.2 [3]	45	9504.0
B	2.19	640	1401.6
C	2.19	200	438.0
D	2.19	120	262.8
E [1]	48.4 [4]	4.00	193.6
F	0.39	60	23.4
G	0.43	120	52.0
H	0.39	130	50.6
I	0.39	35	13.6
J [2]	0.48	N/A	N/A
K [2]	4.55	N/A	N/A

Remark:
[1] The ventilation fans were turned on during sampling, thus the emission rate is determined by the concentration measured downstream of the ventilation fan.
[2] Direct adoption of SOER determined by odour sampling for area sources.
[3] Determined by odour concentration of 64 OU/m^3 and flow rate of 3.3 m/s
[4] Determined by odour concentration of 22 OU/m^3 and flow rate of 2.2 m/s

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7.1.6 The odour emission rate would not achieve as high as the figures estimated above in **Table 7.1** because the excretion collection channels are cleaned regularly at around 2:00pm everyday as described in Section 3.3.2.

7.2 Modelling Approach and Parameter

7.2.1 In order to evaluate the relative odour impact from chicken farm, odour modelling shall be conducted in Ausplume model at rural mode using meteorological data extracted from MM5 for PATH grid (15, 38).

7.2.2 A roughness length of 100 cm is adopted to account for the suburban area in the vicinity of the chicken farm.

7.2.3 More recent researches indicated that the peak-to-mean ratio of odour dispersion would depend upon the type of source, atmospheric stability and distance downwind. For the purpose of this assessment to produce more reasonable predictions for odour dispersion from point sources (wake-affected and non-wake-affected) and area sources, reference is made to the peak-to-mean ratio stipulated in "Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales" published by the Department of Environment and Conservation, New South Wales, Australia (NSW Approved Method).

7.2.4 The dispersion modelling techniques employed for this assessment will follow those described in EPD's "Guidelines on Choice of Models and Model Parameters" except the use of alternative peak-to-mean ratios for wake-affected point sources and area sources. However, it should be noted that the peak-to-mean ratios stated in the NSW Approved Method are derived based on experimental and theoretical analyses and assuming a 0.1% exceedance level (Ref.: Statistical Elements of Predicting the Impact of a Variety of Odour Sources, Peter R. Best, Karen E. Lunney and Christine A. Killip, Water Science and Technology, Australia, 44: 9 pp 157-164 2001). In other words, there would be a 0.1% probability that the actual peak concentration would be higher than those derived with the peak-to-mean ratios stated in the NSW Approved Method.

7.2.5 **Table 7.2** shows the conversion factors to be used for converting the maximum modelled 1-hour average concentrations to corresponding maximum 1-second average concentrations that could occur during that hour. The chicken farm is assumed to be a volume sources for input into model. Other modelling parameters are listed in **Table 7.3.** The size of each volume source will be determined by the averaged wind flux (m/s) within each chicken house multiplied by the cross-sectional area of openings (or house). With the general mixing by internal fans or natural wind, the dilution/diffusion factor between the excrement channel concentration and the room ambient odour concentration will be identified. The odour spot-check results at the downwind location will be used to verified the modelling setting in general.

Table 7.2 Conversion Factors for Volume Sources

Pasquill Stability Class	Conversion Factor (1 hour to 5 seconds)
	Volume Source
A	2.3
B	2.3
C	2.3

Pasquill Stability Class	Conversion Factor (1 hour to 5 seconds)
	Volume Source
D	2.3
E	2.3
F	2.3

