15 Food Safety Implications

15.1 Overview

This section presents the potential food safety implications for the LMC Loop Project. Potential food safety implications on fish ponds in association with excavation works were evaluated taking into account available baseline reference for ecotoxicity of pond fishes, contaminated dust migration to fish pond during excavation and ingestion of contaminated dust by pond fishes. Other water bodies other than fish pond and organisms other than pond fish were considered minor and not a major food supply. Thus these sources are not taken into account. A conservative assessment has been adopted and the findings suggested that potential food safety implication is not anticipated.

The food safety implications have been assessed with reference to the criteria stipulated in the Food Adulteration (Metallic Contamination) Regulations and under Clause 3.2.2(vi) of the EIA Study Brief.

15.2 Legislation, Standards and Guidelines

The relevant legislations, standards and guidelines applicable to the present study for the assessment of fisheries impact assessment and food safety implications include:

- Food Adulteration (Metallic Contamination) Regulations (CAP 132V).

15.2.1 Food Adulteration (Metallic Contamination) Regulations (CAP 132V)

Under the Food Adulteration (Metal Contamination) Regulations, for human consumption, import, consign, deliver, manufacture or sell of food containing metals except where naturally present up to certain limits is prohibited. Maximum permitted concentration of certain metals present in food is specified in Schedule 1 and 2 of the regulation and extracted in **Table 15.1** below.

Table 15.1 Maximum permitted concentration of certain metals present

Description of Food	Contaminants	Criteria
Present in fish	Antimony (Sb)	< 1 mg/kg of fish/fish product
Naturally present in solids being fish and fish products	Arsenic (As_2O_3)	< 6 mg/kg of fish/fish product
Present in fish	Cadmium (Cd)	< 2 mg/kg of fish/fish product
Present in fish	Chromium (Cr)	< 1 mg/kg of fish/fish product
Present in fish	Lead (Pb)	< 6 mg/kg of fish/fish product
Present in fish	Mercury (Hg)	< 0.5 mg/kg of fish/fish product
Present in fish	Tin (Sn)	< 230 mg/kg of fish/fish product

15.3 Baseline Conditions

15.3.1 Food Surveillance Programme

Food safety in Hong Kong is inspected by the “Food Surveillance Programme” (http://www.cfs.gov.hk/english/programme/programme_fs/programme_fs.html), which is undertaken by Center of Food Safety (CFS) under the Food and Environmental Hygiene Department (FEHD) of the Hong Kong Government. The Food Surveillance Programme adopts a three-tier surveillance strategy (consisting of routine food surveillance, targeted food surveillance and seasonal food surveillance). Under this programme, aquatic products (including pond fish) at import, wholesale and retail levels are sampled for microbiological (i.e. bacteria and viruses), chemical (i.e. natural toxins, food additives and contaminants) and radiation testings. With reference to food safety standards in Hong Kong (i.e. the criteria listed in **Table 15.1**), all food safety surveillance results (“Pass” or “Fail”) are reported in a monthly “Food Safety Report” in press releases and also presented in CFS website. In Year 2011, 19 numbers of exceedances were recorded, out of 6500 samples for the territory fish and fish products samples (including both imported and local fish).

15.3.2 Baseline Toxicity of Pond Fish in Mai Po

There is no official monitoring data available for pond fishes. Local academic researchers have conducted toxicity monitoring of pond fishes in Mai Po. Cheung, et al (2008)[15-1] have collected sediment and fish samples from different fish ponds in the Pearl River Delta (Tanzhou, Sanjiao, Guangzhou, Shipai, Changan and Mai Po) for analysis of metalloids and heavy metals. Marine fish purchased from markets in Hong Kong were also analyzed. This study has adopted the pond fish toxicity results in Mai Po as the baseline toxicity levels and these monitoring results are summarized in **Table 15.2**.

Table 15.2 Baseline toxicity in pond fish in Mai Po

	Contaminants (mg/kg)				
	As	Cd	Cr	Pb	Hg
Bighead carp	0.96±0.05	0.35±0.15	0.15±0.05	0.33±0.12	0.02±0.01
Tilapia	1.84±0.98	0.08±0.04	0.22±0.23	0.55±0.10	0.02±0.002
Grass carp	1.78±0.36	0.09±0.004	0.08±0.02	0.81±0.26	0.01±0.001

15.3.3 Sources of Contaminated Fugitive Dust

Dust emission will be generated from heavy construction usually arising from dusty construction activities such as filling activities and excavation works. As the filling materials will be sand or Public Fills, which are uncontaminated inert materials. Thus, release of contaminated fugitive dust is not anticipated from filling activities. In addition, no hot spots of land contamination potential were identified in the work areas outside LMC Loop. Therefore, release of contaminated fugitive dust during construction activities from these areas is not anticipated.

