Operational Risk Assessment

of

Port of London

1999 - 2001

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CONTENTS

APPENDICES

Note: appendix C and D are large documents and therefore separately bound.

1 SUMMARY

This document reports the operational risk assessment, commissioned by the Port of London Authority, as part of the process needed to comply with the Port Marine Safety Code.

The purpose of this document is to present a record of the principal hazards which have been identified in the respective areas, together with an assessment of the comparative risk of such events occurring, and the measures in place to control these risks. A number of additional recommendations for risk control are outlined, which need further consideration by the Port of London Authority (PLA). These are contained in section 6.2. This report also includes recommendations for the elements of a Navigational Safety Management System to safeguard the safety of marine operations within the port.

1.1 BACKGROUND

This project was commissioned by the PLA as part of its on-going process of formalising and enhancing its management control systems for the safety of navigation within the tidal Thames. PLA's objective is to establish a comprehensive, recognised, effective and efficient Safety Management System, which is fully integrated with PLA management structures and contributes directly to the day to day management of navigational safety.

1.2 PURPOSE AND SCOPE

The overall scope of work for this study included all the main navigational approach channels into London and extended from the outer PLA limits in the Thames estuary to Teddington Lock. A number of specific locations required particular attention in that they represented areas where high density of crossing or manoeuvring traffic exists, or precise ship handling is necessary.

The study included all commercial vessels over 40m in length or over 50 gross tonnes, trading externally to and from the Port. Smaller vessels and intra-port traffic were included in the area between London Bridge and Teddington lock.

The study included all navigation-related operational functions including environmental and operational limitations (i.e. tidal regime, channel limitations, weather limitations, vessel cargoes,) and the traffic management infrastructure and its impact on the safety of navigation.

1.3 PORT OF LONDON

The Port of London is somewhat unusual in that it has a very large geographic extent with over 90 miles of river, encompassing some 400 square miles of water. As a result of this, the Port Authority has to interface with numerous and diverse local authorities, emergency services, commercial interests and user groups throughout its area of jurisdiction.

In effect, the port comprises three zones each of which have very different characteristics and requirements:-

- **Below Greenwich,** the river is heavily commercial, handling the complete spectrum of vessel and cargo types, including passengers, containers, bulk, petroleum, chemicals and gas;

- **Above Greenwich**, and particularly through the centre of London, the river supports a very busy tourist trade with Class V passenger vessels, with some commercial traffic;

- **Above Wandsworth**, the river supports a very active private leisure scene, with rowing craft, motor yachts and other water sports.

The hazards affecting marine operations vary widely between these zones. In addition, hazards within the estuarial approaches are also very different from those occurring within any of the above zones. It follows that the approach required for risk management will similarly vary across the zones.

This makes overall management of the port a complex balance between numerous competing stakeholder interests, each with differing viewpoints, and therefore with differing priorities and perceptions of marine safety requirements.

2 RISK ASSESSMENT OVERVIEW

The approach taken by the Study Team is based on the Formal Safety Assessment (FSA) method, adopted by the International Maritime Organisation, (IMO). This consists of five distinct steps:-

1. Hazard Identification (Section 3).
2. Risk Assessment (Section 4).
3. Risk Control Options (Section 6).
4. Cost Benefit Analysis (see below).
5. Recommendations for Decision-Making (see Sections 6 and 8).

This report covers steps 1, 2, 3 and 5 of the FSA process, specific to Port of London. The tasks contained in Steps 1 and 2 result in the generation of a prioritised (ranked) hazard profile against which existing risk control measures are mapped. Gap analysis is then used to identify where further risk control measures may be required and these are generated in Step 3. Cost Benefit Analysis of proposed risk control options was ultimately not required and this report therefore does not cover Step 4. From the options identified in Step 3 recommendations for risk control are made, together with further recommendations relating to enhancement of the Authority's existing Navigational Safety Management Systems. Further details of the methodology are contained in section 4 of this report.

3 HAZARD IDENTIFICATION - DATA GATHERING

In order to ensure that the hazard identification was comprehensive, proactive, and not confined only to hazards that have materialised in the past, a number of techniques were used. These are described below:

3.1 INTERVIEWS AND FAMILIARISATION TRIPS

The Study Team held a series of interviews with Port of London Authority staff, including Harbour Masters, Assistant Harbour Masters, Duty Port Controllers, Duty Officers, VTS Officers, the Pilotage Manager, Pilots, launch crews and Hydrographic Department staff.

The Study Team also undertook familiarisation trips with pilots on a range of different types and sizes of vessels, inbound and outbound, to various berths on the River Thames. A trip was also taken with a master holding a Pilotage Exemption Certificate (PEC).

Questionnaires also were circulated to 184 PLA staff and employees and data from the returns was used to confirm and supplement the hazards identified elsewhere.

3.2 DOCUMENT STUDY AND INCIDENT DATA

PLA Publications and various internal documents relating to navigation within the port area were provided to the Study Team; these were reviewed and hazards relating to navigation were identified.

The Study Team was also provided with incident and near-miss data covering the period from 1997 to 2000 from the port's PLACID database. This information was used to assist in the initial compilation of the hazard lists (and also later in assigning frequency and consequence to the respective hazards).

The results of the study of Emergency Arrangements (for Search and Rescue) on the River Thames, undertaken by BMT RCL and Marine and Risk Consultants Limited on behalf of the PLA and DETR were also reviewed and the information therein used to assist in identifying further hazards relating to the upper reaches of the river.

3.3 HAZID MEETINGS AND WORKSHOPS

Structured HAZID (Hazard Identification) meetings were held on the 12th and the 18th of November 1999 at the premises of PLA. These involved senior PLA personnel, the Study Team and other stakeholders. A list of attendees and the organisations represented are contained in Appendix A to this report. These meetings were lead and structured by experienced facilitators who took the discussions sequentially through the identified accident categories and vessel types affected for each area in turn.

Further Hazard Workshops were held at the Premises of PLA on 8th and 9th February 2000 and 13th April 2000. The purpose of these workshops was to

further explore the hazards associated with particular areas (e.g. the Sunk, Warps, Northfleet Hope, etc). These workshops were attended by senior PLA staff and facilitated by members of the Study Team. A list of attendees and the organisations represented are contained in Appendix A to this report.

Using the data obtained from the interviews, familiarisation trips, document studies, questionnaire returns, HAZID meetings and workshops, a preliminary hazard list was drawn up, from which a hazard database was constructed and populated.

4 RISK ASSESSMENT

4.1 METHODOLOGY

IMO Guidelines define a hazard as "something with the potential to cause harm, loss or injury" the realisation of which results in an accident. The potential for a hazard to be realised can be combined with an estimated (or known) consequence of outcome. This combination is termed "risk". Risk is therefore a measure of the frequency and consequence of a particular hazard. One way to compare risk levels is to use a matrix approach:-

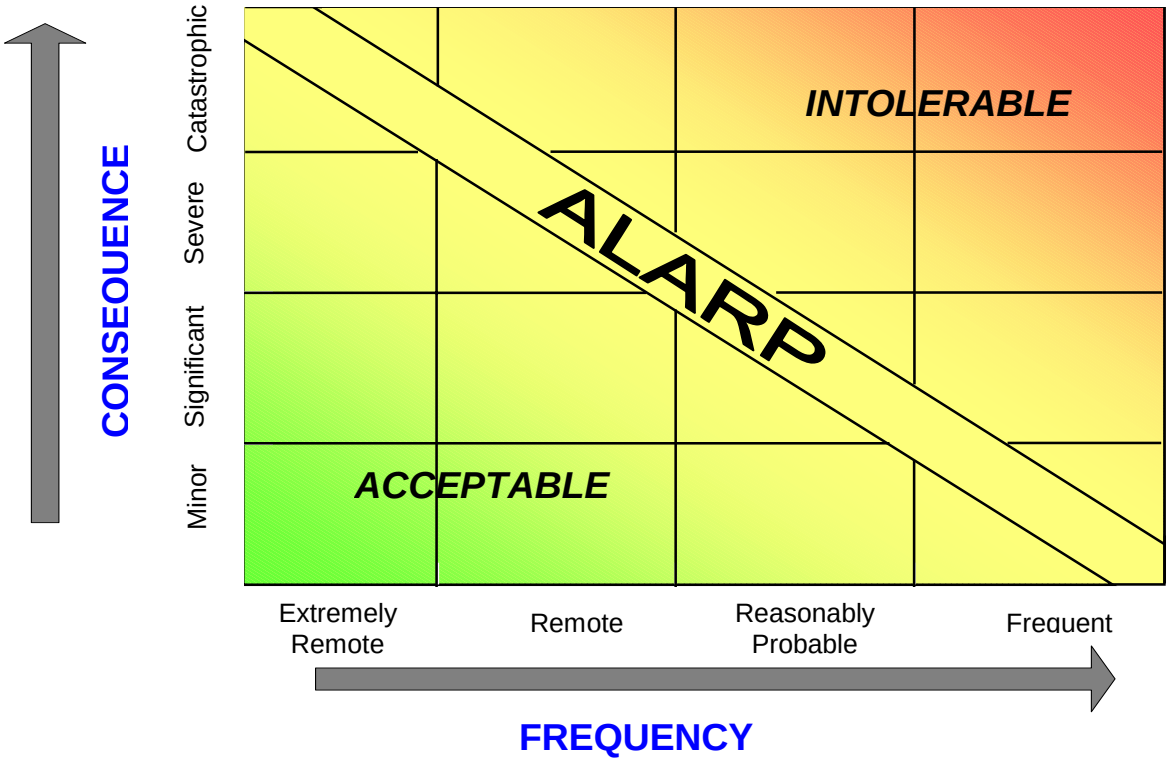

Figure 1 Example Risk Matrix

At the low end of the scale, frequency is extremely remote and consequence insignificant; risk can be said to be negligible. At the high end, where hazards are defined as frequent and the consequence catastrophic, then risk is very high. The "As Low As Reasonably Practicable" (ALARP) principle of risk management is typically applied to reflect that there may be a number of risks that should only be tolerated if the risk mitigation measures in place provide risk reduction into the ALARP region and they cannot be reduced further without grossly disproportionate cost or disruption. In practice, in a range of industries ALARP is widely applied as a risk management (risk reduction) principle regardless of the level of risk involved.

4.2 REDUCING AND MANAGING RISK IN THE MARINE INDUSTRY:

IMO guidelines recognise the existence of ALARP, but do not set any bounds as to how this should be applied and/or demonstrated in the marine industry. This approach is also incorporated into the Port Marine Safety Code and UK shipping policy. This is important as risks need to be managed in a qualitative and comparative way in situations where the actual levels of risk are very difficult to determine.

Part of the reason for this difficulty is that, whilst a Port Authority will aim to reduce risk to ALARP, not all contributory factors and circumstances are under their control. A Port Authority can only set comprehensive requirements as a regulator that, as far as is foreseeable, would reduce the risk of a range of incidents ALARP. This is further compounded by the Open Port Duty of a Port Authority, in which vessels have a right to navigate within the criteria established on safety grounds by the Authority Board. A vessel declaring Port of Refuge status may also pose a risk outside the ALARP region, but the port would be duty bound facilitate entry in order to uphold the principle of safety of life at sea.

The use of ALARP in this study is therefore practical in nature, reflecting the practical problems that a port regulator has in influencing the navigation of a vessel that may not itself be operated to an ALARP standard.

4.2.1 Approach to Risk Management for this Study

For this study, the principles of reducing risk ALARP have been applied by ensuring that risk reduction measures are considered for all identified risks. Particular emphasis has been placed on identifying additional risk reduction measures for those risks that are found to be “significant”.

4.3 CRITERIA FOR ASSESSMENT AT PORT OF LONDON

4.3.1 Port Areas

To undertake any form of port risk assessment, it is necessary to break the port area into geographical areas of relevance and examine risks in each area sequentially, then examine what risks are being transferred from one area to another, as appropriate. The scope of this study included areas under the direct control and responsibility of the Port of London Authority and the waters adjoining the PLA jurisdiction area, including the Sunk Precautionary Area. The geographical breakdown for this study was as follows:

Area A	The Barrow Deep from the NE Gunfleet to the SW Barrow.
Area B	The Black Deep and Knock John Channel from the Black Deep Buoy to a line joining SW Barrow and Shivering Sands Tower.
Area C	The Princes Channel from NE Spit Pilot Station to Shivering Sands Tower.
Area D	From NE Spit Pilot Station to Black Deep 8 via Fisherman's Gat.
Area E	From NE Spit to Shivering Sands Tower via Edinburgh and Knob Channels.
Area G	The Nore Sand Swatchway and Medway Approach Channel
Area H	Sea Reach No.1 Buoy to Gravesend Pilot Station via the Yantlet Channel.
Area I	Gravesend Pilot Station to Crayfordness.
Area J	Crayfordness to London Bridge.
Area K	From London Bridge to Bell Lane Creek.
Area L	From Bell Lane Creek to Teddington.
Warps Area (W)	Western Limit: N/S Line through Sea Reach No.1 Buoy. Eastern Limit: Line from Blacktail Spit to SW Barrow thence to Shivering Sands Tower and then to RST.
Sunk Area (S)	Inner Limit: NE Gunfleet to the Black Deep Buoy – to include Inner Sunk Anchorage and Sunk Precautionary Area.

4.3.2 Risk Matrix Criteria

In this study, each hazard was reviewed with respect to cause and effect. Frequencies were derived for notional 'most likely' and 'worst credible' hazard events in each case, using the following frequency bands:-

1	Frequent	yearly
2	Reasonably Probable	1 - 9 years
3	Remote	10 – 99 years
4	Extremely Unlikely	100 – 999 years
5	None	>1000 years

The first three categories are self-explanatory. Category 4 represents a frequency suggesting an event which is unlikely to happen, but has been identified as a possibility. Category 5 is an event which is *currently* considered

scarcely credible, but where the consequential outcome is catastrophic, and thus needs to be included to take account of possible future changes in risk.

