5.0 WATER QUALITY

5.1 Introduction

5.1.1 This section considers the effect of the development on water quality in the Bandon Estuary. Existing water quality parameters are discussed in terms of published data and water quality analysis carried out for this investigation. The effect of an outfall at Location 1 is considered, followed by an examination of the alternative solutions presented to mitigate any potential negative impacts.

5.1.2 Figure 5.1 shows the extent of harbour activities

5.2 Existing Water Quality Data

5.2.1 Water quality parameters in Kinsale are influenced to a varying extent by the influx of fresh water from the River Bandon. Except during extreme flood conditions, this riverine effect is likely to be minimal, in terms of the estuary's overall status. Data for the period 1971 to 1989 (Foras Forbartha, 1989-1990) for 14 sampling stations on the River Bandon showed a slight decline in Q values (Biological Quality Rating) with time. However, figures for 1989 range from 3-4, doubtful to fair. Median figures for Dissolved Oxygen range from 97% to 103%, maximum BOD from 2.9 to 4.9 mg/l. Total ammonia median figures ranged from 0.028 to 0.062 mg/l. Nitrate median figures ranged from 1.026 to 2.199 mg/l and maximum figures from 2.938 to 6.636 mg/l.

5.2.2 In a survey carried out by the EPA in October 1993, the range of dissolved oxygen in the estuary and harbour was 81-95% saturation. The parameters measured during this one survey indicated unpolluted conditions with no apparent change since the previous review period (1982-1986) (EPA, *Water Quality in Ireland* 1991-1994).

5.2.3 In the period 1993-1997 ongoing surveys by the EPA showed little variation with previous analysis (see Appendix B1)

5.3 Baseline Samples

5.3.1 A once-off water quality survey was also carried out on the 14th of October 1993 for the purpose of this study (Aquafact, Preliminary Report, see section 1). A total of 180 water samples were taken from five sampling locations (Figure 5.2). Water samples were taken at three stages of the tide (high, mid and low water) and at three depths at each stage of the tide (at the surface, at half the maximum depth and 1 m above the bottom) at each station.

5.3.2 Water samples were analysed for the following parameters: nutrient content in the form of Nitrate (NO_3-N), Nitrite (NO_2-N), Ammonia (NH_3-N), Silicate (SiO_4-Si), Phosphate (PO_4-P), Total Phosphorus and Total Nitrogen and Biochemical Oxygen Demand (BOD). Temperature and salinity were recorded at two stages of the tide (high and low water) at each station using a T/S probe.

5.3.3 Bacteriological analyses were carried out on all water samples for the faecal coliform *Escherichia coli*.

Analysis

Water Structure

5.3.4 Temperature and salinity profiles of the water body at each of the five sampling stations for an ebb and flood tide are presented in Figure 5.3. Depths as indicated in these figures are only approximations due to the fact that strong currents experienced caused the probe to lie at an angle in the water, particularly at stations of greater depth.

5.3.5 The salinity data presented here reflects the estuarine nature of the waters in the harbour. The data also indicates that for the sampling date in question there is only slight stratification in the water column in the period around low water. At this stage of the tidal cycle, temperatures varied from 10.2°C at the surface to 16.4°C off bottom at depths of 5 m while salinity values ranged from 18.3 to 32.9S. The sharpest changes in these parameters on this occasion took place between 1-4 m waters depth.

5.3.6 Water temperature and salinities, with values ranging from 12.8-14.9°C and 29.4-32.1S respectively (see Figure 5.3), were higher during the latter stages of the flood tide relative to the period at and immediately after low water. In general there was an increase in salinity and temperature in the high tide period with the exception of Station 4 where higher temperatures were recorded at low water. These features are taken as indicative of the intrusion of more saline waters into the upper harbour waters on the flood tide. As may be expected for an estuarine situation this intrusion is maximal off the bottom as riverine waters are retained in the surface layers.

