

8. HAZARD ASSESSMENT

8.1. Introduction

The hazard assessment undertaken of the proposed Tang Lung Chau DGA considers the potential off-site risk from the operation of the DGA. Operations of the TLCDGA may result in potential hazards from the transport and storage of dangerous goods to nearby population and the railway, road and ferry users. The acceptance of risk to life associated with the TLCDGA was assessed previously during the site search study and in several private development studies.

The *Tsuen Wan Dangerous Goods Anchorage: Alternative Site Search Study - Stage 2 Study* (the Site Search Study) was conducted by the Marine Department in March 1995. For the Ma Wan option, the results of the off-site risk assessment suggested that the individual risk level is within the guideline limit and the societal risk level is within the as low as reasonably practicable (ALARP) region.

The purpose of this hazard assessment is to review and confirm the risk findings of the Site Search Study and to consider the need for re-analysis in light of changes occurred since the off-site risk assessment carried out in 1995. It should be noted that the issue of on-site risk at the proposed TLCDGA, with particular reference to the possibility of a ship fire incident within the TLCDGA, has been addressed in a separate study titled *On-site Risk Assessment for Tang Lung Chau DGA*.

8.2. Sensitive Receivers

Assuming the Ma Wan Island will be developed according to the OZP, the following sensitive receivers were identified under the following groups based on the Site Search Study:

- Population in the northeastern CDA.
- Population in the northwestern village development area.
- Population in the western CDA.
- Users of the Tung Wan Beach.
- Vessel population in the shipping channels.
- Users of the Airport Express.
- Users of the Tung Chung line.
- Users of the Lantau Link.
- Users of the ferry services from Central to Tuen Mun and from Hong Kong to China.

8.3. Environmental Legislation and Guidelines

Criteria for evaluating hazard to life are given in Annex 4 of the *TM on EIA Process*. The same risk guidelines have been referred in the Hong Kong Planning Standards and Guidelines (HKPSG) before the issuance of the TM and were used in the Site Search Study.

8.4. Assessment Methodology

Relevant studies have been reviewed with particular reference to the Site Search Study.

Updated information has been collected through consultation with relevant Government Departments and compared with the assumptions made in the Site Search Study. Particular reference has been made to those parameters that could have a significant effect on the results of the hazard assessment. These include:

- number of population, geographical distance - may affect population at risk

- type of hazardous material transported - may affect source of hazard
- amount of hazardous material, meteorological conditions - may affect hazard range
- frequency of initiating events - may affect frequency of fatality events

8.5. Description of Proposed DGA and the Surroundings

The proposed DGA will, in essence, replicate the facilities provided at the existing Tsuen Wan DGA. Specifically, there will be:

- 72 moorings in an effective area of 44.8 ha;
- breakwaters on all sides;
- two entrances on to the Ma Wan Fairway (at the north-east and south-east corners of the DGA) with minimum width of 120m; and
- Internal fairways of minimum width of 60m.

The current design, which is broadly triangular in shape with sides of approximately 3.4 km, has been revised from that originally envisaged in the Site Search Study following the results of hydraulic modeling and environmental considerations. Of particular note (from a risk perspective) is that the DGA is now surrounded on all sides by breakwaters and is located further away from the shores of Ma Wan.

The prime use of the proposed DGA (as for the existing Tsuen Wan DGA) will be to provide designated moorings for fuel delivery barges when not in use. These barges are used, primarily, to deliver fuel oil from the Tsing Yi terminals to ocean going vessels anchored in the harbor areas, to the container terminals and to industrial areas¹.

Currently at the Tsuen Wan DGA, there are 72 designated moorings and a full listing by mooring and vessel was obtained from Marine Department in September 1998, which is presented in Table 8.1. For comparison purposes, corresponding data used in the Site Search Study have been included. From Table 8.1, it can be seen that:

- over 50 vessels use the same moorings in 1998 as in 1994; and
- Most vessels are licensed to carry Category 5 Class 3 oil cargo.
- Data on the usage rate of the DGA during “normal day” and during typhoon was obtained by site survey in the Site Search Study. These data was further confirmed by a recent site visit which included observation and brief interview with crew members.