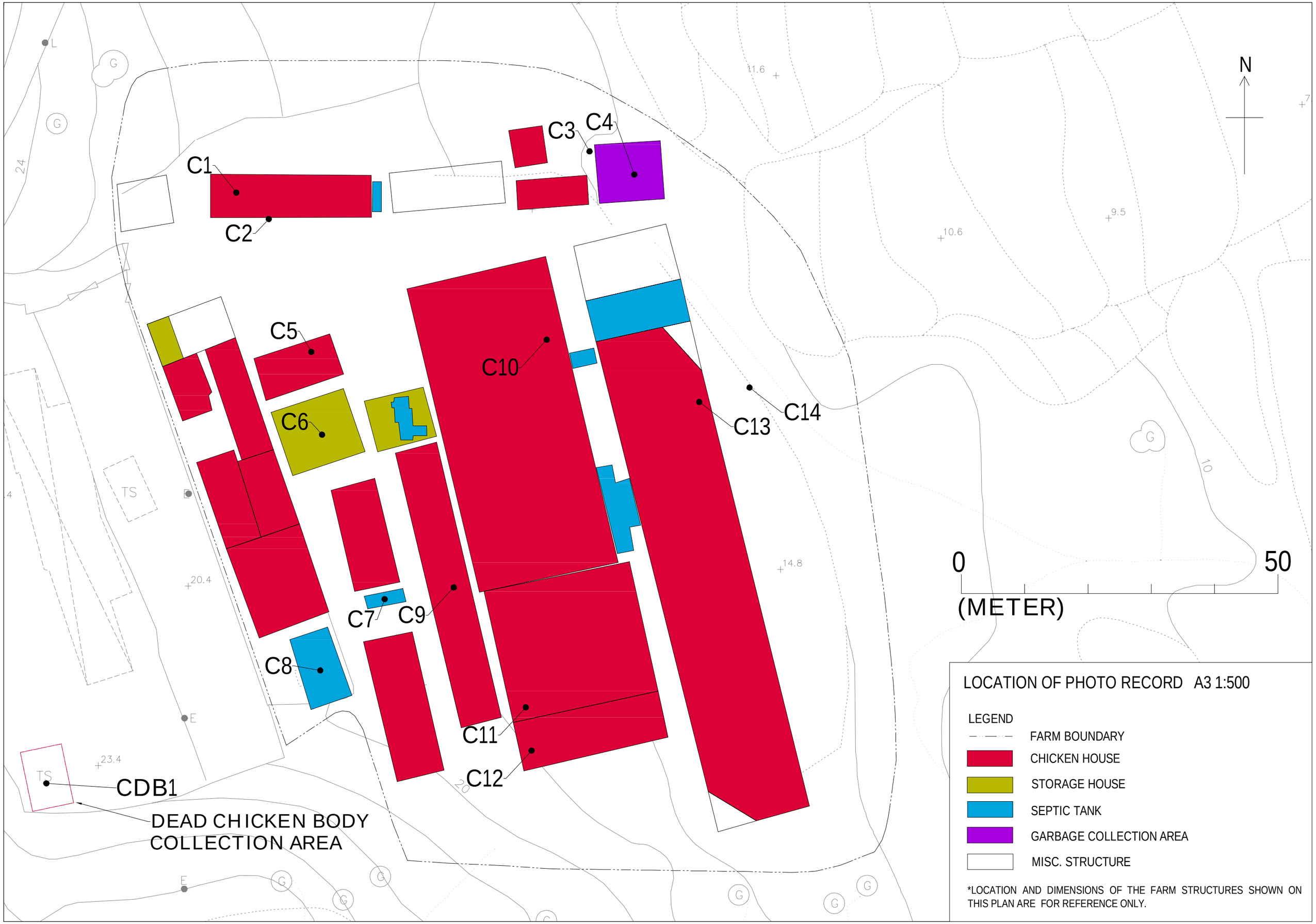

C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
CDB1
DEAD CHICKEN BODY
COLLECTION AREA
N
0
50
(METER)
LOCATION OF PHOTO RECORD A3 1:500
LEGEND
FARM BOUNDARY
CHICKEN HOUSE
STORAGE HOUSE
SEPTIC TANK
GARBAGE COLLECTION AREA
MISC. STRUCTURE
*LOCATION AND DIMENSIONS OF THE FARM STRUCTURES SHOWN ON THIS PLAN ARE FOR REFERENCE ONLY.