Using the assessed notional frequencies for the 'most likely' and 'worst credible' events for each hazard, the probable consequences associated with each event were assessed in terms of damage to:-

- Life (e.g. personal injury, fatality, etc)
- Property - Third party (i.e. non-PLA property)
- The Environment (oil pollution, etc)
- Port Business (reputation, financial loss, etc)

The rating applied was such that the consequences were of broadly equivalent (abhorrence) value across the categories as follows:-

Category	People	Property	Environment	Port Business
0	None	Negligible < £2000	Negligible < £2000	Negligible < £2000
1	Minor (single slight injury)	Minor (> £2,000)	Minor Tier 1 (>£2,000)	Minor (>£2,000)
2	Slight (multiple Moderate or single major injury)	Moderate (> £20,000)	Moderate Tier 2 - (limited outside assistance) oil spill or environmental amenity impaired	Moderate Bad local publicity or short-term loss of dues, revenue, etc (> £20,000)
3	Serious (multiple major injuries or single fatality)	Serious (> £200,000)	Serious Tier 2 (regional assistance) oil spill, localised flooding or multiple amenities impaired	Serious Bad widespread publicity, temporary port closure or prolonged restriction of navigation (> £200,000)
4	Major (More than one Fatality)	Major (>£2,000,000)	Major Tier 3 (national assistance) oil spill, widespread flooding or extensive damage to amenities	Major Port Closes, navigation seriously disrupted for more than 1-2 days. Long term loss of trade (>£2,000,000)

It should be noted that in terms of Property, the risk assessment by necessity considers the loss of a large commercial vessel is of wider implication than the loss of a private leisure cruiser. This assessment criterion is not intended to under-value damage suffered by the leisure user, whose personal loss may be very significant in relative terms, however it is recognised that the loss of a commercial craft often has a wider implication in terms of port business and negative media exposure.

4.3.3 Accident Categories

The Navigational Risk Assessment uses Accident Categories to organise hazards for assessment. The Accident Categories identified as relevant to this study are:

- Collision
- Contact
- Fire / Explosion
- Grounding
- Loss of Hull Integrity
- Personal Injury
- Pollution
- Swamping

4.3.4 Hazard Data Review Process

During a series of workshops on 11th, 16th and 17th January 2001, the hazards previously identified (in Section 3) were scored by an expert panel comprising senior PLA staff, river users and members of the Study Team. A list of attendees and the organisations represented are contained in Appendix A to this report. Frequency and consequence data were assessed for each hazard in terms of a 'most likely' and 'worst credible' scenario, using the criteria described in section 4.3.2. It should be noted that the hazards were scored on the basis of the current 'status quo' – i.e. with all current preventive and mitigative defences being in place.

The frequency and consequence data thus obtained was then reviewed by the Study Team to ensure internal consistency and also consistency with the existing incident data in the PLACID database. At a high level, the ranked hazard list is produced in Appendix B of this report, with a detailed list of Hazards being presented and bound separately in Appendix D.

4.3.5 Risk Matrix Used For The Study

From the individual frequency and consequence ratings, individual risk factors were derived on a scale of 0 (low risk) to 10 (high risk) for each hazard as follows:

Consequence						
	Cat 4	**5**	**6**	**7**	**8**	**10**
	Cat 3	**4**	**5**	**6**	**7**	**9**
	Cat 2	**3**	**3**	**4**	**6**	**8**
	Cat 1	**1**	**2**	**2**	**3**	**6**
	Cat 0	**0**	**0**	**0**	**0**	**0**
	Frequency	>1000 years	99 – 100 Years	9 – 100 years	1 – 9 years	Yearly

Where:-

0 & 1	Negligible Risk
2 & 3	Low risk
4, 5, 6	Assessed to be in the ALARP region
7, 8 & 9	Significant Risk
10	High Risk

From the frequency and consequence data, risk scores were obtained for each hazard, using this criteria, for each of the four consequence categories in both the 'most likely' and 'worst credible' scenarios (i.e. 8 giving risk scores per hazard).

It should be noted that occasionally, most likely scenarios can generate higher risk levels than worst credible; this is due to the increased frequency naturally associated with the most likely event. In effect, the assessment is scoring the risk associated with two different outcomes from the same initiating event. This tends to occur particularly where consequence levels are similar between most likely and worst case and/or where the frequency of the worst credible is very much less than that of the most likely.

Where the most likely event does show higher risk levels it is worthy of special note as, for example, in the case of berthing contact, it may be suggesting that a large number of small berthing contact damages are of greater significance than a single heavy contact at a much lesser frequency.

4.3.6 Hazard Ranking

The risk number of each of the four categories (Life, Property, Environment and Port Business) can be factored to proportionally increase or decrease the effect of that category on the overall hazard ranking. After discussion with the Authority, it was agreed that the risk output should be based on a par value (equal weighting) for each category.

The risk data obtained from the above process was then analysed to obtain four indices for each hazard as follows:

a) the average risk value of the four categories in the 'most likely' set;
b) the average risk value of the four categories in the 'worst credible' set;
c) the maximum risk value of the four categories in the 'most likely' set;
d) the maximum risk value of the four categories in the 'worst credible' set.

Average risk values are sensitive towards hazards that score moderately or highly over a number of categories, whilst the maximum risk values are sensitive towards hazards which score particularly high in any category.

These values were then aggregated to produce a numeric value representing the average of the four indices. The hazard list was then sorted in order of the aggregate of the four indices to produce a Ranked Hazard List, in descending order, with the highest risk hazards prioritised at the top. This list, comprising 244 hazards, is produced in full in Appendix D to this report. This Ranked

Hazard List describes the Risk Profile of the port with regard to navigational operations.

4.4 RISK MITIGATION ACTION TAKEN

The table below describes the approach that was taken to risk mitigation, based on the developed risk profile.

MATRIX OUTCOME	Risk Definition	Action Taken
0 & 1	Negligible Risk	A level where operational safety is unaffected.
2 & 3	Low risk	A level where operational safety is assumed.
4, 5, 6	As Low As Reasonably Practicable (ALARP)	A level defined by Study Team at which risk control in place is reviewed.
7, 8 & 9	Significant Risk:	A level where existing risk control is reviewed and suggestions made where additional risk control could be applied if appropriate (some activities such as boarding operations are inherently significant risk).
10	High Risk	An area where PLA needs to take rapid action.

4.5 HAZARD SUMMARY:

The top ten hazards ranked in individual consequence categories as posing "Significant Risk" (showing a rating of 7, 8 or 9) are presented in the table below. It should be noted that in many cases the hazards are scoring highly due to significant property damage if the risk is realised. Even in the top 10 hazards, the risk of injury remains low except where indicated in the "Life" category.

Ref	Description	Relative Risk No.	Most Likely Risk				Worst credible Risk			
			Life	Prop	Env	Port	Life	Prop	Env	Port
88	Collision with a vessel leaving or manoeuvring to enter Tilbury Lock. This can be a very busy area, particularly on the top of the tide.	6.70	6	8	0	8	6	7	4	6
186	Commercial vessel contacts any bridge between London Bridge and Richmond. Some bridges are particularly vulnerable to contact.	6.02	0	9	0	0	6	7	2	6
51	Thames Barrier (normal navigation - barrier open). The difficulties associated with navigating through the barrier are increased if one or more span is closed.	5.81	0	8	0	0	6	7	4	6
205	Fire / Explosion in a small craft / houseboat. Most small vessels and houseboats are equipped with LPG ranges for cooking. Gas can accumulate in bilges until ignited by a sources ignition.	5.75	8	8	0	0	7	4	0	2
184	Collision between Putney and Richmond. This is a busy area with a range of vessel types.	5.48	6	8	0	0	6	6	0	4
144	Contact with groynes off Diver Shoal. Inbound small vessels are particularly vulnerable (including tugs and tows).	5.29	0	8	0	0	4	6	4	4
122	Personal Injury - Individual in water - requires rescue. Accidental entry, Deliberate act (including attempted suicide).	5.13	9	0	0	0	7	0	0	0
62	Pilot injured / killed boarding / disembarking in adverse weather conditions offshore.	4.74	8	0	0	0	6	0	0	4
138	Personal Injury to passengers waiting / embarking from pontoons and piers, caused by wash from passing ships.	4.74	8	0	0	0	6	0	0	4
134	Mooring breakout, caused by interaction from passing ships, inadequate moorings, etc.	4.74	0	8	0	0	0	6	0	4

Fifty-five hazards ranked in the lowest part of the significant range (rating=7), mainly due to the assessed outcome of the 'Worst Credible' scenarios. Three hazards of this group were also rated as significant (7) within the Most Likely scenarios. For details refer to section 5.1 and Appendix D.

5 MAPPING DEFENCES

A series of workshops were held at the premises of PLA on 13th, 14th and 15th February 2001 to identify and map the risk control measures currently in place to each hazard. Senior PLA staff and the Study Team attended workshops.

Approximately 270 risk control measures were identified, each generally controlling more than one hazard; several risk control measures were applicable to a large number of hazards. A description of all hazards together with the risk controls applicable is contained in Appendix D to this report.

5.1 PRINCIPAL RISKS IDENTIFIED

The defences applicable to the top sixty hazards from the ranked list are summarised in the following section and recommendations for additional risk control measures are made where applicable. In many cases, the suggested additional risk control measures are applicable to more than one hazard; to reduce unnecessary repetition, these suggested additional risk control measures are referenced to the list contained in section 6.

It should be particularly noted that many (if not most) of the hazards identified are controlled to some extent by VTS radar (and visual) monitoring, either from Gravesend PCC or TBNC; to avoid unnecessary repetition this is not generally referenced in the following section, unless specific aspects require highlighting.

5.1.1 No 88 Collision with a vessel leaving or manoeuvring to enter Tilbury Lock.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	8.3	0.0	8.3	5.9	7.0	4.4	5.9	6.704

A total of 19 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Much of the risk control exists in the training and expertise of pilots and masters. Monitoring by Gravesend PCC using both radar and the CCTV on Bevan's Wharf, together with the procedures for leaving Tilbury Lock (PLA Notice to Mariners 2000/29) and the establishment of the radio reporting point at Gravesend for inbound vessels (PLA Notice to Mariners 2000/27) should further combine to reduce this hazard to acceptable levels. In general, therefore, it is considered that the hazard is well controlled by the existing measures.

Additional measures which could be considered are as follows:-

- RCO 22 – Signals for Vessels Departing from Tilbury Lock
- RCO 28 – Container Stacks at Tilburyness - Removal

5.1.2 No 117 Collision in the area between West Oaze and Sea Reach No 1 buoys.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	7.4	3.5	3.5	7.0	7.0	5.9	7.0	6.401

A total of 7 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters. Enhanced VTS Monitoring by Gravesend PCC, together with the radio reporting points marked on the charts combine to further reduce this hazard. The importance of VTS in mitigating this risk is rising. In general, the number of vessels slowing and manoeuvring to ship and land pilots in the Warps / Oaze area has increased since the introduction of Pilotage Direction no.5 as this allows more vessels to transit the estuary without pilots. Current procedures, which involve the use of one launch to serve three pilot stations (including Medway) results in congestion and additional risk caused by shipping and landing pilots to the west of the designated pilot positions.

Additional measures which could be considered are as follows (note also the recommendations for VTS policies contained in section 7.1):-

- RCO 18 – Pilot Launch operations in the Warps Area
- RCO 19 – Warps Precautionary Area – Heightened Profile

5.1.3 No 174 - Collision in Fiddler's or St Clement's Reach (including Stoneness).

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	7.4	3.5	3.5	5.9	7.0	4.4	5.9	6.175

A total of 16 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). In general, the main risk control exists in the training and expertise of pilots and masters. Radar Monitoring by Gravesend PCC, together with the radio reporting points marked on the charts combine to further reduce this hazard.

Additional measures which could be considered are as follows:-

- RCO 01 – Enhancement to Port Control Manual

5.1.4 No 186 - Commercial vessel contacts any bridge between London Bridge and Richmond.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	9.4	0.0	0.0	5.9	7.0	2.4	5.9	6.021

A total of 16 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). In general, the main risk control exists in the training and expertise of pilots and masters. Bridge dimensions are well promulgated (PLA Byelaws and tidetables) and tidal data is regularly promulgated. Navigation marks assist lining up for the correct arch and Byelaws and General Directions assist in controlling towage. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 30 – Third Party Insurance

5.1.5 No 94 - Collision involving VLCC in Sunk Precautionary Area.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
2.4	5.9	4.4	2.4	7.0	7.0	7.0	5.9	5.861

This area is in international waters with limited VTS cover (Harwich keeps a radar watch and advises vessels bound for Harwich but does not 'control' the area).

A total of 5 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). In general, the main risk control exists in the training and expertise of pilots and masters. Additional measures which could be considered are as follows:-

- RCO 20 – Common VHF Channel for the Sunk Area
- RCO 21 – Traffic Routing for the Sunk Area

5.1.6 No 51 - Contact with Thames Barrier (normal navigation - barrier open)

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	8.3	0.0	0.0	5.9	7.0	4.4	5.9	5.812

A total of 16 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). In general, the risk control exists in the training and expertise of pilots and masters. General Direction 15 and Permanent Notice to Mariners 11 set out the procedure for the control of navigation in the Thames Barrier Control Zone. There is also enhanced radar and visual monitoring by in this area. The decision to site TBNC overlooking the barrier is of particular importance to the management of small and medium sized vessels passing through the barrier as VTS can visually monitor their progress. This is also important during periods of reduced visibility as the suspension of traffic movement through the barrier is kept to a minimum. The Thames Barrier Control Zone is also subject to enhanced PEC requirements. Fog meters and Racons are fitted on the barrier itself, which assist in

identifying when operational visibility limits are reached and lining up to the correct span (in all weathers).

In general it is considered that this hazard is adequately controlled by these measures.

5.1.7 No 23 - Collision involving bunker barge.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
Life	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	3.5	3.5	7.0	5.9	5.9	5.9	5.803

A total of 15 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters and barge masters. General Directions (separation of specified vessels) also assists.

Additional measures which could be considered to control mitigation of pollution effects in the event of collision are as follows:-

- RCO 12 – Bunker Barges operating on the Thames – Protective Location
- RCO 27 – Critical Service Operations on the Thames

5.1.8 No 205 - Fire / Explosion in a small craft / houseboat

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
8.3	8.3	0.0	0.0	7.0	4.4	0.0	2.4	5.745

Two risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the education of small craft / houseboat users. Suitable advice is promulgated by PLA in the Pleasure Users Guide. In general it is considered that this hazard is adequately controlled by these measures.