Water Quality

5.3.7 The results of the baseline survey are presented in tabulated form in Table 5.1. Highest levels of nitrate (0.08-1.95 mg/l) were recorded in samples taken at low tide from Stations 1, 2 and 3. When compared with levels recorded in Cork Harbour (0- 2.0 mg/l, ERU, 1989) the levels in the present study are concurrent. Nitrite levels were typically low with levels ranging from 5.02-16.62 µg /l. There are variations in the values for Stations 1, 2 and 3 for samples taken at low water where nitrate values are higher in surface waters which reflects the estuarine nature of the harbour. Levels of ammonia are, for the most part, similar to those recorded on the west coast (Aqua-Fact, 1992) with the exception of one anomalous result for water taken from the surface layers at mid-tide at Station 2. Phosphate levels tend to decrease moving downstream from Station 1 to Station 5, with the highest level, 42.02 µg/l, recorded in water taken from the surface at low tide at Station 1 and the lowest level, 11.97 µg/l, in water taken at mid-tide at Station 5. This downstream decrease is also true for silicate levels. In general nutrient levels tend to be somewhat higher in the period around low water relative to the lower values experienced during the tidal period around high water. This may be due to the intrusion of nutrient poor coastal waters. On the other hand phosphate levels at Stations 4 and 5 show smaller variations.

TABLE 5.1 Results of water quality analyses at Stations 1-5 in Kinsale Harbour (October 1993). A = surface; B = half maximum depth; C = 1 m above bottom; *all values in µg/l.

Tidal Level	Depth (m)	NO_3-N* Nitrate	NO_2-N* Nitrite	NH_3-N* Ionised Ammonia	PO_4-P* Inorganic Phosphate	Total P* Total Phosphorus	Total N* Total Nitrogen	SiO_4-Si* Silicate
STATION 1								
Low	A	1950.37	16.62	89.74	41.02	60.14	2093.62	1043.60
	B	1364.08	16.34	80.61	30.51	48.06	1464.73	667.06
	C	616.90	15.49	69.12	30.11	67.64	1263.74	639.87
Mid	A	743.70	11.69	51.68	25.66	35.31	924.44	413.63
	B	594.37	11.21	49.38	27.41	42.59	781.69	331.58
	C	465.49	10.55	56.02	33.57	54.58	649.30	280.17
High	A	548.15	10.03	46.28	26.70	32.52	631.65	308.41
	B	307.75	7.76	41.59	21.14	27.96	397.41	203.61
	C	164.79	7.20	36.46	17.28	23.99	251.45	163.28
STATION 2								
Low	A	1374.81	15.45	76.99	25.84	40.37	1489.57	600.44
	B	1071.83	13.89	63.72	24.88	41.72	1187.21	500.99
	C	621.13	11.51	56.81	24.44	34.72	773.68	358.32
Mid	A	720.00	11.67	286.28	35.90	-	1105.68	520.79
	B	493.66	11.02	40.00	26.81	32.64	553.82	291.09
	C	257.75	6.86	91.24	37.32	-	385.61	195.13
High	A	520.74	9.25	40.53	18.35	25.76	598.81	289.02
	B	235.21	6.86	31.95	16.76	21.20	284.03	238.71
	C	174.65	6.03	38.94	20.68	29.00	271.70	206.93
STATION 3								
Low	A	1155.50	15.79	59.12	30.23	39.09	1303.74	693.43
	B	547.89	10.36	77.08	33.31	46.91	668.75	407.34
	C	438.03	10.07	50.18	19.86	22.22	511.40	390.46
Mid	A	431.85	9.54	34.96	16.71	24.92	499.97	360.72
	B	266.90	7.70	38.05	22.56	23.33	373.75	286.22
	C	261.27	7.72	31.95	25.11	30.67	257.11	260.69
High	A	354.81	8.04	50.09	20.59	28.23	458.99	310.92
	B	217.61	6.27	35.58	17.77	29.45	306.35	227.18
	C	202.11	6.59	36.11	19.88	24.83	269.07	217.12
STATION 4								
Low	A	790.37	12.28	63.27	22.30	28.53	971.56	493.36
	B	614.79	12.08	62.12	23.33	25.35	795.26	376.26
	C	246.48	8.55	102.21	10.62	16.28	395.87	373.66
Mid	A	359.85	8.05	39.03	18.10	25.17	471.44	240.29
	B	128.77	5.89	33.81	20.68	23.70	258.98	109.88
	C	101.40	4.85	33.19	10.83	16.37	188.87	102.52