Photo Record of Site Inspection to the Chicken Farm

Photo ID	Photo	Description	Odour Perception
C1		Chicken Farm Office /Egg Storage Room (Natural Ventilated Chicken House for Small-sized Chicken underneadth)	Mild
C2		Chicken House for Small-sized Chicken	Mild
C3		Inlet of Chicken Excrements to Septic Tank	No

Photo Record of Site Inspection to the Chicken Farm

Photo ID	Photo	Description	Odour Perception
C4		Garbage Collection Area	Strong
C5		Chicken House for Small Chicken	Mild
C6		Storage House	No

Photo Record of Site Inspection to the Chicken Farm

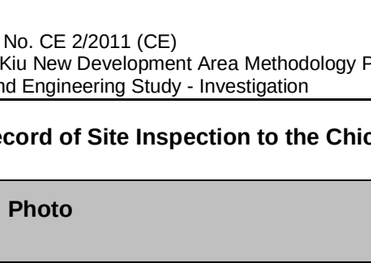
Photo ID	Photo	Description	Odour Perception
C7		Septic Tank with metal covers	No
C8		Septic Tank with metal covers	No
C9		Chicken House for middle-sized or large-sized chicken – “A” Shaped chicken cage and chicken’s excretion channel underneath (Fully Enclosed with Mechanical Ventilation)	Strong

Photo Record of Site Inspection to the Chicken Farm

Photo ID	Photo	Description	Odour Perception
C10		Natural Ventilated Chicken House for middle-sized or large-sized chicken – “A” Shaped chicken cage and chicken’s excretion channel underneath	Strong
C11		Clean “A” Shaped chicken cage	Mild
C12		Natural Ventilated Chicken House for middle-sized or large-sized chicken – “A” Shaped chicken cage and chicken’s excretion channel underneath	Strong

Photo Record of Site Inspection to the Chicken Farm

Photo ID	Photo	Description	Odour Perception
C13		Natural Ventilated Chicken House for middle-sized or large-sized chicken – “A” Shaped chicken cage and chicken’s excretion channel underneath	Strong
C14		Area outside middle-sized or large-sized Natural Ventilated Chicken House	Mild

Appendix 3.6 Chicken Farm Odour Assessment Methodology

Shed Informaiton

House	Approx. Chicken No. Kept during measurement	Channel		Shed Dimension			
		No.	Channel Area (m2)	L (m)	W (m)	H (m)	Volume (m3)
A	26000	4	560	15	80	3	3600
B	20000	16	640	50	23	3	3450
C	6000	5	200	23	21	3	1449
D	1000	3	120	23	8	3	552
E	1000	2	168	45	7	4	1260
F	6000	2	60	16	7	3	336
G	2000	3	120	8	22	3	528
H	12000	5	130	12	15	3	540
I	4000	5	35	5	19	3	285
Chicken No.	78000						
Max. Allowed	102000						

Appendix 3.6 Chicken Farm Odour Assessment Methodology

Calculation of Odour Emission Rate

Source	SOER (OU/m^2·s)	Total Exposed Area (m2)	Odour Emission Rate by Measurement (OU/s)
A	211.2	45	9504
B	2.19	640	1402
C	2.19	200	438
D	2.19	120	263
E	48.4	4	194
F	0.39	60	23
G	0.43	120	52
H	0.39	130	51
I	0.39	35	14
Garb	0.48	-	-
Septic	4.55	-	-
		Total	11940

Source	Effective Odour Emission Rate (OU/s)	Remarks
E1 - E8	535.9	15% of Odour Emission except source E and 86% of Source A
S1 - S5	535.9	15% of Odour Emission except source E and 86% of Source A
W1 - W8	1250.4	35% of Odour Emission except source E and 86% of Source A
N1 - N8	1250.4	35% of Odour Emission except source E and 86% of Source A
FV1	193.6	Source E
FV2	8173.4	86% of Source A