5.1.9 No 4 - Collision - Class V passenger boat - Crayfordness to Teddington.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	5.9	0.0	3.5	7.0	7.0	2.4	7.0	5.651

A total of 13 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of master/skippers. The isophase light system fitted to bridges is also a major risk control. The Large Passenger Vessel (LPV) endorsement (for skippers of vessels over 40m or carrying more than 250 persons), currently a voluntary procedure, further assists. The safety standards of these vessels are laid down in MCA regulations for Class V passenger vessels.

In general it is considered that this hazard is adequately controlled by these measures – see also section 6.3.3.

Additional measures which could be considered are as follows:-

- RCO 16 – Large Passenger Vessel Endorsement - Formalisation
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)
- RCO 27 – Critical Service Operations on the Thames

5.1.10 No 5 - Collision involving any commercial vessel in River (Generic River Collision).

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	7.0	7.0	5.9	5.9	5.651

A total of 11 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and master. A number of General Directions assist in controlling and separating traffic. VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)
- RCO 27 – Critical Service Operations on the Thames

5.1.11 No 63 - Collision at West end of Princes Channel / Shivering Sands area.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	3.5	0.0	7.0	7.0	5.9	5.9	5.651

A total of 6 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and master. VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice

5.1.12 No 64 - Collision with any vessel in Sunk Precautionary Area

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	3.5	0.0	7.0	7.0	5.9	5.9	5.651

This area is in international waters with limited VTS cover (Harwich keeps a radar watch and advises vessels bound for Harwich but does not 'control' the area).

A total of 4 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). In general, the main risk control exists in the training and expertise of pilots and masters.

Additional measures which could be considered are as follows:-

- RCO 20 – Common VHF Channel for the Sunk Area
- RCO 21 – Traffic Routing for the Sunk Area

5.1.13 No 161 - Collision in Oaze Deep.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	3.5	0.0	7.0	7.0	5.9	5.9	5.651

A total of 5 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and master. VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice

5.1.14 No 136 - Grounding - Sugar Vessel (Deep draft) - Special case

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	7.4	0.0	3.5	4.4	7.0	4.4	5.9	5.645

A total of 4 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots. Pilotage procedures include abort procedures (where the vessel due to sail is delayed) although these are not formalised.

Additional measures which could be considered are as follows:-

- RCO 04 – Berth Exchange (Abort) Procedure – Deep Draft – Tate & Lyle

5.1.15 No 115 - Collision in Gravesend reach.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	5.9	7.0	5.9	5.9	5.584

A total of 14 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters. General Directions assist in controlling and separating traffic. Scheduling of vessels for Tilbury also assists in separating vessels. VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 08 – Gravesend Upper Anchorage - Removal
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)

5.1.16 No 170 - Collision between Canvey Island and Western end of Sea Reach

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	5.9	7.0	5.9	5.9	5.584

A total of 16 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters. General Directions assist in controlling and separating traffic. VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. The tanker warning lights will also make a significant contribution to reducing risk both by day and night. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 09 – Thameshaven Anchorage - Removal

5.1.17 No 171 - Collision in Lower Hope Reach

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	5.9	7.0	5.9	5.9	5.584

A total of 15 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters. A number of General Directions assist in controlling and separating traffic. VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)

5.1.18 No 183 - Collision between London Bridge and Bell Lane Creek

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	5.9	0.0	3.5	7.0	7.0	2.4	5.9	5.584

A total of 17 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of master/skippers. The isophase light system fitted to bridges is also a major risk control. The Large Passenger Vessel (LPV) endorsement (for skippers of vessels over 40m or carrying more than 250 persons), currently a voluntary procedure, further assists.

Additional measures which could be considered are as follows:-

- RCO 16 – Large Passenger Vessel Endorsement - Formalisation
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)
- RCO 31 – Education of Leisure Users

5.1.19 No 173 - Collision in Northfleet Hope. (Excluding Tilbury Lock entrance)

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	5.9	7.0	4.4	5.9	5.491

A total of 17 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters. General Directions assist in controlling and separating traffic. Scheduling of vessels for Tilbury also assists in separating vessels. Procedures for vessels leaving Tilbury and reporting at Gravesend inward (PLA Notice to Marinerss 2000/29 and 2000/27) should also materially assist. VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 22 – Signals for Vessels Departing from Tilbury Lock
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)
- RCO 28 – Container Stacks at Tilburyness - Removal

5.1.20 No 184 - Collision between Putney and Richmond

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	8.3	0.0	0.0	5.9	5.9	0.0	4.4	5.478

A total of 17 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). However, the main risk control exists in the training and expertise of masters and skippers. Byelaws, General Directions and Permanent Notices to Mariners assist in controlling traffic (safe speed, etc). The Large Passenger Vessel (LPV) endorsement (for skippers of vessels over 40m or carrying more than 250 persons), currently a voluntary procedure, further assists.

Rowing craft and attending safety boats are permitted to cross the fairway to gain advantage of the slower moving adverse current on the inside of bends between Richmond Footbridge and Fulham Railway Bridge. This practice, known as 'working slacks' is formalised in Permanent Notice to Mariners 1999 (Notice P5). This practice does not apply to all craft and is considered to result in a significant increase in the risk of collision.

Additional measures which could be considered are as follows:-

- RCO 16 – Large Passenger Vessel Endorsement - Formalisation
- RCO 17 – Working 'Slacks' – Elimination of Practice

5.1.21 No 229 - Collision in vicinity of entrance to Black Deep from Fisherman's Gat

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	3.5	3.5	5.9	5.9	5.9	5.9	5.468

Six risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the main risk control exists in the training and expertise of pilots and masters. The establishment of a precautionary area as per PLA Notice to Mariners 2000/59, which clarifies specific ETA reporting procedures, should also assist. Radar Monitoring by Gravesend PCC, together with the radio reporting points marked on the charts combine to further reduce this hazard. In general it is considered that this hazard is adequately controlled by these measures.

It is recommended that this hazard is reviewed frequently in the early stages of use of this channel (e.g. 6 months) – see section 6.2.9.

5.1.22 No 224 - Collision involving High Speed Craft in Sunk Precautionary Area

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
4.4	5.9	2.4	4.4	5.9	5.9	5.9	4.9	5.452

This area is in international waters with limited VTS cover (Harwich keeps a radar watch and advises vessels bound for Harwich but does not 'control' the area).

Three risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Effectively, the risk associated with this hazard is controlled by the manoeuvrability characteristics of the high-speed craft. In general it is considered that this hazard is adequately controlled by these measures.

5.1.23 No 21 - Collision involving tug and dumb barges in the river.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	5.9	0.0	5.9	7.0	5.9	2.4	2.4	5.450

A total of 18 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). However, the main risk control exists in the training and expertise of Pilots, Masters and tug skippers. Byelaws and General Directions assist in regulating the conduct of tows. Radar monitoring by Gravesend PCC and TBNC, together with the radio reporting points marked on the charts combine to further reduce this hazard. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)
- RCO 26 - Towage Operator – Systems and Procedures

5.1.24 No 72 - Passenger vessel contacts bridge between London Bridge and Richmond.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	7.0	5.9	2.4	7.0	5.432

A total of 10 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). In general, the main risk control exists in the training and expertise of masters. Bridge dimensions are well promulgated (PLA Byelaws and tidetables) and tidal data is regularly promulgated. Navigation marks assist lining up for the correct arch. In general it is considered that this hazard is adequately controlled by these measures – see also section 6.3.3.

Additional measures which could be considered are as follows:-

- RCO 27 – Critical Service Operations on the Thames

5.1.25 No 181 - Collision in Greenwich or Limehouse Reach (up to Cuckolds Point).

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	7.0	5.9	2.4	7.0	5.432

A total of 13 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). However, the main risk control exists in the training and expertise of Pilots, Masters and boat skippers. The use of the Harbour Service Launch to escort larger vessels and the promulgation of advice through the Pleasure Users Guide should also assist in reducing the risks. In general it is considered that this hazard is adequately controlled by these measures.

5.1.26 No 182 - Collision in the Lower and Upper Pool (including Limehouse Basin)

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	7.0	5.9	2.4	7.0	5.432

A total of 17 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). However, the main risk control exists in the training and expertise of Pilots, Masters and boat skippers. The

use of the Harbour Service Launch to escort larger vessels and the promulgation of advice through the Pleasure Users Guide should also assist in reducing the risks. In general it is considered that this hazard is adequately controlled by these measures.

5.1.27 No 65 - Grounding in vicinity of Warps / Oaze Area - general

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	3.5	4.4	7.0	7.0	7.0	5.406

A total of 7 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters. Radar Monitoring by Gravesend PCC further reduces this hazard. Current procedures and the use of one launch to serve three pilot stations (including Medway) results in congestion and additional risk caused by shipping and landing pilots to the west of the designated pilot position.

Additional measures which could be considered are as follows:-

- RCO 18 – Pilot Launch operations in the Warps Area
- RCO 19 – Warps Precautionary Area – Heightened Profile

5.1.28 No 89 - Collision with a vessel leaving or manoeuvring onto any berth in the river.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	5.9	7.0	4.4	4.4	5.398

A total of 5 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The risk control exists in the training and expertise of pilots and masters however VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. General Direction 8 requires vessel to inform VTS prior to navigation within port limits, although in practice VTS is often advised after the fact. Byelaw 36 requires vessels to sound one prolonged blast on the whistle before entering the fairway, although the Study Team noted that there is a reluctance to comply with this due to environmental impact.

In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)

5.1.29 No 176 - Collision in Erith Rands or Erith Reach

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	7.0	5.9	4.4	4.4	5.398

A total of 17 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters. TBNC monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)

5.1.30 No 10 - Collision involving VLCC in Warps area.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
2.4	5.9	2.4	4.4	5.9	5.9	5.9	5.9	5.393

A total of 6 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and bridge teams. Radar monitoring by Gravesend PCC, together with the radio reporting points marked on the charts combine to further reduce this hazard. In general, the number of vessels slowing and manoeuvring to ship and land pilots in the Warps / Oaze area has increased since the introduction of Pilotage Direction PD no.5 as this allows more vessels to transit the estuary without pilots. Current procedures and the use of one launch to serve three pilot stations (including Medway) can result in congestion and additional risk caused by vessels being served to the west of the charted pilot boarding positions; this could impede the progress of a VLCC or deep draught vessel at the narrowest point of the transit.

Additional measures which could be considered are as follows:-

- RCO 18 – Pilot Launch operations in the Warps Area
- RCO 19 – Warps Precautionary Area – Heightened Profile

5.1.31 No 41 - Personal Injury - Tug "girding" during manoeuvres to berth.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	5.9	0.0	0.0	7.0	7.0	2.4	5.9	5.365

A total of 5 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and tug skippers and in the maintenance of towing gear. Craft and Boat Registration and Regulation Byelaw (13) is designed to prevent unsuitable craft being used for towage operations.

Additional measures which could be considered are as follows:-

- RCO 26 - Towage Operator – Systems and Procedures
- RCO 27 – Critical Service Operations on the Thames

5.1.32 No 188 - Contact with any moored vessel / structure

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	5.9	7.0	5.9	0.0	5.9	5.365

A total of 10 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots, masters and tug skippers.

Additional measures which could be considered are as follows:-

- RCO 29 – Moored Passenger Vessels – Risk Assessment

5.1.33 No 2 - Collision involving a private leisure vessel (other than at locks).

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	5.9	0.0	3.5	7.0	4.4	2.4	4.4	5.331

A total of 6 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the education and expertise of master and small craft skippers. The PLA Pleasure Users Guide can assist in this area. The use of the Harbour Service launch to escort larger vessels is also a significant risk control measure. In general it is considered that this hazard is adequately controlled by these measures.

5.1.34 No 61 - Grounding - Outward bound deep draft vessels - departing Tilbury Lock and Northfleet Hope

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	5.9	4.4	7.0	4.4	5.9	5.331

Timing of deep draft (>10m) vessels leaving Northfleet Hope terminal and Tilbury can result in vessels 'chasing' the ebb down-river. The vessel must

maintain sufficient speed to avoid running out of water. There is insufficient water in the channel (at low water) to anchor such vessels between Tilbury and the Warps. Situation would be compounded if vessel suffers mechanical failure.

A total of 4 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots. Pilotage procedures include abort criteria / procedures although these are not formalised.

Additional measures which could be considered are as follows:-

- RCO 03 - Departure (Abort) Procedures – Deep Draft Vessels

5.1.35 No 144 - Contact with groynes off Diver Shoal

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	8.3	0.0	0.0	4.4	5.9	4.4	4.4	5.292

A total of 13 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in warning of the presence of the groynes by means of navigational marks (buoys and topmarks) and markings on charts and the PLA Pleasure Users Guide. In general it is considered that this hazard is adequately controlled by these measures.

5.1.36 No 130 - Contact with tanker alongside berths at Coryton / Canvey Island Terminal

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	3.5	4.4	7.0	5.9	5.9	5.272

A total of 11risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters and also in maintenance routines of vessel operators (steering gear, etc). General Directions require vessels to report defects and Permanent Notice to Mariners require vessels to maintain minimum distances off these jetties. Notice to Mariners No 27/2000 required vessels not to change their power configuration during port transit. As the risk assessment concluded, this notice to mariners was prudently incorporated into a revision of General Direction no.5.

Additional measures which could be considered are as follows:-

- RCO 24 - Use of Second Steering Gear during port Entry / Departure

5.1.37 No 234 - Collision involving VLCC (Black Deep and Knock John)

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
2.4	5.9	2.4	2.4	5.9	5.9	5.9	5.9	5.267

7 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the main risk control exists in the training and expertise of pilots and masters. The establishment of a precautionary area as per PLA Notice to Mariners 2000/59, which clarifies specific ETA reporting procedures, should also assist. Radar Monitoring by Gravesend PCC, together with the radio reporting points marked on the charts combine to further reduce this hazard.