Tidal Level	Depth (m)	NO_3-N* Nitrate	NO_2-N* Nitrite	NH_3-N* Ionised Ammonia	PO_4-P* Inorganic Phosphate	Total P* Total Phosphorus	Total N* Total Nitrogen	SiO_4-Si* Silicate
High	A	271.53	7.48	41.42	17.38	23.45	360.17	175.84
	B	228.77	7.14	41.86	21.87	25.12	345.22	150.79
	C	209.79	6.98	49.03	17.09	22.00	278.73	140.68
STATION 5								
Low	A	668.61	12.78	62.74	24.42	28.19	876.95	293.36
	B	586.99	12.01	66.20	19.77	22.45	740.96	256.39
	C	113.99	6.15	31.86	11.57	12.99	248.95	116.86
Mid	A	372.99	9.27	45.31	16.87	18.63	452.87	196.75
	B	226.71	5.02	32.04	13.01	16.99	279.46	129.39
	C	88.11	5.81	37.26	11.97	15.20	181.18	215.39
High	A	162.77	6.31	32.48	23.14	24.03	258.00	99.73
	B	113.01	6.22	38.50	15.31	18.82	197.51	122.40
	C	107.69	6.02	51.68	13.84	17.86	181.52	118.34

5.3.8 The EPA have also been sampling the estuary over the recent past. Figures for the relevant parameters are given in Appendix B1. In summary, the results of the samples show the following ranges:

- Total Organic Nitrogen (TON) levels vary from 4 µg/l to 2416 µg/l with a mean level of 482 µg/l
- Ionised Ammonia(NH3-N) levels vary from 2 µg/l to 92 µg/l with a mean level of 26 µg/l.
- Phosphate levels (PO4-P) levels vary from 2 µg/l to 58 µg/l with a mean level of 21 µg/l.

These correspond to the levels taken during the original survey.

5.3.9 A summary of BOD data is presented in Table 5.2. Average values for the harbour lie between 3-4 mg/l O_2 and are relatively high when compared to the guideline values specified in the Freshwater Fish Directive (78/695/EEC) for salmonid waters and for the Surface Water Directive (75/440/EEC) (see Table 5.3).

TABLE 5.2 Results of BOD tests on water samples taken at five stations in Kinsale Harbour.

Tidal Level	Depth (m)	BOD (mg/l) Station 1	Station 2	Station 3	Station 4	Station 5
Low	0	3.45	3.79	2.93	0.10	2.76
	2	3.27	2.59	3.97	3.62	5.18
	1 off bottom	3.27	4.14	0.17	1.21	2.58
Mid	0	3.28	2.24	0.69	0.10	1.72
	2	4.49	2.93	3.62	—	0.35
	1 off bottom	3.45	1.38	1.04	1.72	0.17
High	0	4.31	2.09	1.47	2.07	2.24
	2	3.45	4.49	1.52	1.03	4.30
	1 off bottom	4.83	4.88	—	1.03	4.14

5.3.10 EPA samples taken over the same period in the estuary (two results only) give values of 1.3 mg/l to 1.5 mg/l. These samples were taken at the surface.

5.3.11 Samples from the areas of the shellfish beds taken in December 1997 show BOD levels of 2.5 mg/l. The position of the sample or their time frame relative to the tides is not known.

TABLE 5.3. Summary of water quality requirements based on various EC Directive mandatory (I), maximum admissible concentrations (MAC) and guideline (G) values (based on Environmental Research Unit, 1992).

EC Directive or Ministerial Regulations		BOD mg/l O_2	
		G-values	I/MAC
Surface, water Regulations	A1 waters	-	5
	A2 waters	-	5
	A3 waters	-	7
Freshwater Fish	Salmonid	≤3	-
	Cyprinid	≤6	-
Salmonid water Regulations		-	≤5

5.3.12 While in their strict application, these directives do not apply to estuarine or marine waters they may be considered appropriate for Station 1. In the presence of organic matter ambient dissolved oxygen (DO) levels fall whilst the biochemical oxygen demand (BOD), a measurement of the rate of oxygen usage by aerobic micro-organisms, rises. The measurement of the ambient concentrations of such parameters, therefore, gives a good indication of the condition of the water as regards contamination by organic waste. Unpolluted coastal and estuarine waters would be expected to have a BOD level of 1-2 mg l^{-1} (milligrams per litre); in contrast, crude sewages have BODs in the range 250-400 mg l^{-1} while some industrial and farming wastes can have BODs significantly exceeding 1,000 mg l^{-1}. However, the scale of deoxygenation caused by such wastes depends to a large extent on factors such as the re-aeration capacity of the water and water temperature. Where the organic matter is deposited in the sediments of quiescent areas, decomposition there may lead to loss of oxygen from the overlying water or to the creation of anaerobic conditions with the production of odorous compounds such as hydrogen sulphide.