¹ As quoted in para 2.1 of the Executive Summary (dated January 1996) of ERM's Site Search Study.

Table 8.1: Allocation of Tsuen Wan DGA Moorings in 1998 and 1994

Ref	Mooring	Vessel Name (in Sept 1998)	Cargo (Sept 98)	Vessel Name (in 1994)	Same?	Certification of Fitness for Class (in 1998)	Comment
1	1004	Wide Sea 3	Fuel Oil	Wide Sea 3	Yes	Cat 5 Cl 1,2 &3	
2	1017	Green Pine	Fuel Oil	Green Pine	Yes	Cat 5 Cl 1,2 & 3	
3	1018	Green Cypress	Oil	Shun Lee	No	Cat 5 Cl 1,2 &3	
4	1019	Carfai	Fuel Oil	Carfai	Yes	Cat 5 Cl 1,2 &3	
5	1020	Carfat	Jet Fuel A	Carlingta	No	-	
6	1038	Vingtor	-	Vingtor	Yes	Cat 2 Cl 2	In 1995, carried oxygen/acetylene cylinders
7	1041	Silver Right	Red Diesel	Lin Fung Shing	No	Cat. 5 Cl 3	
8	1056	HYFCO II	Diesel & Lub. Oil	Mei Fung	No	Cat. 5 Cl. 3	
9	1060	Tai Lee 6	Naphtha	Tai Lee 6	Yes	Cat 5 Cl 2	
10	1061	Tai Lee 3	Fuel Oil	Tai Lee 3	Yes	Cat 5 Cl 1,2 & 3	
11	1147	Carrie	Fuel Oil	Carrie	Yes	Cat 5 Cl 1, 2 & 3	
12	1148	Carson	Fuel Oil	Carson	Yes	Cat 5 Cl 1, 2 & 3	
13	1149	Feoso 8	Diesel	Vacant	No	Cat 5 Cl 3	
14	1150	Feoso 1	Diesel	Feoso 1	Yes	Cat 5 Cl 3	
15	1158	Great Island	Diesel	Great Island	Yes	Cat 5 Cl 3	No name in 1998 but same licence no. Dumb Oil Barge.
16	1198	Caltex HK 5	Diesel	Caltex HK 5	Yes	Cat 5 Cl 3	
17	1199	Caltex HK 11	Diesel	Caltex HK 11	Yes	Cat 5 Cl 3	
18	1201	Carhon	Fuel Oil	Carhon	Yes	Cat 5 Cl 1, 2 & 3	
19	1202	Carwai	Fuel Oil	Carwai	Yes	Cat 5 Cl 1, 2 & 3	
20	1229	Vacant		CRC	No	n/a	
21	1257	Lee Wah	Diesel	Hoi Lay 2	No	Cat 5 Cl 3	Hoi Lay 2 now at 1375
22	1313	Caltex HK 6	-	Xouk 2	No	Cat 5 Cl 3	Xouk 2 carried LPG cylinders
23	1315	Feoso 3	-	Fu Hing 3	No	Cat 5 Cl 1, 2 & 3	
24	1316	HYFCO III	Diesel	HYFCO III	Yes	Cat 5 Cl 3	
25	1332	Kun Tuo	M/Launch	Win Han	No	n/a	In 1995, Win Han carried explosives
26	1333	Kun Yieh	M/Launch	Kun Yieh	Yes	N/a	
27	1358	Wah Fu 3	Diesel	Wah Fu 3	Yes	Cat 5 Cl 3	
28	1359	Wah Fu 18	Diesel	Wah Fu 8	No	Cat 5 Cl 3	
29	1360	Sun Kong	Diesel	Sun Kong	Yes	Cat 5 Cl 3	
30	1362	Feoso Delegate	Diesel	Feoso 8	No	Cat 5 Cl 3	Feoso 8 now moved to 1149
31	1363	Carcheong	Fuel Oil	Carcheong	Yes	Cat 5 Cl 1, 2 & 3	
32	1364	Caryun	Fuel Oil	Caryun	Yes	Cat 5 Cl 1, 2 & 3	
33	1365	Carho	-	Carho	Yes	Cat 5 Cl 1, 2 & 3	
34	1366	Carching	Fuel Oil	Carching	Yes	Cat 5 Cl 1, 2 & 3	
35	1367	Wide Sea 4	Fuel Oil	Wide Sea 4	Yes	Cat 5 Cl 1, 2 & 3	
36	1368	Oiler 1	Fuel Oil	Oiler 1	Yes	Cat 5 Cl 1, 2 & 3	
37	1369	Hop Fat 3	Diesel	Hop Fat 3	Yes	Cat 5 Cl 3	