[15-1] Cheung, Leung and Wong (2008), Archives of Environmental Contamination and Toxicology, Vol 54 Number 4, 705-715: DOI: 10.1007/s00244-007-9064-7.

Within LMC Loop, soil samples in the entire area were collected during land contamination investigation and contaminated soil had been identified at 5 locations (i.e. A-S01, A-S03, A-S20, A-S24, A-SG10). Dust migration from excavation at these 5 contaminated zones for remediation and site formation will give rise to potential food safety implications from consumption of fish and fish products from the fish ponds. An assessment of the food safety implication is therefore conducted to evaluate its significance.

In addition, excavation of existing soil will be required to establish the bottom profile of Ecological Area. Given that LMC Loop is formed by sediment dumping during training work of Shenzhen River, potential emission of contaminated fugitive dust is anticipated.

15.4 Assessment Methodology

Literature review has been conducted to assess food safety implications. Literature and websites reviewed included:

- AFCD's website (http://www.afcd.gov.hk/english/fisheries/fish_aqu/fish_aqu.html);
- Food Adulteration (Metal Contamination) Regulations;
- Oral reference dose of metallic contaminants under the "Integrated Risk Information System" developed by U.S. Environmental Protection Agency (EPA); and
- Food Safety Report under the Food Surveillance Programme conducted by Centre of Food Safety (CFS) (http://www.cfs.gov.hk/english/programme/programme_fs/programme_fs.html)

In the course of site investigation, metal contaminants were identified in the soils. A remediation plan has been prepared for treatment of these contaminated soils and details can be referred to **Chapter 8** Land Contamination. In the process of excavating these contaminated soils, the contaminants will adhere to the fugitive dust and land on the fish ponds. Through intake of these fugitive dust by the pond fishes and their subsequent consumption by human, there are potential food safety implications.

The assessment methodology takes a conservative approach to evaluate the estimated toxicity accumulation level in the pond fishes for comparison with the respective metal contaminant criteria under the Food Adulteration (Metal Contamination) Regulations as follows:

Step 1: Estimation of the emission rate of fugitive dust

During excavation works, metallic contaminants in soil may be dispersed into the air via fugitive dust. According to **Chapter 3** Air Quality, the TSP emission rate due to wind erosion (E_w) has been assumed to be 0.85 Mg/ha/yr, while that due to heavy construction (E_h) is assumed to be 2.69 Mg/ha/yr. With the implementation of watering once per hour on exposed worksites, a dust removal efficiency (D) of 92.1% can be achieved. The emission rate of fugitive dust can therefore be estimated by:

TSP emission rate in kg/ha/yr

$$\text{TSP emission rate} = (1000\ E_w \times 24/24 + 1000\ E_h \times 8/24) \times R_A \times (1 - D)$$

where, E_w = TSP wind erosion (Mg/ha/yr): 0.85 (24hr/day , representing non-working hours in nighttime) (see **Chapter 3**)

E_h = TSP heavy construction (Mg/ha/yr): 2.69 (8hr/day, representing working hours in daytime) (see **Chapter 3**)

R_A = Percentage of annual active working area: 6% (see **Chapter 3**)

D = Dust removal efficiency of watering once per hour on exposed worksites: 92.1% (see **Chapter 3**)

The calculated TSP emission rate during excavation works is 8.28 kg/ha/yr.

Step 2: Estimation of the emission rate of contaminated fugitive dust

By conservatively assuming 100% of the concentrations of contaminants in soil are carried to the fish pond, the emission rate of contaminant can be estimated by:

Emission rate of contaminant (M) in mg/yr

M = C_s x A x TSP emission rate

where, Cs = Concentration of contaminants in soil (mg/kg): 0.79 to 3.39 (Sb), 19.5 to 27.7 (As), 0.17 to 2.52 (Cd), 43.9 to 67.5 (Cr^{3+}), < 0.5 to 62.1 (Cr^{6+}), 0.11 to 90 (Pb), 4.8 to 44.3 (Sn) (see **Chapter 8**)

A = Area of construction workfronts (ha): 11.95 (Ecological Area), 0.35 to 0.56 (Decontamination area) (see **Chapter 8**)

Step 3: Estimation of the project contribution to accumulated toxicity level in the pond fishes

Accumulated toxicity in pond fishes is estimated by conservatively assuming 100% ingestion of contaminated fugitive dust by pond fish within the Assessment Area. According to **Tables 13.1** and **13.2** in **Chapter 13**, the total fish production (P) is 1975 kg/ha/yr in Year 2010 and the area of concerned fish ponds (A_p) is 114.4 ha including both active and inactive fish ponds. Thus, the total yearly fish production is then 225,940 kg/yr. The project contribution of accumulated toxicity level per fish biomass (C_f) is calculated as follows:-