Appendix 3.6 Chicken Farm Odour Assessment Methodology

Emission Inventory for Odour Sources in AERMOD

Source	Type	X1	Y1	X2	Y2	Height	Angle	Emission rate (OU/s-m^2 for Area Source, OU/s for Volume Source)
Septic	Area	816449.0	835134.1	2.0	2.0	0.0	-20	4.55
Garbage	Area	816493.2	835203.6	10.3	9.2	1.5	-4	0.48
E1	Volume	816508.3	835182.8	-	-	1.5	-	66.99
E2	Volume	816510.8	835173.1	-	-	1.5	-	66.99
E3	Volume	816513.3	835163.4	-	-	1.5	-	66.99
E4	Volume	816515.8	835153.8	-	-	1.5	-	66.99
E5	Volume	816518.2	835144.1	-	-	1.5	-	66.99
E6	Volume	816520.7	835134.4	-	-	1.5	-	66.99
E7	Volume	816523.1	835124.7	-	-	1.5	-	66.99
E8	Volume	816525.6	835115.0	-	-	1.5	-	66.99
FV1	Volume	816474.5	835121.6	-	-	1.5	-	193.60
FV2	Volume	816519.6	835107.7	-	-	1.5	-	8173.44
N1	Volume	816431.0	835185.5	-	-	1.5	-	156.30
N2	Volume	816440.8	835187.6	-	-	1.5	-	156.30
N3	Volume	816450.6	835189.7	-	-	1.5	-	156.30
N4	Volume	816460.4	835191.8	-	-	1.5	-	156.30
N5	Volume	816470.2	835193.9	-	-	1.5	-	156.30
N6	Volume	816479.9	835196.0	-	-	1.5	-	156.30
N7	Volume	816491.8	835188.3	-	-	1.5	-	156.30
N8	Volume	816501.6	835190.4	-	-	1.5	-	156.30
S1	Volume	816465.0	835109.0	-	-	2.0	-	107.18
S2	Volume	816474.8	835111.0	-	-	1.5	-	107.18
S3	Volume	816484.6	835113.1	-	-	1.5	-	107.18
S4	Volume	816494.4	835115.2	-	-	1.5	-	107.18
S5	Volume	816504.2	835117.3	-	-	1.5	-	107.18
W1	Volume	816425.8	835179.5	-	-	1.5	-	156.30
W2	Volume	816428.3	835169.8	-	-	1.5	-	156.30
W3	Volume	816430.8	835160.1	-	-	1.5	-	156.30
W4	Volume	816433.2	835150.4	-	-	1.5	-	156.30
W5	Volume	816435.7	835140.8	-	-	1.5	-	156.30
W6	Volume	816443.2	835134.8	-	-	1.5	-	156.30
W7	Volume	816455.4	835127.5	-	-	1.5	-	156.30
W8	Volume	816457.9	835117.8	-	-	1.5	-	156.30