Table 8.1: Allocation of Tsuen Wan DGA Moorings in 1998 and 1994 (cont.)

Ref	Mooring	Vessel Name	Cargo	Vessel Name	Same?	Classification	Comment
		(in Sept 1998)	(Sept 98)	(in 1994)		(in 1998)	
38	1370	Ta Kang 6	Diesel	Ta Kang 6	Yes	Cat 5 Cl 3	
39	1371	Shell Shik Toy Shan	-	Shin You Shan	No	Cat 5 Cl 1, 2 & 3	
40	1372	Shell Heng Fung	-	Shell Heng Fung	Yes	Cat 5 Cl 1, 2 & 3	
41	1374	Yee Lee	Diesel	Yee Lee	No	Cat 5 Cl 3	
42	1375	Hoi Lay 2	Diesel	Hoi Lay 1	No	Cat 5 Cl 3	
43	1407	Shui Cheong 3	-	Shui Cheong	Yes	Cat 5 Cl 3	Same licence = same vessel
44	1408	Shui Cheong 1	Diesel	Shui Cheong 1	Yes	Cat 5 Cl 3	
45	1409	Shui Cheong 2	Diesel	Shui Cheong 2	Yes	Cat 5 Cl 3	
46	1410	CDL 1	Diesel	CDL 1	Yes	Cat 5 Cl 3	
47	1411	Lee Hing Hong 2	Diesel	Lee Hing Hong 2	Yes	Cat 5 Cl 3	
48	1412	CDL 3	Diesel	CDL 3	Yes	Cat 5 Cl 3	
49	1420	Tak Shing 1	Diesel	Leung Tai Hei	No	Cat 5 Cl 3	
50	1424	Mei Foo Pearl	Diesel	Mei Foo Pearl	Yes	Cat 5 Cl 3	
51	1425	Ruby II	Diesel	Ruby II	Yes	Cat 5 Cl 3	
52	1426	Ruby III	L. Diesel	Ruby III	Yes	Cat 5 Cl 3	
53	1427	Ruby 4	Diesel	Ruby 4	Yes	Cat 5 Cl 3	
54	1428	Ruby 5	Diesel	Ruby 5	Yes	Cat 5 Cl 3	
55	1429	Shiu Wing 2	Red Diesel	Shiu Wing 2	Yes	Cat 2 Cl 3	In 1995, carried oxygen/acetylene cylinders
56	1430	Tak Who	Diesel	Kun Kei	No	Cat 2 Cl 3	LPG cylinders
57	1432	Elite	Diesel		No	Cat 5 Cl. 3	Mooring not listed in 1995
58	1438	Hop Fat 8	Diesel	Hop Fat 8	Yes	Cat 5 Cl 3	
59	1439	Fu Yung Shan	Fuel Oil	Fu Yung Shan	Yes	Cat 5 Cl 1, 2 & 3	
60	1440	Shell Tai Ping Shan	LPG	Shell Tai Ping Shan	Yes	Cat 2 Cl 2	LPG product barge
61	1441	(Shell) Wor Fung	-	(Shell) Wor Fung	Yes	Cat 5 Cl 1, 2 & 3	Now vacant
62	1442	Shell Hui Fung	Lub Oil A50	Shell Hui Fung	Yes	Cat 5 Cl 3	
63	1443	Shell Aberdeen I	Diesel		No	Cat 5 Cl 3	Mooring not listed in 1995
64	1445	Tai Lee 1	Diesel	Tai Lee 1	Yes	Cat 5 Cl 3	
65	1446	Tai Lee 2	Diesel	Tai Lee 2	Yes	Cat 5 Cl 3	
66	1447	Chextrusion 1	Diesel	Chextrusion 1	Yes	Cat 5 Cl 3	
67	1448	Hoi Hung 1	Waste Oil	DI 15	No	Cat 5 Cl 3	
68	1449	Hoi Hung 2	Waste Oil	Caltex HK 5	No	Cat 5 Cl 3	Caltex HK 5 in 1198 (typing error?)
69	1481	Locator	Freon & Gas Cylinder		No	Cat 2 Cl. 2	Mooring not listed in 1995
70	1868	Dumb Barge 101	Diesel	Leung Koon Tai	Yes	Cat 5 Cl.3	Same licence = same vessel, but cancelled in 1970.
71	1869	Dumb Barge 102	-	Law Po Sun	Yes	Cat 5 Cl 1, 2 & 3	Same licence = same vessel, but not renewed since 1968.
72	1919	Sun Yau	Diesel	Sun Yau	Yes	Cat 5 Cl 3	