5.3.13 The results of the bacteriological analyses for *Escherichia coli* are presented in Table 5.4. As already pointed out, the contamination of water with faecal bacteria and viruses, some of which may be pathogenic, is one of the consequences of waste discharges to a body of water. This effect is mainly attributable to sewage discharges but may also be related to waste inputs and surface runoff from agricultural activities and related industries. Impacts are of particular concern in waters used for bathing or other water-contact sports and for shell-fisheries. The measurement of the degree of contamination and the definition of acceptable limits are mainly based on the numbers in the water of faecal coliforms, particularly *E. coli*.

TABLE 5.4 Results of *E. coli* analysis at five stations in Kinsale Harbour, October 1993. A = surface; B = half maximum depth; C = 1 m above bottom.

Tidal Level	Depth (m)	*E. coli* per 100 ml				
		Station 1	Station 2	Station 3	Station 4	Station 5
Low	A	—	60	<1	<1	<1
	B	15	60	3	12	<1
	C	45	8	2	10	<1
Mid	A	30	8	8	<1	2
	B	120	8	5	<1	1
	C	8	<1	8	<1	<1
High	A	<1	<1	<1	<1	<1
	B	1	<1	<1	<1	<1
	C	2	<1	<1	<1	8

5.3.14 In general the highest levels of contamination were recorded at the upstream Stations of 1 and 2. Flooding midwater on the date on which samples were taken occurred at approximately 2:30 pm. It is at this time of the day that the greatest amount of sunlight is available. The effect of sunlight and its UV radiation content has been established as being a major factor in controlling the survival of faecal coliforms in seawater. However, highest numbers of *E. coli* were recorded at this time at Station 1. It must be said that the lower angle of incidence of the Winter sun may not have the same detrimental effects as that of a higher and warmer Summer sun. It may be possible that the flooding tide caused the accumulation of faecal coliforms at Station 1 upstream of the existing sewerage outfalls located in close proximity to Stations 2 and 3. In theory optimum conditions for the survival of bacteria would occur at high water in the absence of bright sunlight provided that temperature and salinity were favourable. However, a dilution factor caused by the incoming tide would result in lower numbers as is the case for our results.

5.3.15 The European Communities (Quality of Bathing Water) Regulations, 1988 (Minister for the Environment, 1988) gave legal effect to the Irish standards or NLVs which included 13 parameters. Of these, the more important relate to permissible levels of contamination with faecal bacteria and other micro-organisms. The faecal bacteria mandatory limit values are 5,000/100 ml for total coliforms, 1,000/100 ml for faecal coliforms, 300/100 ml for faecal streptococci and 0/1 for *Salmonella;* the limit for enteroviruses is 0/101. Compliance with the Regulations requires that 95% of the samples taken have parameter values inside the NLVs except in the case of total and faecal coliforms where 80% of samples should conform with the limits. However, the levels recorded in the present study (<1 to 120) do not exceed the EC guideline levels.

Dispersion Model

5.3.16 Dispersion analyses which were carried out during the Preliminary Report modelled the two proposed outfall sites, as well as the existing regime and the proposed overflow from the pumping station at Denis' Quay. The modelled water quality parameter was faecal coliform (*E. Coli*) which is a recognised indicator of the presence of pathogenic organisms. A decay rate of T_{90} equal to 9 hours was specified in the model, which is regarded as conservative. The decay rate governs the build-up mechanism with the result that 90% of faecal coliform concentrations will have died off after 9 hours.

5.3.17 The dispersion analyses were carried out for a simulation period of 100 hours using a time step of 20 seconds. This simulation period was sufficient to ensure that steady state conditions were obtained for all analyses. At the start of each analysis, the study area was considered to be filled with clean water and as the simulation proceeded, a build-up of concentration levels develops throughout. Eventually, a steady state condition wass reached whereby the rate of increase in concentration levels due to the effluent discharge was in equilibrium with the rate of decrease in concentration levels due to flushing, take-up and die-off.

5.3.18 The results of the simulations are shown in Appendix A

Baseline Benthic Flora/Fauna

5.3.19 Results of the flora/fauna study carried out during the Preliminary Report indicate that the two subtidal environments sampled in the vicinity of the proposed outfall locations represent animal assemblages which are typical of north-western European shallow shelf, estuarine conditions. Nothing unusual was found that would indicate cause for alarm as regards pollution.