Additional measures which could be considered are as follows:-

- RCO 11 – K1 and K2 Anchorages - Removal from chart

5.1.38 No 87 - Collision with a tanker getting under way or manoeuvring to berth at Coryton or Canvey Island.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
2.4	4.4	2.4	4.4	5.9	7.0	5.9	5.9	5.262

A total of 18 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The risk control exists in the training and expertise of pilots and masters however VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. The Tanker Manoeuvring Light and Escort Launch for VLCCs also significantly reduce the risks. In general, it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)

5.1.39 No 68 - Collision of Deep Draft vessel in SW part of Sunk Precautionary Area.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
2.4	5.9	4.4	2.4	5.9	5.9	4.9	4.9	5.259

This area is in international waters with limited VTS cover (Harwich keeps a radar watch and advises vessels bound for Harwich but does not 'control' the area).

A total of 5 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). In general, the main risk control exists in the training and expertise of pilots and masters.

Additional measures which could be considered are as follows:-

- RCO 20 – Common VHF Channel for the Sunk Area

5.1.40 No 44 - Contact with vessel anchored in Gravesend Lower or Higham Bight anchorages.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	3.5	5.9	7.0	4.4	4.4	5.179

A total of 12 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters and also in maintenance routines of vessel operators (steering gear, etc). General Directions require vessels to report defects. Notice to Mariners No 27/2000 required vessels not to change their power configuration during transit past structures or other vessels. As the risk assessment concluded, this notice to mariners was prudently incorporated into a revision of General Direction no.5.

Additional measures which could be considered are as follows:-

- RCO 24 - Use of Second Steering Gear during port Entry / Departure

5.1.41 No 60 - Collision between merging traffic from Nore Sand Swatchway & Sea Reach

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	0.0	7.0	5.9	4.4	4.4	5.179

A total of 7 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The main risk control is in the education and expertise of tug and small craft skippers. General Direction 14 which allows private leisure craft to navigate along the South side of the channel assists in reducing risk between small craft and commercial vessels. Additional measures which could be considered are as follows:-

- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)

5.1.42 No 75 - Grounding on Black Shelf (Grays)

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	3.5	2.4	7.0	5.9	5.9	5.147

A total of 9 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The risk control exists in the training and expertise of pilots and masters however VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. The lighted barge moored on the edge of the shelf also materially assists in marking navigable limits.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 05 – Establishment of Navigation Buoy off Broadness

5.1.43 No 90 - Contact with Wouldhams (GATX) Jetty or tanker alongside on jetty

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	0.0	5.9	7.0	5.9	5.9	5.147

A total of 9 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters and also in maintenance routines of vessel operators (steering gear, etc). General Directions require vessels to report defects.

Additional measures which could be considered are as follows:-

- RCO 24 - Use of Second Steering Gear during port Entry / Departure
- RCO 25 – Minimum distances of Petroleum Jetties

5.1.44 No 191 - Contact with West Thurrock Tanker Jetties (Van Ommeren) or vessel alongside.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	0.0	5.9	7.0	5.9	5.9	5.147

A total of 9 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters and also in maintenance routines of vessel operators (steering gear, etc). General Directions require

vessels to report defects and Permanent Notice to Mariners No 10 requires vessels to maintain minimum distances off gas tankers alongside.

Additional measures which could be considered are as follows:-

- RCO 24 - Use of Second Steering Gear during port Entry / Departure
- RCO 25 – Minimum distances of Petroleum Jetties

5.1.45 No 42 - Fire on Class V passenger vessel

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	5.9	0.0	3.5	5.9	5.9	1.8	5.9	5.146

Two risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The safety standards of these vessels are laid down in MCA regulations for Class V passenger vessels. From the PLA position, the principal risk control lies in it's emergency response procedures – see section 6.3.3. The London Fire and Rescue Service own fast multipurpose fire fighting vessels.

5.1.46 No 57 - Collision with a vessel getting under way from Southend, Great Nore, Leigh, Yantlet, Chapman or Thameshaven Anchorages.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
2.4	4.4	2.4	2.4	5.9	7.0	5.9	5.9	5.137

A total of 15 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The risk control exists in the training and expertise of pilots and masters however VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. In general, it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice
- RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)

5.1.47 No 122 - Personal Injury - Individual in water - requires rescue

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
9.4	0.0	0.0	0.0	7.0	0.0	0.0	0.0	5.129

Four risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the main risk control lies in

education of the general public. From the PLA position, the principal risk mitigation control lies in it's emergency response procedures. The addition of fast response craft and the introduction of a coastguard presence and RNLI stationed vessels, will assist in response times. The Fire and Rescue Service also own fast multipurpose vessels.

5.1.48 No 108 - Collision with private leisure vessels in way of marina locks and British Waterways Canal Entrances.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	7.0	5.9	0.0	4.4	5.121

A total of 6 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the education and expertise of master and small craft skippers. The PLA Pleasure Users Guide can assist in this area. The use of the Harbour Service launch to escort larger vessels (up to London Bridge) is also a significant risk control measure.

Additional measures which could be considered are as follows:-

- RCO 32 - Small Craft Locking Out- The current practice of St Katherine's and West India Dock Lock Keepers in calling TBNC when large numbers of small craft are locking out should be formalised.

5.1.49 No 240 - Collision between small bulker and Class V Passenger Vessel (Special Case)

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
4.4	4.4	0.0	4.4	7.0	7.0	2.4	5.9	5.084

A total of 22 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The main risk control exists in the training and expertise of pilots and masters however the special risk assessment introduced further measures which require a high standard of operation to be maintained on the bulk vessels, including ISM, D&A, Training, Additional Manning, Extra Nav Lights, and special procedures including separate PEC authorisation. In general, it is considered that this hazard is adequately controlled by these measures – see also section 6.3.3. Additional measures which could be considered are as follows:-

- RCO 27 – Critical Service Operations on the Thames

5.1.50 No 7 - Collision involving dredger (self-propelled).

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	5.9	5.9	4.4	4.4	5.063

A total of 20 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The main risk control exists in the training and expertise of pilots and masters however VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. In general, it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

- RCO 02 – Documentation of VTS Best Practice

5.1.51 No 29 - Contact with vessel anchored in Southend Anchorage (including the small ship anchorage).

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	0.0	5.9	7.0	5.9	4.4	5.054

A total of 11 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters and also in maintenance routines of vessel operators (steering gear, etc). General Directions require vessels to report defects.

Additional measures which could be considered are as follows:-

- RCO 10 – Southend Anchorage Positions
- RCO 24 - Use of Second Steering Gear during port Entry / Departure

5.1.52 No 201 - Fire on moored Restaurant Vessel (or vessel/structure used for office

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	5.9	0.0	3.5	5.9	5.9	0.0	4.9	4.964

Two risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Only the rooms available to the public are subject to Fire Brigade inspection. From the PLA position, the principal risk control lies in it's emergency response procedures – see section 6.3.3. The London Fire and Rescue Service own fast multipurpose fire fighting vessels.

5.1.53 No 48 - Contact with a vessel moored on Erith Tier or Erith Swing buoy, or anchored in Erith Anchorage

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	0.0	5.9	7.0	4.4	4.4	4.961

A total of 11 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters and also in maintenance routines of vessel operators (steering gear, etc). General Directions require vessels to report defects.

Additional measures which could be considered are as follows:-

- RCO 24 - Use of Second Steering Gear during port Entry / Departure

5.1.54 No 55 - Contact with Jetties, berths, during river passage (not berthing)

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	0.0	5.9	7.0	4.4	4.4	4.961

A total of 13 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the training and expertise of pilots and masters and also in maintenance routines of vessel operators (steering gear, etc). VTS radar monitoring can also significantly assist. General Directions require vessels to report defects. River works licenses require jetty and berth operators to maintain navigation marks / lights.

Additional measures which could be considered are as follows:-

- RCO 24 - Use of Second Steering Gear during port Entry / Departure

5.1.55 No 105 - Grounding at West end of Princes Channel

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	0.0	4.4	7.0	4.4	5.9	4.961

A total of 6 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the buoyage and the training and expertise of pilots and masters. VTS monitoring and communications also make a significant contribution, although not all of the 'best practice' is documented. In general it is considered that this hazard is adequately controlled by these measures.

Additional measures which could be considered are as follows:-

RCO 02 – Documentation of VTS Best Practice

5.1.56 No 187 - Contact with any jetty pier or pontoon where passengers are waiting / boarding or disembarking.

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
5.9	5.9	0.0	0.0	7.0	4.4	0.0	4.4	4.961

A total of 10 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The main risk control exists in the training and expertise of pilots and skippers\masters. General Directions and Byelaws assist in reducing the risks further. The Large Passenger Vessel (LPV) endorsement (for skippers of vessels over 40m or carrying more than 250 persons), currently a voluntary procedure, further assists. Crew competence is also to be set by PLA under craft registration rules.

Additional measures which could be considered are as follows:-

- RCO 16 – Large Passenger Vessel Endorsement - Formalisation
- RCO 27 – Critical Service Operations on the Thames

5.1.57 No 239 - Small bulk carrier contacts bridge (Special Case)

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	0.0	5.9	0.0	7.0	2.4	5.9	4.928

A total of 14risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The main risk control exists in the training and expertise of skippers (these vessels are less than 50m and therefore outwith compulsory pilotage criteria). There is a need for a high standard of operation to be maintained on these vessels and crew competence is to be set by PLA under craft registration Byelaws. In general, it is considered that this hazard is adequately controlled by these measures.

5.1.58 No 143 - Grounding - Vessel grounds across dredged box on berth. Unable to refloat before tide falls

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	4.4	4.4	0.0	5.9	4.9	4.9	4.863

A total of 4 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). The main risk control exists in the training and expertise of pilots and masters. Tidal information (real time)

promulgated by VTS would further assist to reduce these risks. In general, it is considered that this hazard is adequately controlled by these measures.

5.1.59 No 91 - Grounding - Deep draft vessel grounding on W end of Oaze bank or E end of Nore

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
0.0	5.9	2.4	2.4	1.8	5.9	5.9	5.9	4.861

A total of 6 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). Essentially, the risk control exists in the navigation aids, training and expertise of pilots and masters. Radar Monitoring by Gravesend PCC further reduces this hazard.

Additional measures which could be considered are as follows:-

- RCO 19 – Warps Precautionary Area – Heightened Profile

5.1.60 No 180 - Collision in Bugsby's or Blackwall Reach

The assessed risk for this hazard is as follows:-

Most Likely				Worst Credible				
People	Property	Environment	Business	People	Property	Environment	Business	Overall
3.5	5.9	0.0	3.5	5.9	4.9	1.8	4.9	4.861

A total of 16 risk control measures were identified which reduce the risk associated with this hazard (see Appendix D). However, the main risk control exists in the training and expertise of Pilots, Masters and boat skippers. The use of the Harbour Service Launch to escort larger vessels and the promulgation of advice through the Pleasure Users Guide should also assist in reducing the risks. In general it is considered that this hazard is adequately controlled by these measures.

5.2 OTHER HAZARDS FOR SPECIAL CONSIDERATION

The following additional hazards do not come within the top sixty, however the Study Team considered that these merit attention and further review in the light of incident and near miss statistics:

5.2.1 No 208 - Loss of Hull Integrity in Restaurant Vessel (or vessel / structure used for office accommodation) – Ranked 61st

In the worst case this could required the evacuation of large numbers of people and may require waterborne response by PLA and other SAR resources already available or being introduced – see section 6.3.3. This hazard would also be addressed by RCO 29 – Moored Passenger Vessels – Risk Assessment.

5.2.2 No 73 - Grounding, off Jenningtree Point, Erith Reach – Ranked 69th

There were several references given by pilots to the Study Team with regard to vessels touching the bottom off this point, supported by incidents recorded in PLACID. This hazard would benefit from the establishment of a navigational buoy - see RCO 07 – Establishment of Navigation Buoy off Jenningtree Point.

5.2.3 No 125 - Contact (over-run) inside berth Tilbury Grain Terminal – Ranked 70th

This hazard needs to be kept under review. The difficult approach to the inside berth has been made more so by the extension of the Tilbury Container terminal

5.2.4 No 151 - Contact with Sunk Head Light Tower Remains – Ranked 72nd

This hazard is considered adequately covered by the existing risk control, however the worst-case scenario could be realised if the buoy marking the tower moved out of position. The tower lies outside PLA jurisdiction.

5.2.5 No 62 - Personal Injury - Pilot injured / killed (dis)embarking – Ranked 73rd

This hazard scored high in the most likely life scenario. It should be adequately covered by adherence to the Code of Practice for Pilot Boats and the normal working practices of pilots

5.2.6 No 138 - Personal Injury to passengers waiting / embarking from pontoons and piers – Ranked 75th

This hazard scored high in the most likely life scenarios. It would be improved by RCO 16 – Large Passenger Vessel Endorsement - Formalisation and RCO 27 – Critical Service Operations on the Thames.

5.2.7 No 54 - Contact with ship moorings or ship/barge on moorings – Ranked 76th

Many moorings are in close proximity to the channel. Some are near the outside of bends. The majority are unlit.

5.2.8 No 133 & 134 - Mooring breakout – Ranked 74th and 77th

This is currently considered adequately controlled by the 'safe speed' requirements in the Port of London Act, River Byelaws and Permanent Notices to Mariners. However it is considered that greater emphasis could be placed on this in the Port Control manual.

5.2.9 No 92 - Grounding on either side of Knock John channel (between Knock John No1 and Knock John No7) – Ranked 78th

This needs to be kept under review due to the worst-case scenario where the deep draft channel could be severely obstructed.

5.2.10 No 111 - Contact with "Hawksdale" wreck – Ranked 79th

This needs to be kept under review due to the changing nature of the channel

5.2.11 No 228 - Collision - Warps pilot station (North of Oaze Bank) – Ranked 81st

This hazard would benefit from RCO 18 – Pilot Launch operations in the Warps Area and RCO 19 – Warps Precautionary Area – Heightened Profile.

5.2.12 No 76 - Grounding – Off Broadness and Stoneness Points – Ranked 83rd

Inbound vessels tend to steer wide off Stoneness and outbound vessels tend to steer wide off Broadness because the shoal water is not marked. This can result in on-coming vessels being pushed toward the opposite side of the channel. This is particularly serious off Broadness where the channel width is narrower and the tide sets onto the opposite bank, which is also very hard in nature.