Project contribution of accumulated toxicity level in fish (C_f) in mg/kg

$C_f = (M \times R) / (P \times A_p)$

where, R = Percentage of contaminant intake by fish (assume 100% for conservative approach, i.e. all released contaminant were eaten by fish)

P = Fish production (= 2049 kg/ha/yr in 2011) (See **Table 13.1** in **Chapter 13**)

A_p = Area of concerned fish ponds (= 137.8 ha) (See **Table 13.2** in **Chapter 13**, active and inactive fish ponds)

Step 4: Estimation of cumulative toxicity level in pond fishes

The baseline toxicities of pond fish (**Table 15.2**) are added to the project contribution to estimate the cumulative toxicity level of pond fishes.

15.5 Identification and Evaluation of Food Safety Implications

During excavation works, such as de-contamination of soil in land contaminated areas (A-S01, A-S03, A-S20, A-S24, A-SG10) (See **Chapter 8**) and excavation for creation of Ecological Area, the contaminated fugitive dust emitted may arouse food safety concerns. As transportation pathway of contaminants from soil to fish (and to human ultimately) take places in such an indirect manner along with multiple dilutions, contaminant concentrations in fish in the ponds of concerned under this study are anticipated to be low.

Detailed estimation of contaminant emissions is presented in **Table 15.3** and the summary is given in **Table 15.4**.

Table 15.3 Emission rate of contaminant from soil (mg/yr)

Excavation Works Areas	Contaminants	Contaminant concentration, C_s (mg/kg in soil)	Excavation Area, A (ha)	Emitted Contaminants, $M = C_s \times A \times$ TSP emission rate (mg/yr)
Ecological Area (excl. A-S20&A-SG10)	Antimony	3.39	11.95	335.4
	Arsenic	19.5		1929.1
	Cadmium	2.52		249.3
	Chromium (III)	64.7		6400.7
	Chromium (VI)	0.5 *		49.5
	Lead	90		8903.6
	Mercury	0.25		24.7
	Tin	44.3		4382.6
Decontamination Area ID - A-S01	Antimony	0.81	0.56	3.7
	Arsenic	24		110.8
	Cadmium	0.21		1.0
	Chromium (III)	43.9		202.7
	Chromium (VI)	62.1		286.7
	Lead	0.11		0.5
	Mercury	0.11		0.5
	Tin	4.8		22.2
Decontamination Area ID - A-S03	Antimony	0.89	0.46	3.4
	Arsenic	26.8		101.6
	Cadmium	0.18		0.7
	Chromium (III)	33.1		125.5
	Chromium (VI)	0.5 *		1.9
	Lead	57.3		217.3
	Mercury	0.06		0.2
	Tin	7.87		29.8
Decontamination Area ID - A-S20	Antimony	1.26	0.50	5.2
	Arsenic	23		95.0
	Cadmium	0.25		1.0
	Chromium (III)	67.5		278.8
	Chromium (VI)	0.5 *		2.1
	Lead	67.3		278.0
	Mercury	0.08		0.3

Excavation Works Areas	**Contaminants**	**Contaminant concentration, C_s (mg/kg in soil)**	**Excavation Area, A (ha)**	**Emitted Contaminants, M = C_s x A x TSP emission rate (mg/yr)**
	Tin	6.79		28.0
Decontamination Area ID - A-S24	Antimony	1.12	0.40	3.7
	Arsenic	27.7		91.8
	Cadmium	0.22		0.7
	Chromium (III)	58.4		193.5
	Chromium (VI)	0.5 *		1.7
	Lead	71.8		237.8
	Mercury	0.12		0.4
	Tin	5.66		18.7
Decontamination Area ID - A-SG10	Antimony	0.79	0.35	2.3
	Arsenic	27.3		79.6
	Cadmium	0.17		0.5
	Chromium (III)	42.1		122.7
	Chromium (VI)	0.5 *		1.5
	Lead	86.5		252.1
	Mercury	0.09		0.3
	Tin	4.9		14.3

Note: * the measured concentration is less than reporting limit of 0.5mg/kg in soil.