5.4 Impact

5.4.1 Outfall Location 1, situated midway in the estuary channel, exhibits high dispersive characteristics with a modelled plume being transported in a rectilinear manner along the central axis of the channel on both the ebb and flood tides. The characteristic of the modelled plume is a long narrow form which exhibits high longitudinal dispersion and poor transverse dispersion particularly so during a spring tide as a result of the high current speeds. The plume extends a considerable distance both upstream and downstream of the outfall location during both flood and ebb tides respectively.

5.4.2 During spring tides the effluent plume would extend beyond Money Point with faecal coliform (*E. coli*) concentrations in the order of 10/100 ml.

5.4.3 Results clearly show that the impact would not be significant, with levels exceeding 1,000/100 ml confined to a mid-stream area of 100 m upstream and downstream of the outfall site.

5.4.4 The impact would be very small in the Kinsale Town area, and further downstream with predicted values being in the order of 30/100 ml. The highest levels of 3,204 are predicted at the outfall site with a near field dilution of 104 between the receiving waters and effluent discharge. This represents the lowest dilution rate obtained during the tidal cycle with the highest being 660 at mid-flood and mid-ebb.

Bathing Water Quality (Faecal Coliform)

5.4.5 While there are no designated bathing areas in the immediate vicinity of the proposed outfall, and while the requirements of the bathing water directive only apply to designated bathing areas, the regulations are taken to mean that if swimming occurs and is not prohibited, then the site must comply with the regulations. It should be noted that some bathing does take place at locations S1 and S3.

5.4.6 Notwithstanding this, the dispersion analyses indicate that an outfall at this location would not exceed the EU mandatory level of 1,000/100 ml at any of the four sensitive sites nor in the harbour area itself. The mandatory level would be exceeded only in the vicinity of the outfall site. The guideline value of 100/100 ml would be exceeded for a considerable section of the estuary both upstream and downstream of the Outfall site. However, this guideline value would not be exceeded in the harbour and docking area, Jarley's Cove (S1), the Marina (S2), Summer Cove (S3) or Castlepark (S4).

Shellfish Production Water Quality (Faecal Coliform)

5.4.7 The Council of the European Communities has adopted a number of directives in relation to shellfish water; Council Directive 79/923/EEC on the quality required of shellfish waters, and Council Directive 91/492/EEC laying down the health conditions for the production and the placing on the market of live bivalve molluscs. The latter directive supersedes the former and sets out the requirements for faecal coliform levels in shellfish flesh taken from production areas. These requirements are set out in the following Table 5.5.

TABLE 5.5 Requirements for Live Bivalve Molluscs in accordance with EC Directive 91/492/EEC in relation to Faecal Coliform in Shellfish Flesh (No./100 g of Flesh).

	Faecal Coliforms/ 100 g of Flesh	**Compliance of Samples**	**Further Treatment**
Immediate Human Consumption	<300	100% <300	Not Required
Human Consumption after Treatment	300–6,000	90% <6,000	Purification after Relaying
Human Consumption after Treatment	6,000–60,000	100% <60,000	Relaying for Long Period, Intensive Purification

Note: The faecal coliform levels in the flesh of treated molluscs must be less than 300/100g prior to consumption.

5.4.8 The Department of the Marine have adopted the 'Shellsan Classification System' which relates directly to the faecal coliform concentration in the waters inhabited by the shellfish. This system has three water classifications as detailed in Table 5.6. The three classifications are:

Approved: No further treatment necessary.
Conditional: Purification necessary by relaying in uncontaminated sea water.
Restricted: Pressure cooking essential.

While the Shellsan Standard is adopted by the Department of the Marine, it is not a mandatory standard.

TABLE 5.6 Shellsan Category Limits.

Geometric Mean of Faecal Coliform/100 ml of Water		Compliance f.c. / 100 ml	Classification
< 14	and	90% <46	Approved
>14 <140	and	90% <460	Conditional
>140	or more than	10% >460	Restricted

5.4.9 For the proposed outfall at location 1, analysis of the simulation results for effects on the shellfish beds show an improvement in the water quality in terms of faecal coliform concentrations. A comparison of these concentrations for a mean tide for the existing and proposed outfalls is given in the following Table 5.7.

TABLE 5.7 Predicted faecal coliform concentrations at shellfish licence sites (no/100 ml).