This hazard would benefit from RCO 05 – Establishment of Navigation Buoy off Broadness and RCO 06 – Establishment of Navigation Buoy off Stoneness

5.2.13 No 145 - Wash - Vessel damaged by wash from passing traffic – Ranked 84th

This is currently considered adequately controlled by the 'safe speed' requirements in the Port of London Act (see section 108), River Byelaws and Permanent Notices to Mariners. However it is considered that greater emphasis could be placed on monitoring / warning vessels in the Port Control manual – see section 6.3.1.

5.2.14 No 135 - Personal Injury / fatality to personnel working on civil engineering work near the waterline – Ranked 85th

This is currently considered adequately controlled by the 'safe speed' requirements in the Byelaws and Permanent Notices to Mariners, and also the duty to navigate with due care (section 108 of the Port of London Act). However it is considered that greater emphasis could be placed on monitoring / warning vessels in the Port Control manual - see section 6.3.1.

5.2.15 No 95 - Grounding in vicinity of Warps / Oaze Area – general – Ranked 93rd

This hazard would benefit from RCO 18 – Pilot Launch operations in the Warps Area and RCO 19 – Warps Precautionary Area – Heightened Profile.

5.2.16 No 86 - Grounding - Deep draft vessel outside Yantlet Channel – Ranked 95th

This needs to be kept under review due to the worst-case scenario where the deep draft channel could be severely obstructed.

5.2.17 No 16 - Collision involving passenger ship in the Estuary – Ranked 99th

This needs to be kept under review due to the worst-case scenario, which could require a major evacuation operation offshore.

5.2.18 No 162 - Collision at Eastern end of Princes Channel – Ranked 104th

This hazard needs to be kept under review due to the possibility of extension of the bank.

5.2.19 No 30 - Contact - Vessel anchored in Knob DW anchorage (K1, K2) – Ranked 126th

This hazard was scored low due to the extremely rare usage of this anchorage but would benefit from RCO 11 – K1 and K2 Anchorages - Removal.

5.2.20 No 81 - Contact with Thames barrier, caused by vessel turning onto or off adjacent berths – Ranked 135th

This hazard scores high in the worst credible property scenario and needs to be kept under review.

5.2.21 No 110 - Grounding at SE entrance to N Edinburgh Channel – Ranked 148th

This hazard needs to be kept under review due to the changing nature of the channel.

5.2.22 No 52 - Contact with Thames Barrier (barrier in defence) – Ranked 155th

This hazard is considered satisfactorily covered by existing risk control measures but needs to be kept under review due to the high potential consequences.

5.2.23 No 227 - Collision with vessel manoeuvring to berth or unberth at Purfleet, Van Ommeren or Wouldhams (GATX) jetty – Ranked 171st

This hazard would benefit from RCO 02 – Documentation of VTS Best Practice and RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36).

5.2.24 No 38 - Contact with a vessel anchored in Thameshaven anchorage – Ranked 184th

The anchorage is not used. This hazard would benefit from RCO 09 – Thameshaven Anchorage - Removal of the anchorage from the charts.

5.2.25 No 215 - Pollution - Oil / Chemical overflow during loading (Tanker Loading or Discharge Operations) – Ranked 203rd

This scored moderately highly in environmental categories and should be kept under review. It is currently controlled by periodic inspections of petroleum jetties and their procedures.

5.2.26 No 216 - Pollution - Oil Spill during bunkering operations (from dedicated bunker barge) – Ranked 204th

This scored moderately highly in environmental categories and there were reports of a persisting number of small operational spills occurring during bunkering. Permanent Notice to Mariners P7 does provide clear guidance for bunkering operations, however they do not make requirements for monitoring attendance by personnel, regular testing of fuel supply hoses or recommend that the bunker supplier themselves maintain bunkering procedures and have systems of audit in place. Nor do they provide any specific guidance (VTS or for the movement of bunker barges.

Additional measures which could be considered are:

RCO 13 – Bunker Operators – Safety and Anti-Pollution Systems

RCO 14 – Bunker Barge Safety and Anti-Pollution Criteria.

5.2.27 No 213 - Pollution - Bilge Water Discharge – Ranked 209th

This scored moderately highly in environmental categories and there are database reports of some unidentified oil discharges appearing on the estuary. Risk control for this hazard is currently limited to deterrent (fines). Although it is normal requirements for discharge valves to be closed in port, there are very few random inspections carried out to influence the probability of a spill occurring in the first place. Additional measures which could be considered are:

RCO 15 – Oily Water Separators and Bilge Systems.

5.2.28 No 8 - Collision involving High Speed Craft on river – Ranked 217th

Currently scored as only moderate due to the absence of non-displacement craft operating on the river. This hazard requires review (special risk assessment) if a high-speed service is mooted – see also section 6.3.3.

5.2.29 No 214 - Pollution - Oil Spill during bunkering operations (from shore, including from road tankers on quay) – Ranked 221st

This scored moderately highly in environmental categories. Additional measures which could be considered include:

RCO 13 – Bunker Operators – Safety and Anti-Pollution Systems.

5.2.30 No 212 - Pollution - Oil / Chemical discharge through Sea Valves / Overboard valves (Tanker Systems) – Ranked 228th

This scored moderately highly in environmental categories and should be kept under review. It is currently controlled by periodic inspections of petroleum jetties and their procedures.

6 RISK CONTROL MEASURES

6.1 PROPOSED RISK CONTROL MEASURES

6.1.1 RCO 01 – Enhancement to Port Control Manual

It is recommended that consideration should be given to adding specific instructions in the Port Control Manual to exercise particular vigilance in monitoring (and, if appropriate, communicating with) vessels which are seen to be meeting between Stoneness and Broadness.

This addresses hazard No 174.

6.1.2 RCO 02 – Documentation of VTS Best Practice

It is recommended that consideration should be given to documentation of VTS 'Best Practices' with regard to communication and vessel position monitoring, particularly with regard to vessels getting under way and vessels approaching those getting under way, and also communications at the VHF changeover points in Sea Reach and Crayfordness.

This addresses hazard Nos 5, 7, 57, 63, 75, 87, 89, 105, 115, 161, 170, 171, 173, 176, and many others.

6.1.3 RCO 03 - Departure (Abort) Procedures – Deep Draft Vessels

It is recommended that consideration should be given to the documentation of an approved criteria and procedures for deep(er) draft vessels leaving berths up-river, where there is possibility of the vessel having inadequate underkeel clearance or grounding on an ebb tide departure. This particularly applies to deep draft vessels leaving Tilbury after high water.

This addresses hazard No 61.

6.1.4 RCO 04 – Berth Exchange (Abort) Procedure – Deep Draft – Tate & Lyle

It is recommended that consideration should be given to formal documentation of the berth exchange abort procedure where vessel departing Tate and Lyle berth is delayed.

This addresses hazard No 136.

6.1.5 RCO 05 – Establishment of Navigation Buoy off Broadness

It is recommended that consideration should be given to establishing a lighted navigational buoy to mark the 3.7 metre patch to the NE of Broadness Point. By defining the southern edge of the channel, vessels outward bound will not be forced to give excessive clearance to the point and thereby restrict the channel width for vessels inbound passing along the north (Grays) shore.

This addresses hazard Nos 75 and 76.

6.1.6 RCO 06 – Establishment of Navigation Buoy off Stoneness

It is recommended that consideration should be given to establishing a lighted navigational buoy to mark the southern extent of the 5 metre contour off Stoneness Point. By defining the northern edge of the channel, vessels inward bound will not be forced to give excessive clearance to the point and thereby restrict the channel width for vessels outbound.

This addresses hazard No 76.

6.1.7 RCO 07 – Establishment of Navigation Buoy off Jenningtree Point

It is recommended that consideration should be given to establishing a lighted navigational buoy to mark the north-eastern extent of the 5 metre contour off Jenningtree Point.

This addresses hazard No 73.

6.1.8 RCO 08 – Gravesend Upper Anchorage - Removal

This RCO recommended that consideration be given to the removal of Gravesend Upper Anchorage from charts. The anchorage was exposed to vessels overshooting the turn when proceeding downstream and was no longer used. This RCO was implemented during the progress of the risk assessment.

This addresses hazard No 115.

6.1.9 RCO 09 – Thameshaven Anchorage - Removal

It is recommended that consideration should be given to the removal of Thameshaven Anchorage from charts. The anchorage is close to both the main channel and to the berths. This anchorage is no longer used and the notation on the chart could encourage its use by pilot exempt vessels.

This addresses hazard No 170.

6.1.10 RCO 10 – Southend Anchorage Positions

It is recommended that guidance should be issued to vessels to avoid unnecessary use of the anchorage positions abreast of Sea Reach 1 to Sea Reach 2. These are in the 'overshoot' zone of the approach to Sea Reach 1 from the W Oaze, and whilst their use does not pose a major risk, vessels should be recommended to use other positions if available. The same principle can be extended to other anchorages.

This addresses hazard No 29.

6.1.11 RCO 11 – K1 and K2 Anchorages - Removal

It is recommended that consideration should be given to the removal of K1 and K2 Anchorages from charts. The anchorages lie on the deep-water route and are

not used. It is considered that the notation on the chart could encourage its use by pilot exempt vessels.

This addresses hazard Nos 30 and 234.

6.1.12 RCO 12 – Bunker Barges operating on the Thames – Protective Location

It is recommended that consideration should be given to implementing a policy for the *progressive* phase-out of bunker barges which do not incorporate some form of protective location for their cargo in the sense of double hulled or full-length side ballast tanks.

This addresses hazard Nos 23.

6.1.13 RCO 13 – Bunker Operators – Safety and Anti-Pollution Systems

It is recommended that consideration should be given to requiring Bunker Operators to produce evidence of adequate systems to ensure satisfactory safety and pollution standards, including procedures and checklists, and incident investigation procedures with appropriate follow-up

This addresses hazard No 214 and 216.

6.1.14 RCO 14 – Bunker Barge Safety and Anti-Pollution Criteria

It is recommended that consideration should be given to the Port of London Authority producing minimum safety criteria for the movement of bunker barges and interaction with other vessels within the Authority's jurisdiction.

This addresses hazard No 216.

6.1.15 RCO 15 – Oily Water Separators and Bilge Systems

On the basis of the continuing importance of environmental issues in the public viewpoint, it is recommended that consideration should be given to enhancing methods that prompt masters to confirm that they have isolated oily water separator and bilge overboard discharge valves, to prevent accidental discharge in port. Any random or routine visits made to vessels could also include the seeking of such confirmation. It could also be achieved by being part of the information requirements to be provided by inbound vessels.

This addresses hazard No 213.

6.1.16 RCO 16 – Large Passenger Vessel Endorsement - Formalisation

It is recommended that the current arrangement with Watermens' Hall, in which passenger vessels of over 40 metres in length or carrying more than 250 persons are subject to enhanced competency requirements, should be formalised into Byelaws.

This addresses hazard Nos 4, 138, 183, 184 and 187

6.1.17 RCO 17 – Working 'Slacks' – Elimination of Practice

It is recommended that consideration should be given to discontinuing the practice of 'working slacks' on the river. This practice results in vessels crossing the channel unnecessarily and thereby creating additional close-quarters situations with other vessels.

This addresses hazard No 184.

6.1.18 RCO 18 – Pilot Launch operations in the Warps Area

The current single launch on station cannot cover the distance between the three pilot boarding positions it has to serve. To avoid delays, vessels are served well to the west of the designated points. This results in congestion in the Sea Reach / Medway approach with consequent risk of collision and grounding.

It is therefore recommended that consideration should be given reviewing pilot boarding and landing procedures in the Warps and Oaze areas so as to minimise risk.

This addresses hazard Nos 10, 65, 85, 95, 117 and 228.

6.1.19 RCO 19 – Warps Precautionary Area – Heightened Profile

It is recommended that consideration should be given to enhancing the current "restricted" area on the BA charts to show a "precautionary" area, drawing attention to possible high traffic density, crossing traffic from various directions and vessels shipping and landing pilots, in addition to the (present) remarks concerning deep draft vessels and the restriction on anchoring

This addresses hazard Nos 10, 65, 91, 85, 95, 117 and 228.

6.1.20 RCO 20 – Common VHF Channel for the Sunk Area

The area is beyond the jurisdiction of the Port of London Authority. The Authority has previously held discussions with Harwich Haven Authority and Medway concerning safety in this area. It is recommended that the authorities should continue to work together to implement a single VHF channel for traffic information service in the Sunk Precautionary Area.

It is also recommended that the Port of London Authority work with the neighbouring authorities towards sharing VTS tagging information to improve communication flow and reduce VTS operator workload.

This addresses hazard Nos 64, 68 and 94.

6.1.21 RCO 21 – Traffic Routing for the Sunk Area

The area is beyond the jurisdiction of the Port of London Authority. Previous joint discussions relating to establishing a routing system in the Sunk Precautionary Area have met with practical obstacles (i.e. the cure could be

worse than the problem). It is however recommend that the Port of London Authority should work together with Harwich Haven Authority and Medway to keep under review the traffic situation and the possibility of establishing a form of traffic routing in the Sunk Precautionary Area.

This addresses hazard Nos 64, 68 and 94.

6.1.22 RCO 22 – Signals for Vessels Departing from Tilbury Lock

It is suggested that consideration should be given to the installation of a visual signal on the bank opposite the entrance to Tilbury Lock. The signal would exhibit green towards the lock entrance and a shielded red upstream and downstream. It could be activated by Gravesend PCC when the pilot requests permission to lift away from the dock.

It is further suggested that encouragement should be given to the application of Byelaw 36 (Sound signals) in the case of vessels departing the Lock.

This addresses hazard Nos 88 and 173.

6.1.23 RCO 23 – Sound Signals for Vessels Entering Fairways (Byelaw 36)

It is recommended that encouragement should be given to the application of Byelaw 36 (Sound signals for vessels entering fairways from berths, anchorages, etc).

This addresses hazard Nos 4, 5, 21, 57, 60, 87, 89, 115, 171, 173, 176, 183 and 227.

6.1.24 RCO 24 - Use of Second Steering Gear during port Entry / Departure

It is recommended that consideration should be given to updating Notice to Mariners No 27/2000 to require vessels to operate both steering gear (where fitted) during port entry / departure. This forms a natural partner to the requirement not to change the power configuration during transit. It is further recommended that this measure should be transferred into the General Directions.