8.6. Changes Since the Site Search Study

The changes occurred to the DGA and its surrounding since the Site Search Study that may have affected the resultant risk levels to “off-site” sensitive receivers have been analyzed and are summarized in this section.

The location of the DGA has been changed since the Site Search Study. The DGA is now located further away from the Ma Wan Island (about 270m). This increase in separation distance between the source of hazardous event and the population at risk as compared to the Site Search Study layout would result in lower risk levels.

The design and layout of the DGA has undergone some changes as well. The DGA is now surrounded on all sides by breakwaters. This would have no significant bearings on the off-site risk assessment.

The population at risk remains essentially the same as in the Site Search Study except there have been proposals from private developers to develop the southern part of Ma Wan into a film city which would result in an increase of the Ma Wan population if the application is approved.

There has been no significant change in the type of vessels, the number of vessels using the DGA, and the type and amount of DG carried by the vessels as compared to the information reported in the Site Search Study. No significant change in meteorological condition was envisaged. Therefore, the consequences of hazardous incidents resulting from the DGA in terms of hazard ranges as evaluated in the Site Search Study are still applicable.

8.7. Assessment

The assumptions and assessment results of the Site Search Study are still applicable in most of the issues considered. Also, the nature of operation, number and types of vessels, number and type of DG associated with the TLCDDGA remains essentially the same as TWDGA.

Individual Risk

The Site Search Study predicted an individual risk level of less than 10^{-6} per year at the shore of Ma Wan. In the Site Search Study on the Ma Wan option, various scenarios have been considered, including non-site specific and site-specific scenarios. Non-site specific case remains essentially the same since the number and types of vessels to be using the TLCDDGA are very similar to that assessed. Site-specific cases include collision between DGA vessel and other vessels, striking, impact, ranging,² grounding, foundering, fire or explosion and human error. These have remained essentially the same to those studied in the Site Search report in terms of consequences of hazardous incidents and their impact distance. Therefore, the individual risk levels would be very similar to that presented in the Site Search Study. Considering the location of the DGA has been moved further away from the shore, the individual risk would be lower and below the acceptable risk level of 10^{-5} per year, as prescribed in Annex 4 of the *TM on EIA Process*.

2 The definition of ranging, as given in the Site Search Study, is movement of a moored vessel resulting from vessel breaking loose from a moored or anchored situation, or dragging of anchor leading to an impact on a fixed target and damage to the vessel.

Societal Risk

Since most of the background data remains unchanged, the recent change that may have some significance would be the proposed increase in population in Ma Wan (Film City proposal) as proposed by a private developer (Section 17 Review submitted by developer was rejected by TPB in June 1998). However, since the proposed Film-City development is a separate private project and not a committed project at present, the potential impact associated with this development is outside the scope of the present study. Therefore, without taking into account the potential increase in transient population associated with the Film-City development, the societal risk remains essentially the same as that obtained in the Site Search Study. The societal risk for primary events, such as sinking, fire/explosion, grounding and collision with other DG vessel, lies within the acceptable region, whilst the societal risk for ferry collision events lies in the lower ALARP region.