Table 15.4 Estimation of contaminant in fish from indirect impact

Contaminants	**Total Emitted Contaminants M (mg/yr)**	**Project Contribution of Accumulated Toxicity Level in Pond Fishes $C_f = (M \times R) / (P \times A_p)$ (mg/kg in fish)**	**Baseline Toxicity in Pond Fish[2] (mg/kg in fish)**	**Maximum Cumulative Concentration in Fish (mg/kg in fish)**	**Food Safety Standards (mg/kg in fish)**	**Percentage of Project Contributions to Food Safety Standards**
Antimony	358.4	0.001	-	-	< 1	0.1%
Arsenic	2440.0	0.009	2.82	2.829	< 6	0.1%
Cadmium	256.6	0.001	0.50	0.501	< 2	0.0%
Chromium (III)	7421.7	0.026	-	-	-	-
Chromium (VI)	347.8	0.001	-	-	-	-
Chromium[1]	-	0.027	0.45	0.477	< 1	2.7%
Lead	10021.4	0.035	1.07	1.105	< 6	0.6%
Mercury	26.8	0.000	0.03	0.030	< 0.5	0.0%
Tin	4555.7	0.016	-	-	< 230	0.0%

Note:

[1] Total Cr = $Cr^{3+} + Cr^{6+}$

[2] Maximum upper limit in **Table 15.2**

From **Table 15.3**, it is seen that the increment of antimony, arsenic, cadmium, lead, mercury and tin concentrations in fish attributed to indirect impact is less than 1% of the Food Safety Standards. With the considerable remaining margin, potential food safety implications from these contaminants are not anticipated. The chromium contribution is 2.7% of Food Safety Standard and around 94% of the contribution is due to chromium (III) ions. Chromium (III) is essential to health as it is necessary for insulin action and it is not carcinogens. For insoluble chromium (III), the USEPA has established a chronic oral reference dose of 1.5 mg/kg per day (CASRN 16065-83-1), based on reduction of liver and spleen weight as toxicological endpoints in rat studies. While the maximum chromium (III) in fish is 0.026 mg/kg, chronic effect to human health is not anticipated if the human daily intake is less than 58 kg of fish per day.

In addition, given the affected fish ponds contributes only 10.3% of all local fish ponds (see **Tables 13.1** and **Table 13.2** in **Chapter 13**) and the local fish production has accounted only 4% of total pond fish consumptions (see **Table 13.2** in **Chapter 13**), the pond fish consumption affected by the excavation works will be around 0.4% of total pond fish consumptions in the territory. Thus, food safety implication is not anticipated.

15.6 Mitigation Measures

15.6.1 Contingency Plan

The contractor should have effective communication with Food and Environmental Hygiene Department (FEHD) / Centre of Food Safety (CFS), on food surveillance and food incidents. Food Surveillance Programme (http://www.cfs.gov.hk/english/programme/programme_fs/programme_fs.html).
is undertaken by CFS to inspect food safety in Hong Kong, with a three-tier surveillance strategy (consisting of routine food surveillance, targeted food surveillance and seasonal food surveillance). Under this programme, aquatic products (including pond fish) at import, wholesale and retail levels are sampled for microbiological (i.e. bacteria and viruses), chemical (i.e. natural toxins, food additives and contaminants) and radiation testings. All food safety surveillance results of by a monthly "Food Safety Report" in press releases and also presented in CFS website. If pond fish samples do not comply with food safety standards and they are verified to be from fish ponds of concerned under this study through "food tracing", fish selling shall be stopped as instructed by CFS.

15.6.2 Dust Minimization

- During all excavation works, good site practice should be adopted to minimize the release of TSP, impact of land contamination and the associated food safety implications. The below site practices should be adopted during excavation works.
- Any excavated or stockpile of dusty material should be covered entirely by impervious sheeting or sprayed with water to maintain the entire surface wet and then removed or backfilled or reinstated where practicable within 24 hours of the excavation or unloading;
- Any dusty materials remaining after a stockpile is removed should be wetted with water and cleared from the surface of roads;

- Exposed earth should be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen, shortcrete or other suitable surface stabiliser within six months after the last construction activity on the construction site or part of the construction site where the exposed earth lies;
- Excavation profiles must be properly designed and executed with attention to the relevant requirements for environment, health and safety;
- In case the soil to be excavated is situated beneath the groundwater table, it may be necessary to lower the groundwater table by installing well points or similar means;
- Supply of suitable clean backfill material after excavation, if required;
- Vehicles containing any excavated materials should be suitably covered to limit potential dust emissions or contaminated run-off, and truck bodies and tailgates should be sealed to prevent any discharge during transport or during wet season;
- Speed control for the trucks carrying contaminated materials should be enforced; and
- Vehicle wheel washing facilities at the site's exit points should be established and used.

15.7 Residual Environmental Impacts and Monitoring and Audit

There is no adverse residual impact and EM&A requirements as potential food safety implication is not anticipated.

15.8 Conclusion

Estimated contaminant concentrations in fish attributed to indirect impact is insignificant compared with the Food Safety Standards under Hong Kong Regulations, and thus potential food safety implication is not anticipated.