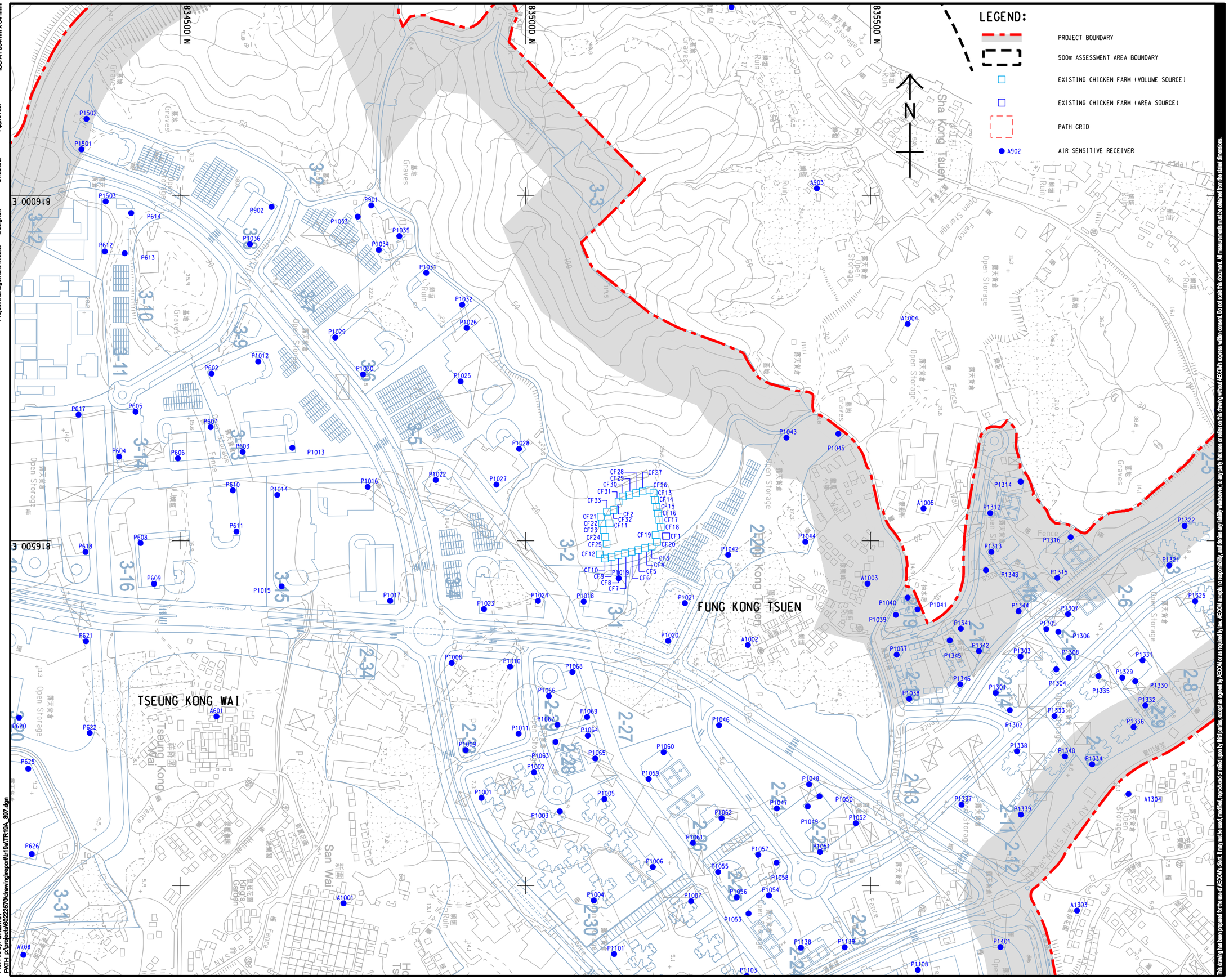
ISO A1 594mm x 841mm

Approved:

Checked:

Designer:

Project Management Initials:



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SCALE 比例
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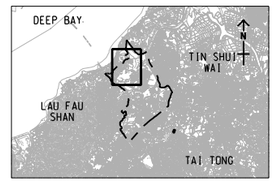
DIMENSION UNIT 尺寸單位
METRES

KEY PLAN 索引圖 A3 1 : 300000



PROJECT NO. 項目編號
60222570

AGREEMENT NO. 協議編號
CE2/2011 (CE)

SHEET TITLE 圖紙名稱

LOCATIONS OF ODOUR EMISSION SOURCE AT EXISTING CHICKEN FARM

SHEET NUMBER 圖紙編號

60222570/TR19A/APPENDIX 3.6.1