	Existing Regime, No Treatment, Outfall at World's End			Proposed Outfall at Location 1		
	Site A	Site B	Site C	Site A	Site B	Site C
Mid-Ebb	10-100	100-250	10-100	10-100	10-100	10-100
Low Water	<10	<10	<10	<10	10-100	<10
Mid-Flood	10-100	500-1,000	10-100	10-100	10-100	10-100
High Water	10-100	250-500	250-500	<10	<10	10-100

5.4.10 From Table 5.7, it can be seen that, under the existing regime, the waters in the area would generally be classified as 'conditional' under the Shellsan Classification. While the faecal coliform counts will improve under the proposed outfall by ensuring that the waters will remain within this classification at the shellfish sites, the waters will in all likelihood be still classified as 'conditional'. This will not impact on levels within shellfish flesh which, based on improved water quality, should see lessened levels in the future.

5.4.11 Liquid and flesh samples have been tested from February 1996 (see Appendix B2). The results from April 1997 to the present are shellfish flesh levels. There is no accepted scientific correlation between the faecal coliform levels found in flesh and the level in surrounding waters. However, in order to attempt to compare the faecal coliform levels in the surrounding waters, a notional factor of 25 is used on the flesh results. (Ref. Test sample results for September 1996 to April 1997). In general, these notional figures correspond to the simulated results for the existing regime.

5.4.12 From the above results, it can be seen that the proposed treatment and discharge at Location 1 will improve the water quality at the three shellfish sites over a tidal period, particularly in relation to sites B and C. While the water quality at these locations could be classified at 'restricted' at some points of the tide under the present regime, the water quality would be classified as 'conditional' under the proposed regime.

Overflow Outlet

5.4.13 The pumping station and holding tank proposed at Denis Quay will include an overflow from the holding tank. It is likely that this overflow will impact on the water quality at adjacent areas, particularly downstream in the Docks/Marina area. However, even for an extreme condition (discharge of 255 l/sec), levels in excess of 1,000/100 ml are confined to within 200 m upstream and downstream of the overflow outlet. Away from the discharge site the numbers fall sharply to a predicted 290/100 ml at Summercove and 4/100 ml at Jarley's Cove. It should be noted that above predicted values are for a worst case scenario, under extreme conditions, and would occur very infrequently. It should also be noted that the predicted overflow faecal coliform levels are considerably lower than the existing outfall levels from the present scheme.

Benthic Fauna and Fisheries

5.4.14 Benthic fauna in the location of the outfall pipe will experience temporary impacts due to the operation of heavy equipment for trenching and dredging. Direct mortality and disruption of substrate impacts will be experienced. However, re-colonisation after dredging operations has been shown to be rapid, varying from two weeks to two years, depending on the magnitude and timing of the dredging. Because of their resilience to frequent natural disturbance caused by wind and wave energy, marine benthic organisms along the line of the proposed outfall are expected to colonise the area in a short period after construction.

5.4.15 Short duration sedimentation caused by disturbance and suspension of silts in the area of the proposed outfall pipe will also affect benthic communities. The increase in sedimentation may smother benthic fauna located in adjacent areas. Increased turbidity in the water column may also lead to lowering the rate of photosysnthesis by macroalgae and phytoplankton.. As most marine benthic organisms can withstand short term exposure to high concentrations of suspended solids for short periods, the impacts are likely to be minor only.

5.4.16 Salmon and Sea Trout migration occurs in the estuary; the adults swimming upstream throughout the year, and the smolts returning between March and May. The introduction of a treated effluent rather than a raw untreated effluent, as currently exists, will improve the general water quality through which the fish will pass. These comments will also be true for leisure angling which takes place in the harbour.