This addresses hazard No 29, 48, 44, 55, 90, 130, 191, and most ‘contact’ hazards.

6.1.25 RCO 25 – Minimum distances of Petroleum Jetties

It is recommended that Permanent Notice to mariners Nos 9 (minimum distance of 60 m off petroleum jetties between Canvey Island and Thameshaven)) should be extended to all petroleum jetties.

This addresses hazard No 90, 123 and 191.

6.1.26 RCO 26 - Towage Operator – Systems and Procedures

It is recommended that the PLA takes steps to assure itself that Towage Operator(s) have in place adequate systems to ensure satisfactory training standards and incident investigation procedures with appropriate follow-up systems.

This addresses hazard No 21 and 41.

6.1.27 RCO 27 – Critical Service Operations on the Thames

It is recommended that the PLA takes steps to assure itself that the operators of safety critical services, including passenger vessels, bunker barges and tugs have in place adequate systems for controlling drugs and alcohol consumption, and for measuring and controlling crew hours of work to ensure crews are adequately rested.

This addresses hazard Nos.4, 5, 23, 41, 72, 138, 187 and 240 and many others.

6.1.28 RCO 28 – Container Stacks at Tilburyness - Removal

It is suggested that consideration should be given to the container stacks which currently obscure the view of the lock entrance from Gravesend Reach (and vice versa) being removed or substantially reduced in height, to allow departing vessels and vessels bound in from sea to see that Northfleet Hope is clear before proceeding.

This addresses hazard Nos 88 and 173

6.1.29 RCO 29 – Moored Passenger Vessels – Risk Assessment

It is recommended that consideration should be given to requiring the operators of moored passenger vessels (particularly those in vulnerable positions such as the outsides of bends) to undertake special survivability risk assessments in the event of a range of likely impacts.

This addresses hazard No 188.

6.1.30 RCO 30 – Third Party Insurance - Compulsory

It is recommended that consideration should be given to requesting proof of Third Party Insurance (£5m?) for vessels of more than 20(?) tonnes displacement, navigating above Tower Bridge.

This addresses hazard No 186.

6.1.31 RCO 31 – Education of Leisure Users

It is recommended that consideration should be given to the production of a leaflet aimed specifically at hire (especially canal) boat users. Alternatively, the current PLA Pleasure Users Guide could be enhanced to bring together the more important safety advice (Steering and sailing rules, sound signals, and

correct use of arches). It is further recommended that advice on the safety issues relating to the misuse of drugs and alcohol should also be incorporated.

This addresses hazard No 183.

6.1.32 RCO 32 - Small Craft Locking Out

It is recommended that consideration should be given to formalising the current practice whereby St Katherine's and West India Dock Lock Keepers call TBNC when large numbers of small craft are locking out.

This addresses hazard No 108.

6.2 OPERATIONAL RISK ASSESSMENT – GENERAL RECOMMENDATIONS

There are a number of general observations and recommendations that have resulted from the risk assessment, which are listed below:-

6.2.1 VTS Radio Procedures

The VTS study and the Navigational Risk Assessment both identified a need to improve VHF radio procedures. Many pilots and VTS personnel also shared this view. The use of Message Markers and the avoidance of colloquialisms and informality on the radio not only improves effectiveness of communication but also engenders professional respect for the Port of London Authority from navigational users of the Thames.

It is recommended that all navigation communications regarding navigation and especially collision avoidance should be on the appropriate port working frequencies. This is already stated in the various PLA Manuals and Notice to Mariners but requires more emphasis. Vessel / Tug operations should be on dedicated frequencies.

It is recommended that the appropriate port control VHF channel to monitor should be advised to small craft entering the Thames by means of notices posted at Locks, Marina exits, Slipways, etc.

6.2.2 Review of Tug Operations

It was reported that if vessel enters the port in deteriorating visibility, tug operators policy is not to make fast (understood to be resulting from a girding incident some time ago). This policy could compromise safety of a vessel which may then have to turn in the river and return to anchorage. It is recommended that this policy be reviewed with tug operators and a system developed which adequately addresses the safety requirements of both vessels and tugs.

6.2.3 Review of Anchorages

A number of hazards identified record potential problems surrounding anchorages. Marked Anchorages exist which have fallen into disuse and some that are in use require review of location or extents/limits.

It is therefore recommended that a general review of anchorage locations/utility be an objective of the first year safety management system plan. The review should be undertaken to ensure that they are still appropriate to current needs. In the case of the anchorage circles, it is recommended that the use of these should be changed such that they are used by VTS to assist the mariner in identifying a recommended position within the anchorage, rather than absolute boundaries.

6.2.4 VTS – Movement Commencement Control

It is recommended that the profile of VTS should be enhanced by a policy whereby the commencement of a movement is authorised by VTS who will then

support the movement through to its completion. This will mean minor changes to the wording of Byelaws and General Directions, for example in GD8:

> "(3) The master of a reporting vessel, berthed or anchored within port limits must *inform* the appropriate PLA VTS Centre ...etc"
>
> to
>
> "(3) The master of a reporting vessel, berthed or anchored within port limits must *request permission to proceed* from the appropriate PLA VTS Centre ...etc"

As in most UK ports, the importance of VTS in controlling risk from vessel movements is rising as this technology is coming of age. This is turn has driven a need for VTS training to reflect the greatly enhanced role. During the course of the study, the Authority prudently commenced a process of formal VTS Officer 'Authorisation', using similar arrangements to those used for pilot Authorisation, in conjunction with training to IALA standards. This will enhance the professional status of the VTS Officers.

6.2.5 Mutual Knowledge and Information Sharing

Pilots spend time in the Port Control Centre when required to carry out the role of Duty Port Controller; which gives them in-depth understanding of the operation from the VTS point of view. A policy for VTSOs and DOs to trip on vessels to gain an understanding of the operation from the Pilot / PEC Holders perspective has been in place for many years. It was reported to the Study Team that this has recently tailed off, for a number of practical operational reasons.

The value of this exchange is significant and we therefore recommended policy be introduced to record the tripping frequency and maintain it as an equal priority to other operational demands. This already includes VTSOs and DOs, although we also recommend the opportunity be extended to Tug Masters and PEC holders. Pilots under training already trip on tugs, but a system of continuous professional development should also include occasional tug trips for trained pilots and PECs. It may also be beneficial for tug masters to be given the opportunity to sit in on a VTS watch.

6.2.6 Medway Pilotage Operations

It is recommended that PLA should seek the means for Gravesend PCC to check the validity of a vessel offering a Medway Pilotage Exemption for transit of the PLA jurisdiction within the Estuary.

It was reported that Gravesend PCC is not aware of scheduling of vessels for the Medway Ports. Although we recognise that ongoing discussions occur with Medway Port Authority, it is recommended that a channel of communication be sought to give Gravesend PCC advance notice of scheduled arrivals and departures together with any pertinent details (e.g. deep draft).

The responsibilities for investigation of incidents involving Medway Pilots or Medway PEC Holders within the PLA jurisdiction remains unclear. Ongoing efforts to resolve this with Medway are prudent and endorsed by the risk assessment. It is recommended that the PLA be represented if investigations are carried out by Medway Port Authority within PLA harbour limits and in any event, PLA should be provided with a copy of the final report.

6.2.7 PLA Publications

There are many documents which are used for the promulgation of navigation and safety information including General Directions, Byelaws, Notices to Mariners, Permanent Notices to Mariners, Pilotage memos, "Lessons Learned", etc. The type of information contained in these documents is often similar in nature. The Study Team found the personnel generally knew requirements but commonly had difficulty in referencing the correct source documents. There was however, more than one occasion where outdated information was quoted verbally to the study team. This may indicate a possible problem with the information archiving system. PLA has a number of different document types; resulting in numerous locations where information of a specific type may be found.

It is therefore recommended that as part of the introduction of the safety management system documentation, especially that in the public domain, be rationalised to allow easier access to pertinent information.

6.2.8 Best Practice and Development of Procedures

Much valuable information, custom and practice and procedures resides (only?) in the collective memory of PLA marine staff. Our experience in many ports has shown that where this is the case, some individuals have significant 'voids' in their knowledge, whereas others will have developed much better ways of discharging a task or movement, which may only be shared with close colleagues or not at all It is therefore recommended that safety of navigation 'best practice' should be documented and that ownership of this be given to relevant PLA marine staff.

Formal Pilotage procedures and VTS procedures will form an essential part of the Safety Management System required under the Port Marine Safety Code.

This would include, inter alia, guidance on the allocation of anchorages, communications with vessels approaching one another, and areas where enhanced VTS monitoring of traffic is required (e.g. Warps, Northfleet Hope, etc).

6.2.9 Management of Changes to Hazards

Changes in trade patterns, vessels types, topography are inevitable over a period of time. Such changes should be subject to thorough review and, if necessary risk assessment in order to establish whether current risk controls are adequate and whether additional risk controls are required.

Following implementation of new procedures and processes, the hazards and risk control should be kept under short term review until confidence is developed in risk levels and mitigation effectiveness. Examples to which this review process should be applied are project cargoes (temporarily increasing trade to a particular wharf) and the opening of Fisherman's Gat channel (see Hazard No 229 (5.1.21)).

6.2.10 Liaison with Leisure Activities Clubs and Associations

It is recommended that PLA should operate a policy of proactive liaison with Leisure Activity Clubs (yacht clubs, rowing clubs, etc) to facilitate and monitor the effective flow of information for safety of navigation on the Thames to these user groups. This could typically take the form of standard presentations to local clubs and associations.

6.3 OBSERVATIONS

6.3.1 VTS Speed Monitoring - Wash

The PLA already has a policy to limit speed below Wandsworth Bridge commensurate with wash generation. A speed of 10 knots through the water is considered a reasonable maximum for the purposes of limiting wash and interaction. The VTS radar speed alarm is generally set to 12 knots over the ground to account for tidal flow. It follows that a vessel proceeding against the tide could make 14 knots before triggering the alarm, at which speed significant wash can be created. VTS operators are aware of this VTS technology limitation, but it does result in a need to focus on vessels proceeding against the tide.

6.3.2 Small Passenger Vessels

The importance of Class V passenger operations on upper reaches of the Thames is significant, and capacity has risen significantly in the last three years (ref: data analysis from the PLA/MCA Search and Rescue (SAR) report). The risks associated with collision involving small passenger vessels is difficulty to properly establish due to the wide variance of vessels of this type on the river. It is clear however that the risk of capsize resulting from collision with a larger vessel is very real. The potential loss of life will be dramatically mitigated by rapid emergency response.

6.3.3 Search and Rescue

The introduction of a Search and Rescue cell at TBNC and new technology (e.g. UAIS) will ultimately deliver a vital source of information for emergency services, which together with the provision of a rapid marine emergency SAR response service is part of a total package of risk control that is breaking new ground in the ports industry. Of further benefit to the Thames will be the agreed introduction of dedicated RNLI resources.

7 NAVIGATIONAL SAFETY MANAGEMENT SYSTEM – COMPONENTS

7.1 INTRODUCTION

Under the Port Marine Safety Code, a formal safety management system needs to be introduced to manage the Safety of Navigation on the Thames. This is designed following the findings of the risk assessment. The core information is retained in the hazards list, which has been developed by this project as the starting point. With time and experience, and as the system evolves new hazards may be developed and existing ones modified. Thus the risk control needed within a Navigational SMS will also continually develop to maintain an influence on vessel owners, operators, managers and masters using the port to maintain a system that operates with the ALARP region.

In the case of PLA, there are already a number of proactive systems managing safety. The introduction of a Navigational Safety Management System (SMS) will therefore comprise pulling together existing systems and the review of areas already identified as requiring attention. The Port Marine Safety Code requires a designated person to be in place to monitor the effectiveness of the SMS and report any problems directly to the PLA Board. The position within the PLA which will incorporate the role of designated person has already been debated by the PLA board and determined.

A Safety Management System basically comprises the Following Components:

- Policy
- Responsibility
- Safety Control Mechanisms (Procedural or Hardware)
- Annual Planning (training)
- Audit and Review

It is designed to be a process of continual improvement that allows best practices to evolve and be shared by the organisation. For ports, it needs to demonstrate compliance with the PMSC guidelines for: Procedures; Ongoing risk assessment; Emergency Response; Incident Reporting; Organisation; Auditing and Performance Monitoring.

Safety Policy can be set at high and low levels in the PLA organisation. Policy can be set in functional areas, such as VTS and Pilotage, and it can be set in geographical areas of the Port where a particular hazard may exist. Safety is managed by agreed systems (or procedures) designed to deliver policy. Procedures should also provide agreement of working practices in areas of relatively high risk as identified by the risk assessment. PLA already possesses Harbourmaster's and VTS procedures, although Pilotage procedures need to be developed. Responsibility for each area of safety needs to be formally recorded.

The SMS system therefore requires formal links between PLA board level and the operational interfaces, allowing both parties to have clarity over what is required and who is responsible for each area of risk control, thus allowing one end of the organisation to support the other.

7.2 THE NAVIGATIONAL SMS DESIGN

Functionally the PLA Navigational SMS can be organised into documented areas:

- Navigational SMS Manual
- Standards
- Operations
- Review

7.2.1 Navigational SMS Manual

This should have the following sections:

- Policies and policy setting
- Responsibilities
- Performance indicators
- Procedural areas covered
- Review and Audit Systems Employed

PLA has already decided to introduce PLASMA to manage the systems of Audit and review. This computer-based system allows hazards identified and risk levels to be systematically reviewed, along with the barriers in place mitigating risk.

7.2.2 Standards

This section will bring together all of the documentation that sets the standards of navigation in the port:

- Port of London Act
- Byelaws
- General Directions
- Pilotage Directions
- Notices to Mariners
- Towage Criteria
- Pilotage and VTS Authorisation Criteria
- Etc

7.2.3 Operations

This section will bring together documentation controlling the way in which operations are discharged.

- Pilotage Procedures
- VTS Procedures

- Harbour Masters' Procedures
- Harbour Service Procedures
- Hydrographic Manual
- Marine Services Operations Manual

7.2.4 Review

This section will record the safety status as reported in six monthly intervals to the PLA Board and set objectives to address any safety recommendations arising from the operation of the SMS.