In summary, the individual risk and societal risk levels associated with the TLCDGA are acceptable according to the risk levels prescribed in the *TM on EIA Process*, Annex 4. The Site Search Study also recommended certain procedural measures related to marine traffic operation. These procedural measures are not required to attain the acceptable risk levels under the scope of this DEIA study.

8.8. Mitigation Measures

The review concluded that the changes in the design of the DGA and its surrounding environment since the Site Search Study do not alter the individual risk and societal risk levels as presented in the Site Search Study. The risk levels were concluded in the Site Search Study to be low and within the acceptable region.

The Engineering Study³ of the DGA conducted by the Consultants included an evaluation of the marine impact on vessel routes caused by the DGA relocation. Potential impact from marine traffic along the Ma Wan Fairway and Kap Shui Mun Fairway on the DGA layout in terms of crossing traffic and locations of entrances to the DGA were reviewed. It was concluded that "Traffic generated by the Tang Lung Chau DGA is small and does not have a significant effect on traffic intensities or encounters in the area. The locations of the 2 entrances to the DGA are adjacent to Ma Wan Fairway which has significantly less traffic than Kap Shui Mun Fairway particularly south bound, and adequate room is available for manoeuvring clear of the fairway⁴". Thus, as the marine impact on vessel routes was considered not significant, additional engineering mitigation measures are not required.

8.9. Conclusion

The proposed relocation of the dangerous goods anchorage (DGA) from Tsuen Wan Bay to Tang Lung Chau may result in potential hazards from the transport and storage of the dangerous goods to nearby population and the railway, road and ferry users. The potential off-site risk associated with the DGA at Tang Lung Chau was the subject of a few recent assessments. The most relevant study is the *Tsuen Wan Dangerous Goods Anchorage: Alternative Site Search Study - Stage 2 Study* (Site Search Study) conducted by Marine Department in March 1995. The results suggested that the individual risk level is within the acceptable risk level and the societal risk level is within the as low as reasonably practicable (ALARP) region. Other assessments were mostly qualitative analyses

3 Tsuen Wan Bay Further Reclamation Area 35 Technical Report on Reprovisioning and Marine Impact of Dangerous Goods Anchorage at Tang Lung Chau Issue 2 September 1998 (Chapter 10).

4 Both entrances of the DGA are located well clear of the fairway (200m), allowing plenty of room for DGA vessels to accelerate/decelerate clear of through traffic. The north entrance is 400m clear of Ma Wan and the West tower of Tsing Ma Bridge giving plenty of manoeuvring room and adequate sight distances.

largely based on results from previous assessments.

The purpose of this hazard assessment in the DEIA is to review and confirm that the potential hazard associated with the TLCDGA, as presented in the assessment for the Site Search Study, is still valid in light of changes incurred since the assessment was carried out in 1995. This off-site risk assessment has included a review of past assessments and collection of updated information and data from Government so as to assess the potential effect of these changes to the risk levels. The findings confirm that the assumptions and assessment results of the Site Search Study are still applicable in most of the issues considered. For those assumptions that have changed since the Site Search Study, a review was carried out and it was concluded that they do not change the individual risk and societal risk results as presented in the Site Search Study. Therefore, the individual risk and societal risk associated with the TLCDGA are acceptable according to the risk levels prescribed in Annex 4 of the *TM on EIA Process*.

With respect to the "Film-City" development at south Ma Wan proposed by a private developer, since this is a separate private sector project and is uncommitted at the time of this assessment, it is considered to be outside the scope of this study. According to the decision of the Town Planning Board, the proponent of the "Film-City" development would need to provide sufficient information including those on risk issues in relation to the DGA for the Town Planning Board's consideration of approving this proposed tourist development.