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ABSTRACTS OF POSTER EXHIBITS

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Modelling industrial discharges to the Forth estuary

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Waste material discharged to an estuary such as the Forth becomes diluted, degraded by bacteria and eventually flushed out to sea. If the capacity of the estuary to deal with effluents is exceeded then toxic concentrations of material may be found in the waters, and this could result in kills of fish and other estuarine life. A mathematical model has been developed to look at the effect of individual discharges of effluent to the Forth estuary. This model computes the concentrations of material within the effluent plume as the tide moves it away from the discharge point. Two distinct versions of the model are available to look at the effect of continuous discharges to the estuary and to estimate the hazard to fish life in the estuary, of an accidental release of chemical. In each case the expansion of the plume or patch and the dilution of waste is computed as the tide carries the material away.

The models are based on data collected from the literature, Admiralty charts and specialised surveys of the estuary. The parameters needed are water depth, speed and direction of tidal and residual currents, horizontal and vertical mixing coefficients, the vertical shear coefficient and data on the rise and fall of the tide. Calibration of the model is achieved by comparing model predictions against the results of dye dilution and tracking experiments carried out in the estuary. Figure 1 shows a model run predicting the movement of effluent on a flood tide and Figure 2 shows an expanded model of the area from Grangemouth to Kincardine Bridge with the spread of material from a simulated release on the ebb tide. Associated with these diagrams are data giving the tidal conditions and effluent dilutions at five-minute intervals from the start of discharge, as shown below:

Time	Location		Depth	Current		Plume		Dilutions	
				Dir	Speed	Width	Depth		
(hr)	(km)		(m)	(deg)	(m/s)	(km)	(m)	Surface	Boom
0·00	11·80	2·85	7·5	271·	0·23	0·130	0·60	0·100E+03	0·000E+00
0·08	11·73	2·85	7·7	271·	0·25	0·133	1·59	0·272E+03	0·605E+23
0·15	11·66	2·85	7·9	271·	0·27	0·136	2·16	0·379E+03	0·106E+15
0·23	11·58	2·86	8·0	272·	0·29	0·140	2·62	0·469E+03	0·557E+11
0·30	11·50	2·86	8·0	275·	0·30	0·143	3·00	0·549E+03	0·698E+09
0·38	11·41	2·87	7·9	278·	0·31	0·146	3·34	0·625E+03	0·470E+08
0·45	11·33	2·88	7·9	281·	0·31	0·149	3·65	0·696E+03	0·748E+07
0·53	11·25	2·89	7·8	284·	0·30	0·151	3·93	0·765E+03	0·196E+07
etc.									

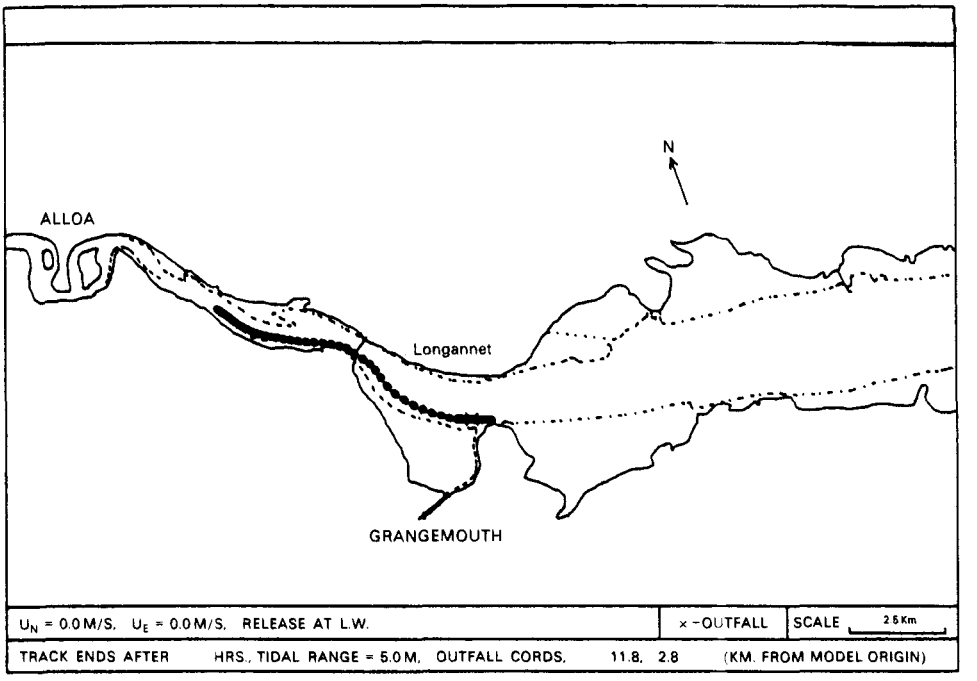

Figure 1. Forth estuary, Grangemouth model.

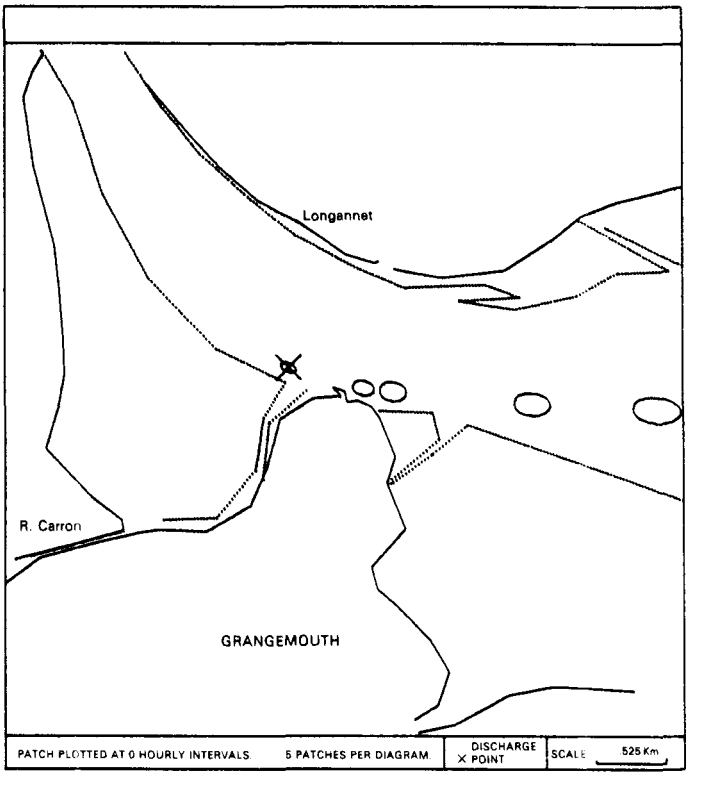

Figure 2. Grangemouth coastal model

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