This part of the SMS would also include forward-looking plans, thus providing for status to be reviewed accordingly. Objectives can thus be kept achievable.

7.3 POLICY AREAS

As policy is fundamental to a successful SMS, guidance is offered in the following section.

7.3.1 Board

The PLA board has already discussed and confirmed it's high level navigational safety policy. However, it is prudent to also set policies in key areas of PLA functions, namely: Pilotage, VTS, Hydrographic and Enforcement. These policies have also been approved, and will be recorded in the SMS Manual. They should also be reflected and interpreted in more detail in procedural manuals.

7.3.2 VTS Policies

The introduction of VTS policies will provide high-level organisational underpinning (The Board), and support VTS operatives in discharging the VTS function. VTS policies need to be reflected further developed in general areas underpinning operative's competence. Some of these are already implicit PLA policies, such as:

- Training
- Authorisation
- Working Hours
- Use of VTS – Proactivity

At a more detailed level, policies for enhanced monitoring are also already in place. However, these need to be integrated and extended in areas such as:

- Special Areas (e.g. Warps, Tilbury Entrance, etc,)
- Vessels getting under way from berths, anchorages, etc
- Vessels passing Oil Terminals
- Vessels meeting at Broadness

7.3.3 Pilotage Policies

As with the VTS, Pilotage Policies need to be reflected and further developed in accordance with existing pilot authorisation and training systems. For example:

- Training
- Authorisation
- Working Hours
- Ownership of Best Practice
- Navigational Interfacing

8 CONCLUSIONS

8.1 RISK ASSESSMENT

Our review of the hazards identified during the operational risk assessment carried out at Port of London between October 1999 and February 2001 indicates that the principal risks to the Safety of Navigation exist in four main areas:

- Sunk Precautionary Area
- Warps Restricted Area
- Northfleet Hope and Broadness areas
- Upper Thames (particularly in relation to Class V Passenger vessels)

In each of the above, the principal risks relate to the frequency and consequence of collision and safety of life in the consequences. Pollution was also represented; it was considered that one of the highest pollution risks stemmed from the threat of breach of a large bunker fuel oil tank in the side of a large container ship or a cargo tank of a VLCC or Black Oil tanker.

It should be appreciated that the main causational factors for marine incidents throughout the area of the study are much more likely to be due to mechanical failure of the vessel, its equipment or crew error (i.e. generic hazards), rather than the any of the hazards, specific to the Port of London, identified in this risk assessment. In this respect, although additional risk control has been recommended, it is concluded that much of the influence by PLA as the port navigational regulator is well placed to keep navigational operations in the As Low As Reasonably Practicable (ALARP) region.

8.1.1 Hazard Summary:

The top ten hazards ranked in individual consequence categories as posing "Significant Risk" (showing a Risk Matrix rating of 7, 8 or 9) are presented in the table below. It should be noted that in many cases the hazards are scoring highly due to significant property damage if the risk is realised. Even in the top 10 hazards, the risk of injury remains low except where indicated in the "Life" category.

Ref.	Description	Relative Risk No.	Most Likely Risk				Worst credible Risk			
			Life	Prop	Env	Port	Life	Prop	Env	Port
88	Collision with a vessel leaving or manoeuvring to enter Tilbury Lock. This can be a very busy area, particularly on the top of the tide.	6.70	6	8	0	8	6	7	4	6
186	Commercial vessel contacts any bridge between London Bridge and Richmond. Some bridges are particularly vulnerable to contact.	6.02	0	9	0	0	6	7	2	6
51	Thames Barrier (normal navigation - barrier open). The difficulties associated with navigating through the barrier are increased if one or more span is closed.	5.81	0	8	0	0	6	7	4	6
205	Fire / Explosion in a small craft / houseboat. Most small vessels and houseboats are equipped with LPG ranges for cooking. Gas can accumulate in bilges until ignited by a sources ignition.	5.75	8	8	0	0	7	4	0	2
184	Collision between Putney and Richmond. This is a busy area with a range of vessel types.	5.48	6	8	0	0	6	6	0	4
144	Contact with groynes off Diver Shoal. Inbound small vessels are particularly vulnerable (including tugs and tows).	5.29	0	8	0	0	4	6	4	4
122	Personal Injury - Individual in water - requires rescue. Accidental entry, Deliberate act (including attempted suicide).	5.13	9	0	0	0	7	0	0	0
62	Pilot injured / killed boarding / disembarking in adverse weather conditions offshore.	4.74	8	0	0	0	6	0	0	4
138	Personal Injury to passengers waiting / embarking from pontoons and piers, caused by wash from passing ships.	4.74	8	0	0	0	6	0	0	4
134	Mooring breakout, caused by interaction from passing ships, inadequate moorings, etc.	4.74	0	8	0	0	0	6	0	4

A further fifty-five hazards ranked as significant (rating=7) mainly within the 'Worst Credible' scenarios. Of these, three hazards also rated as significant (7) within the Most Likely scenarios. Details are contained in section 5.1.

8.1.2 Risk Control

We consider that the top sixty hazards from the ranked hazard list, including the hazards summarised above, merit continued review, and consideration should be given to the risk control measures proposed.

In some cases it may be appropriate to set up working groups to consider the costs and benefits of introducing further measures.

Thirty two risk control options are suggested for consideration by PLA Board. These are described in detail in section 6.1. The Study Team considers that implementation of these measures would assist in mitigating the risks associated with the top sixty hazards identified. In many cases, these measures will address more than one hazard and may additionally address hazards that which are outside the top sixty.

8.2 GENERAL RECOMMENDATIONS

During the course of the study, the team also noted a number of additional areas where it was considered that further improvements could be made to the port operation. These generally relate to procedural areas where the Study Team considers that enhancements to current procedures would benefit navigational safety. These areas include VTS procedures, particularly with regard to communications and the control of movements; documentation of Best Practices; rationalisation of documents which control navigation; review of operational policies; external and internal communications and the management of change (for critical areas and systems). These are described in details in section 6.2.

8.3 THE WAY FORWARD

Under the Port Marine Safety Code, a formal safety management system is required to manage the Safety of Navigation on the Thames. This needs to incorporate best practice and comply with the PMSC for Documentation, Procedures, Risk Assessment, Emergency Response, Incident Reporting, Organisation, Audit and performance Measuring.

The Navigational Safety Management System should therefore set high level policy and define standards and operational procedures together with the means to set targets and measure progress towards them.

The Study Team recommends that PLA should rationalise its existing individual safety systems and procedures into a consolidated Navigational Safety Management System, which incorporates the recommendations from this study.

DISTRIBUTION:

Port of London Authority	12 Copies
BMT Reliability Consultants Limited	1 Copy
Marine and Risk Consultants Ltd	1 Copy

Appendix A

Stakeholder Consultees to the Risk Assessment Process

1. HAZARD IDENTIFICATION (HAZID) MEETINGS

The initial HAZID meetings took place at Devon House on the 12th, November 1999 and at London River House on 18th November 1999 – see section 3.3. Present at these meetings were:-

Harbour Master (Upper)
Harbour Master (Lower)
Deputy Harbour Master (Lower)
Pilotage Manager
Senior Marine Officer (TBNC)
VTS Officer (TBNC)
Sea Pilots
River Pilot
Port Hydrographer
Pilot Boat Coxswain
Hanson Aggregates (PEC Master)
The Company of Watermen & Lightermen
Tilbury Docks (Assistant Harbour Master)
Marine and Risk Consultants Ltd.
BMT Reliability Consultants Ltd

2. EMERGENCY ARRANGEMENTS (SAR) STUDY OF THE RIVER THAMES

This study was carried out by BMT Reliability Consultants and Marine and Risk Consultants (MARICO Marine) on behalf of PLA and the DETR. It included separate data gathering and HAZID exercises which were specific to passenger operations on the river between the Thames Barrier and Teddington. The hazards identified were incorporated into this study – see section 3.2. Consultees to the Emergency Arrangements study were as follows: -

Port of London Authority
Maritime & Coastguard Agency
Local Authorities adjoining the study area
Civil Aviation Authority
Metropolitan Police Marine Support Unit.
London Fire Brigade
The company of Watermen and Lightermen
London River Services
Campion Launches
Cleanaway Ltd
Cory Environmental
J Prior (TPT) Ltd
Woods River Cruises

3. HAZARD WORKSHOP

These meetings took place at Devon House and London River House on the 8th and 9th of February 2000 to further identify hazards in particular areas (e.g. Sunk, Warps, etc) - see section 3.3. Present at these meetings were:-

Deputy Harbour Master (Upper)
Senior Marine Officer (Woolwich)
Deputy Harbour Master (VTS)
Deputy Harbour Master (Lower)
River Pilot
Sea Pilots / Duty Port Controllers
BMT Reliability Consultants Ltd.
Marine and Risk Consultants Ltd.

4. HAZARD WORKSHOP

This took place at London River House on the 14th April 2000 to further review hazards and risk control options related to the Sunk Area - see section 3.3. Present at these meetings were:-

Deputy Harbour Master (Lower)
Senior Marine Officer (Woolwich)
Pilotage Manager
Sea Pilots
Harwich Haven Authority (Harbour Master, Pilotage Manager and Pilot)
Medway Port Authority (Harbour Master and Pilots)
BMT Reliability Consultants Ltd.
Marine and Risk Consultants Ltd.

5. HAZARD SCORING WORKSHOP

This took place at London River House on the 11th, 16th and 17th of January 2001 - see section 4.3.4. Present at these meetings were:-

Deputy Harbour Master (Upper)
Deputy Harbour Master (Lower)
Assistant Harbour Master (P&C)
Pilotage Manager
River Pilot
Sea Pilot / Duty Port Controllers
Duty Officers
Deputy Port Hydrographer
Harbour Service Launch Coxswains
Medway Port Authority (Harbour Master and Pilots)
Cory Environmental
City Cruises Ltd (Passenger Operator)

Cobelfret (PEC Holder)
Dart Line (PEC Holder)
Hanson Aggregates (PEC Holder)
Marine and Risk Consultants Ltd.

6. DEFENCE MAPPING WORKSHOPS

This workshop took place at London River House on the 13th, 14th and 15th of February 2001 – see section 5. Present at these meetings were:-

Deputy Harbour Master (Upper)
Deputy Harbour Master (Lower)
Assistant Harbour Master (P&C)
Pilotage Manager
River Pilot
Sea Pilots / Duty Port Controllers
Sea Pilot (Inner List)
VTS Officers
Duty Officer
Harbour Service Launch Coxswains
Marine and Risk Consultants Ltd.

Appendix B

Ranked Hazard List
By Hazard Title Only

Hazard Reference	Short Hazard Title in Order of Rank
88	Collision with a vessel leaving or manoeuvring to enter Tilbury Lock.
117	Collision in the area between West Oaze and Sea Reach No 1 buoys.
174	Collision in Fiddler's or St. Clement's Reach (including Stoneness).
186	Commercial vessel contacts any bridge between London Bridge and Richmond.
94	Collision involving VLCC in Sunk Precautionary Area.
51	Contact with Thames Barrier (normal navigation - barrier open)
23	Collision involving bunker barge (includes barges carrying fuel oil to power stations upriver).
205	Fire / Explosion in a small craft / houseboat.
4	Collision involving a Class V passenger boat between Crayfordness and Teddington.
5	Collision involving any commercial vessel in River (Generic River Collision).
64	Collision with any vessel in Sunk Precautionary Area - Note VLCC and HSS are also covered in separate hazards.
63	Collision at West end of Princes Channel / Shivering Sands area.
136	Grounding - Sugar Vessel (Deep draft) - Special case.
183	Collision between London Bridge and Bell Lane Creek.
171	Collision in Lower Hope Reach.
170	Collision between Canvey Island and Western end of Sea Reach.
115	Collision in Gravesend Reach.
173	Collision in Northfleet Hope. (Excluding Tilbury Lock entrance)
184	Collision between Putney and Richmond.
229	Collision with a vessel in vicinity of entrance to Black Deep from Fisherman's Gat (Black Deep Precautionary Area)
224	Collision involving High Speed Craft in Sunk Precautionary Area.
21	Collision involving tug and dumb barges in the river.
181	Collision in Greenwich or Limehouse Reach (up to Cuckolds Point).
72	Passenger vessel contacts any bridge between London Bridge and Richmond.
182	Collision in the Lower and Upper Pool (including Limehouse Basin)
65	Grounding in vicinity of Warps / Oaze Area – general.
176	Collision in Erith Rands or Erith Reach.

