APPLICATION OF GIS TECHNIQUES IN OIL SPILL RISK ASSESSMENT FOR THE GULF OF SUEZ

By

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2008
DECLARATION

I certify that all the material in this dissertation that is not my work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessary endorsed by the Arab Academy for Science and Technology and Maritime Transport.

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ABSTRACT

Gulf of Suez (GOS) has unique, sensitive and vulnerable marine environment and ecosystems. It has many tourism attraction factors based mainly on the marine activities in the area. GOS is an important navigational route that forms the southern approach to the Suez Canal, which is an international congested waterway. GOS is rich in aquaculture, fishing grounds and natural resources. Many modern ports, oil terminals, oil exploration and oil production activities are developed in the area.

GOS is shallow confined water and always exposed to operational and accidental oil spill risks despite the continuous efforts taken by the involved organizations. High accidental oil spill rates, high dissolved and dispersed oil concentrations, and high oil concentrations in the sediments are recorded in the area. Major oil spills could expose the area to significant environmental and socio-economic consequences due to its vulnerable nature. GOS needs management system to control, mitigate and reduce risk of oil spills.

This study presents the application of GIS in the organization of information that will determine the degree of vulnerability in standard formats. Information on relevant factors aimed to assess the level and status of oil pollution, in addition to recording natural features, sensitivity, economic importance, human use and activities of these coasts. The collected data are utilized GIS technologies to establish a categorization and ranking system to aid contingency planning.

The ESRI’s ArcGIS 9.0 platform is chosen as it guarantees an efficient means of managing geospatial data such as enabling easy alterations and updates. The Environmental Sensitivity Index (ESI) technique developed by the National Oceanic and Atmospheric Agency (NOAA) is used to organize the information in standard formats for shoreline sensitivity, biological resources,
exposure to wave and tidal energy and human-use resources. In this study the technique used to set up an updated and accurate oil spill sensitivity map is described. Based on all these information, appropriate methods to respond to oil spills in the different areas of GOS have also been assessed. Admiralty Chart of GOS number (159) with scale 1:750,000 was used to build a Digital map as base map for the thematic layers and listings of each processed data. Spatial and non-spatial data were analyzed through various functions of GIS techniques, such as geo-processing, data analysis and overlaying, to yield the risk Assessment system as thematic layers.

The chart is scanned and encoded into the GIS to establish new themes for the different types of the necessary features of GOS such as TSS, Ports, OOI, OT, Coasts and sensitive areas. For the purpose of simplifying the identification of the elements, they are specified by their co-ordinates.

Every element on the chart is provided with information table.

The risk mapping by GIS will provide the user with a number of data for each element, which are the following:

- Location of the necessary features of GOS (in Latitude and Longitude or any other system like (UTM),
- Estimated Risk Probability of Sp < 100 t with its category,
- Estimated Risk Probability of Sp > 100 t with its category,
- Depositary level of Floating Litter and Oil if it is a coastal element
- Integrated Vulnerability Ranking of the element
- Length of TSS, Ports Approach, Oil Terminal Approach in addition to the Length of Pipelines in Nautical Miles
- Number of Ports, Oil Terminals and Off-shore Installation Facilities


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<td>Accident</td>
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<tr>
<td>ALARP</td>
<td>As Low As Reasonably Practicable</td>
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<td>DWT</td>
<td>Dead Weight Tonnage</td>
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<td>EEAA</td>
<td>Egyptian Environmental Affairs Agency</td>
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<td>EMDB</td>
<td>Egyptian Maritime Data Bank</td>
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<td>ENOSCP</td>
<td>Egyptian National Oil Spill Contingency Plan</td>
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<td>ERM</td>
<td>Environmental Risk Management</td>
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<td>ESI</td>
<td>Environmental Sensitivity Index</td>
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<td>ESRI</td>
<td>Environmental Systems Research Institute</td>
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<td>GAFRD</td>
<td>General Authority for Fish Resources Development</td>
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<td>GESAMP</td>
<td>Group of Experts of Scientific Aspects of Marine Pollution</td>
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<td>GIS</td>
<td>Geographic Information System</td>
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<td>GOS</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>ICS</td>
<td>Incident Command System</td>
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<td>IMO</td>
<td>International Maritime Organization</td>
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<td>IPIECA</td>
<td>International Petroleum Industry Environmental Conservation Association</td>
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<td>ITOPF</td>
<td>International Tanker Owners Pollution Federation</td>
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<td>IUCN</td>
<td>International Union for Conservation of Nature and Natural Resource</td>
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<td>IVR</td>
<td>Integrated Vulnerability Ranking</td>
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<tr>
<td>Long.</td>
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<td>MARPOL</td>
<td>International Convention for the Prevention of Pollution from Ships</td>
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<td>MHRAs</td>
<td>Marine High Risk Areas</td>
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<td>MMT</td>
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<td>MSL</td>
<td>Mean Sea Level</td>
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<td>n.m.</td>
<td>Nautical Mile</td>
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<td>NOAA</td>
<td>The National Oceanic and Atmospheric Agency</td>
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<td>NOSCP</td>
<td>National Oil Spill contingency Plan</td>
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<td>NOWPAP</td>
<td>Northwest Pacific Action Plan</td>
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<td>OOI</td>
<td>Off-Shore Oil Installation.</td>
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<td>Ultra Large Crude Carrier</td>
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<td>UNEP</td>
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<td>Very Large Crude Carrier</td>
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