Hazard Reference	Short Hazard Title in Order of Rank
89	Collision with vessel manoeuvring onto or off any berth in river.
10	Collision involving VLCC in Warps area.
41	Personal Injury - Tug "girding" during manoeuvres to berth.
188	Contact with any moored vessel / structure (e.g. restaurant, office accommodation, etc)
2	Collision involving a private leisure vessel (other than at locks)
61	Grounding - Outward bound deep draft vessels departing Tilbury Lock and Northfleet Hope.- Especially late on sailing,
144	Contact with groynes off Diver Shoal.
130	Contact with tanker alongside berths at Coryton / Canvey Island Terminal.
234	Collision involving VLCC (Black Deep and Knock John)
87	Collision with a tanker getting under way or manoeuvring to berth at Coryton or Canvey Island.
68	Collision of Deep Draft vessel in SW part of Sunk Precautionary Area, leading toward Black Deep.
60	Collision between merging traffic from Nore Sand Swatchway and Traffic in Sea Reach.
44	Contact with a vessel anchored in Gravesend Lower or Higham Bight Anchorages.
191	Contact with West Thurrock Tanker Jetties (Van Ommeren) or vessel alongside.
89	Contact with Wouldhams (GATX) Jetty or tanker alongside on jetty.
75	Grounding on Black Shelf (Grays) Barge on Black Shelf assists in identifying the edge of the channel.
57	Collision with a vessel getting under way from Southend, Great Nore, Leigh, Yantlet, Chapman or Thameshaven Anchorages.
122	Personal Injury - Individual in water - requires rescue.
108	Collision with leisure vessels in way of marina locks and British Waterways Canal Entrances.
240	Collision between small bulker and Class V Passenger Vessel (Special Case)
7	Collision involving dredger (self propelled)
29	Contact with vessel anchored in Southend Anchorage (including the small ship Anchorage)
201	Fire on moored Restaurant Vessel (or vessel/structure used for office accommodation)
187	Contact with any jetty pier or pontoon where passengers are waiting

Hazard Reference	Short Hazard Title in Order of Rank
	/ boarding or disembarking.
55	Contact with Jetties, berths, during river passage (not berthing)
48	Contact with a vessel moored on Erith Tier or Erith Swing buoy, or anchored in Erith Anchorage.
105	Grounding at West End of Princes Channel.
239	Small bulk carrier contacts bridge (Special Case)
143	Grounding - Vessel grounds across dredged box on berth. Unable to refloat before tide falls.
180	Collision in Bugsby's or Blackwall Reach.
91	Grounding - Deep draft vessel grounding on West end of Oaze bank or East end of Nore Sand.
208	Loss of Hull Integrity in Restaurant Vessel (or vessel / structure used for office accommodation)
46	Contact with Greenhithe Swing buoy, a vessel moored to it, or anchored in St Clements Anchorage.
204	Fire/Explosion on any Jetty (including Oil terminals)
36	Contact with a vessel anchored in Leigh and Yantlet Small Ships Anchorages.
148	Heavy contact with berth / quay / jetty during berthing manoeuvres)
235	Collision in Medway Approach Channel.
169	Collision in Yantlet Dredged Channel.
175	Collision in Long Reach.
73	Grounding, off Jenningtree Point, Erith Reach.
125	Contact (over-run) inside berth Tilbury Grain Terminal.
121	Contact - All Areas
151	Contact with Sunk Head Light Tower Remains.
62	Personal Injury - Pilot injured / killed boarding / disembarking.
138	Personal Injury to passengers waiting / embarking from pontoons and piers.
134	Mooring breakout - General (Non Tanker)
54	Contact with ship/barge moorings or ship/barge on moorings.
133	Mooring breakout from tanker berths.
111	Contact with "Hawksdale" wreck.
92	Grounding on either side of Knock John channel (between Knock John No1 and Knock John No7)
228	Collision in vicinity of Warps pilot station (North of Oaze Bank)

Hazard Reference	Short Hazard Title in Order of Rank
120	Collision (any Area) due to Master / Pilot / PEC error.
11	Collision involving VLCC in Sea Reach.
145	Wash - Vessel damaged by wash from passing traffic.
76	Grounding on Broadness and Stoneness Points (on inside of bends)
135	Personal Injury / fatality to personnel working on civil engineering work near waterline.
123	Contact with vessel alongside at tanker berths (Purfleet)
53	Any vessel contacts QE II Bridge.
238	Contact - Vessel immobilised by damage / blockage to propulsion system.
3	Collision involving large passenger ship in the river between Sea Reach 1 and London Bridge.
13	Collision involving medium sized coastal tanker in river.
15	Collision involving small coastal tanker within the river.
56	Contact with berths in Northfleet Hope (Container terminal, Seacon or Bevan's Jetty) or vessel thereon.
95	Grounding in vicinity of Warps / Oaze Area – general.
235	Vessel grounds South or South West of Red Sand Tower.
119	Contact - All Areas
86	Grounding - Deep draft vessel grounding outside Yantlet Dredged channel.
160	Collision in vicinity of Knob Buoy.
16	Collision involving passenger ship in the Estuary.
14	Collision involving small coastal tanker in the Estuary.
118	Collision (any Area) due to Master overriding the pilots advice.
247	Collision - Seaward Approach to Fishermans Gat.
162	Collision at Eastern end of Princes Channel.
12	Collision involving medium sized coastal tanker in the Estuary.
113	Collision in vicinity of North East spit pilot station.
109	Collision in the North Edinburgh Channel (between Edinburgh and Tizard buoys)
163	Collision at the western end of the Knob Channel (between the Tizard Buoy and South East Knob)
22	Collision involving local (cross-Thames) ferry.
185	Collision between Richmond Lock and Teddington.
19	Collision involving LPG tanker in the Estuary.

Hazard Reference	Short Hazard Title in Order of Rank
37	Contact with a vessel anchored in Chapman anchorage.
142	Contact (heavy landing on Oikos No 1 Jetty)
190	Contact with Coryton No4 Upper Dolphin whilst berthing on No1.
244	Collision between Small Bulk carrier and Leisure Craft (Special Case)
157	Collision in the vicinity of Barrow No 3.
156	Collision between Barrow No 7 and Barrow No. 9
18	Collision involving chemical tanker in the river.
168	Collision in the vicinity of South West Barrow (Mouse Channel)
158	Collision in the vicinity of Barrow No 10.
159	Collision in Barrow Deep (General) See also: Collision between Barrow 7 & 9 (Haz 156) Collision in the vicinity of Barrow No 10. (Haz 158) Collision in the vicinity of Barrow No 3. (Haz 157)
17	Collision involving chemical tanker in the Estuary.
177	Collision in Halfway, Barking or Gallions Reach.
206	Fire / Explosion caused by world war II Ordnance.
200	Grounding in areas between London Bridge and Teddington Lock.
243	Collision between Small Bulker and Tug/Tow or other Small Bulker (Special Case)
202	Fire /Explosion in Cargo Spaces – generic.
30	Contact with a vessel anchored in Knob Deep Water Anchorage (K1, K2)
85	Grounding, Yantlet Flat, Grain spit, Nore Sand.
6	Collision involving a fishing vessel in the Estuary.
116	Grounding - Tails of banks.
242	Small bulk carrier contacts pier (Special Case)
179	Collision in Woolwich Reach.
20	Collision involving LPG tanker in the river.
128	Collision in Knock John Channel.
82	Contact (over-run) inside berth Erith Oil Works (veg oil)
81	Contact with Thames barrier, caused by vessel turning onto or off adjacent berths.
192	Contact with vessel anchored in Black Deep, Deep Water Anchorage.
223	Contact with new construction works extending into or over the river.
33	Contact with a vessel anchored in Barrow Deep Anchorage.

Hazard Reference	Short Hazard Title in Order of Rank
34	Contact with a vessel anchored in Shivering Sands Anchorage.
35	Contact with a vessel anchored in Oaze Anchorage.
31	Contact with a vessel anchored in Sunk Deep Water Anchorage.
47	Contact with a vessel anchored in Long Reach Anchorage.
231	Contact with Outer Tongue Light Float or vessel anchored in Tongue Deep Water Anchorage.
248	Grounding - in Fisherman's Gat.
110	Grounding at South East entrance to North Edinburgh Channel.
107	Grounding either side of Princes channel Eastern End between Princes Buoy and Princes No. 3.
249	Grounding -either side of Fisherman's Gat.
66	Grounding - All Areas.
129	Tide can vary significantly in time and height from prediction with differences exceeding one metre.
237	Grounding either side of Medway Approach Channel or Gt Nore anchorage.
230	Grounding on Eastern End of Long Sand Spit (Nr Outer Fisherman Buoy)
58	Grounding - All Areas - due to inadequate supply of navigational or hydrographical information to the vessel.
59	Grounding on North East end of Long Sand Head - Especially deep draft vessels.
93	Grounding between Black Deep No.10 and Knock John No.1.
52	Contact with Thames Barrier (barrier in defence)
127	Grounding on East Barrow Sand (from Barrow Deep)
114	Grounding in Gravesend reach.
189	Contact with vessel anchored in Gt Nore Anchorage.
50	Contact with a vessel anchored in Gallions Reach, Bow Creek, West India Dock, Regents Canal and Rotherhithe Anchorages.
49	Contact with a vessel anchored in Belvedere, Halfway and Barking Anchorages.
106	Grounding elsewhere in Princes channel.- other than at East (Hazard 107) and West (Hazard 105) ends.
9	Collision involving High Speed Craft (Estuary)
24	Collision with a vessel getting under way from any anchorage within the Estuary.
32	Contact with a vessel anchored in Sunk Inner Anchorage.

Hazard Reference	Short Hazard Title in Order of Rank
154	Contact with Gunfleet Tower.
26	Contact with navigation buoy, mooring buoy.
225	Collision with Civil Engineering Craft (workboats, tugs, tow-boats, etc)
1	Collision between the pilot launch and a ship.
126	Collision involving a private leisure vessel (offshore)
227	Collision with vessel manoeuvring to berth or unberth at Purfleet, Van Ommeren or Wouldhams (GATX) jetty.
199	Grounding on either side of the N Edinburgh Channel (Eastern end, between Edinburgh and Shingles Patch buoys)
96	Grounding either side of Knob Gat (between Barrow No. 10 and Knock John No.7)
78	Grounding, South side of channel, Opposite Thameshaven. (West Blythe Buoy gives good indication of shoal area but (small) vessels commonly pass outside of buoys when vessels manoeuvring off Thameshaven).
245	Grounding - Resulting from inability to manoeuvre due to navigation being impeded by leisure vessels.
141	Grounding - Sea reach and Lower Hope.
124	Grounding on Barking Shoal.
112	Grounding on the outside of the bend in the vicinity of Blackwall.
137	Personal Injury / fatality to personnel working on floating works / pontoon (with little freeboard)
164	Collision at the Northern end of East Swin / Middle Deep.
155	Contact with Tongue Sand Tower.
153	Contact with Knock John Tower.
27	Contact with Shivering Sands Towers
152	Contact with Red Sands Towers.
38	Contact with a vessel anchored in Thameshaven Anchorage.
67	Grounding - All Areas.
140	Collision - All Areas.
217	Collision caused (in part) by misdirection (or lack of appropriate direction) by VTS - All areas (contributory cause only)
220	Collision caused (in part) by misdirection (or lack of appropriate direction) by VTS - All areas (contributory cause only)
195	Contact with vessel anchored in Great Nore Anchorage.
80	Contact with berth/tanker alongside Thunderer Jetty when

Hazard Reference	Short Hazard Title in Order of Rank
	manoeuvring to berth at inside berth on White Mountain / East Jetty.
25	Contact with any navigation buoy, beacon.
167	Collision at the SW end of West Swin (between Shoe Hole, Blacktail Spil Buoy and South West Barrow Buoy)
166	Collision in the vicinity of Maplin Bank Buoy.
165	Collision in the vicinity of Whitaker Buoy.
39	Contact with a vessel anchored in Mucking anchorage.
194	Any vessel contacts Tower Bridge or London Bridge.
232	Contact - Vessel imobilised by damage / blockage to propulsion system.
84	Contact with a vessel anchored in Barrow Deep Anchorage.
43	Contact with vessel on Shellhaven Bravo Jetty whilst berthing on Alpha Jetty.
40	Grounding on sand waves near Trinity Buoy.
97	Grounding either side of Mouse Channel.
172	Grounding in the Mouse Channel or vicinity of North Mouse.
216	Pollution - Oil Spill during bunkering operations (from dedicated bunker barge)
215	Pollution - Oil / Chemical overflow during loading (Tanker Loading/Discharge Operations)
77	Grounding, West Side of channel, Lower Hope Reach (Mucking Flats) Mucking buoys give a good indication of the side of the channel.
74	Grounding on shoal patch, east of Crayfordness on the south side.
28	Contact with wreck of "Richard Montgomery".
213	Pollution - Bilge Water Discharge.
139	Contact with moored vessel on HMS President and / or Tower Bridge 'Lower' mooring.
70	Grounding, North end of Bugsby's Reach, West side, off Millenium Pier.
69	Grounding, on Saunders Ness Shoal, (south end of Blackwall reach, West Side, above Millwall Wharf)
221	Contact - All Areas
218	Contact - All Areas.
219	Grounding - All Areas.
222	Grounding - All Areas.
178	Collision in Barking Creek.

Hazard Reference	Short Hazard Title in Order of Rank
8	Collision involving High Speed Craft on river.
226	Grounding - All Areas.
71	Grounding, in various shallow areas above Thames Barrier including the spur from the north bank off Silvertown (<5m), South East part of Greenwich Reach, Limehouse Reach (West Side), Lower and Upper Pool.
209	Pollution - Hydraulic Oil Spill to water
214	Pollution - Oil Spill during bunkering operations (from shore, including from road tankers on quay)
98	Grounding either side of Barrow Deep - General (from Barrow 3 to Barrow 10 Buoys) See also grounding on East Barrow Sand (Haz 127).
101	Grounding on South End of East Swin Channel (South End of Middle Bank, between North East Maplin and Maplin Edge)
102	Grounding at South End of Middle Deep (transit area between West Swin and East Swin channels)
246	Contact - Resulting from loss of ability to manoeuvre.
150	Contact with Sunk Light Vessel or "Storm" Buoy.
131	Contact between aircraft and vessel in Gallions Reach.
212	Pollution - Oil / Chemical discharge through Sea Valves / Overboard valves
99	Grounding either side of East Swin channel (except as identified elsewhere - see also North end (Haz 164), South end (Haz 101), Maplin Bank (Haz 166), Whitaker Buoy (Haz 165).
100	Grounding on North End Middle Bank.
241	Small Bulker Grounding (Special Case)
83	Contact - with barrier in Barking Creek.
207	Personal Injury - Members of general public trapped on islands or riverbanks during organised events with rising water level, impeding escape.
104	Grounding either side of South West Reach and Barrow Swatchway.
103	Grounding either side of Middle Deep channel (except as identified elsewhere)
210	Pollution - Oil / Chemical residues on deck spilt to water.
211	Pollution - Hydraulic Oil spill to Water (Propulsion Systems)
149	Grounding - Generic - in the Thames Estuary.
45	Grounding - Generic - in the River Thames.
203	Fire / Explosion caused by ignition of flammable gas cloud.
147	Contact - Generic.

Hazard Reference	Short Hazard Title in Order of Rank
79	Vessel drops anchor or drags anchor across gas pipelines at Coalhouse Point, Bugsbys Reach or Oil Pipeline in Long Reach.
132	Collision - Loss of signal from remote radar stations.
146	Collision - Generic.

Operational Risk Assessment

of

Port of London

1999 - 2001

Appendix C

Basic Hazard list

Operational Risk Assessment

of

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1999 - 2001

Appendix D

Ranked Hazard List
(With Risk Control)