5.5 Mitigation

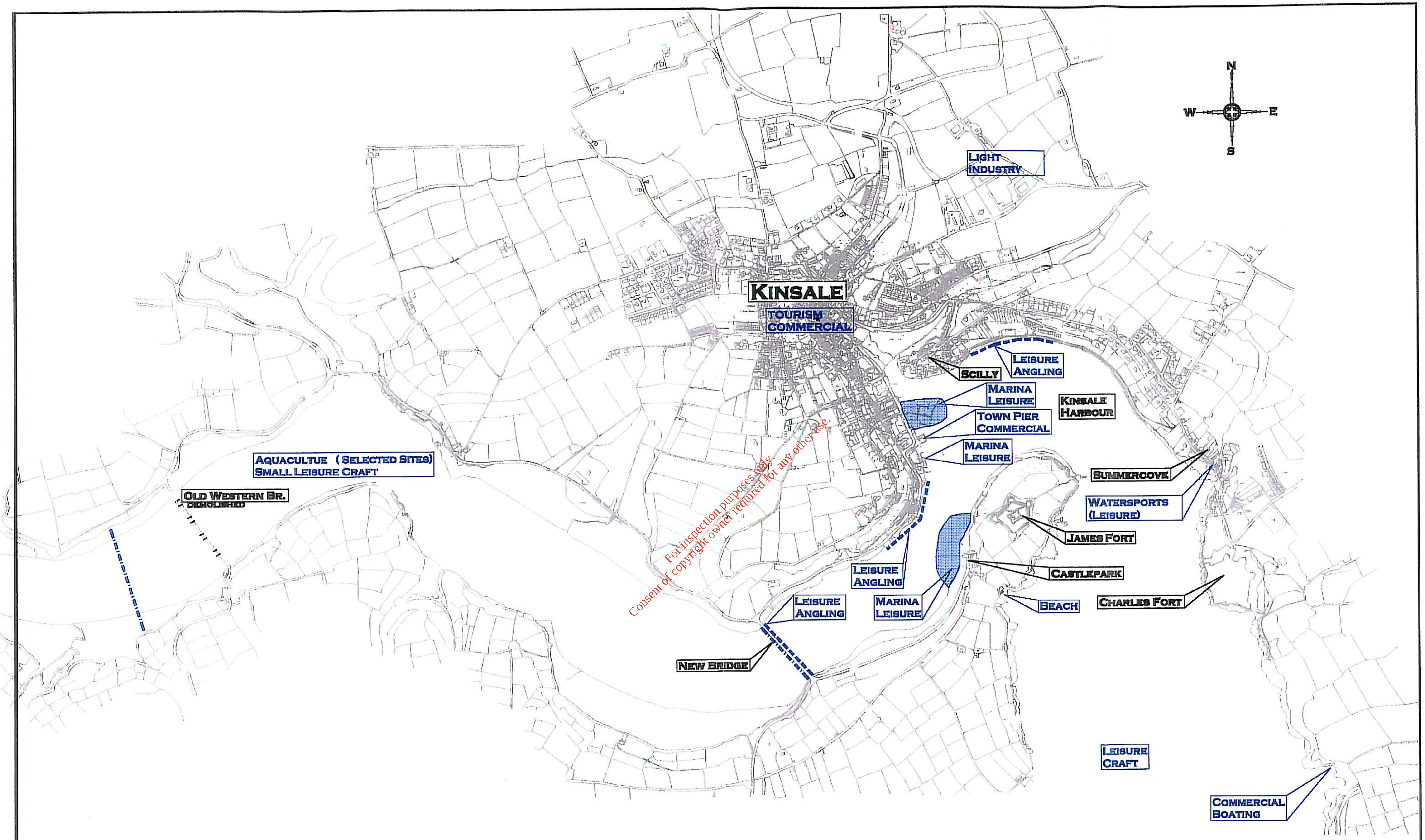
5.5.1 As can be seen from the above, the water quality within the harbour and estuary will be significantly improved. Reference to the simulated results for faecal coliforms (see Appendix A) show that a treated discharge from either of the proposed outfall locations will considerably improve the water quality over the situation which currently exists. Appendix A shows simulated results for Spring, Neap and Mean tides for Outfall Locations 1 and 2, and for Mean Tides for the existing regime and the proposed overflow.

5.5.2 The selection of Outfall Location 1 over Outfall Location 2 has already been discussed in Section 2 – Alternatives, and has been based on better dispersive characteristics and lower predicted maximum bacterial concentrations at the sensitive sites. Faecal coliform counts from Outfall Location 2 are measurable only at High Water for Spring and Mean Tides within the Oyster Fishery Order area, in the range 10–100 no./100 ml. However, taking all other considerations into account as previously detailed, locating the Outfall in the proposed location, and consequently the Waste Water Treatment Plant, has been shown to improve the water quality in the general location.

5.5.3 In order to minimise disturbance, it is proposed that the outfall pipe be laid during the winter months when the densities of benthic organisms are at their lowest.

5.5.4 Impacts caused by sedimentation may also affect the commercial oyster beds in the vicinity of the outfall. However, as the majority of the outfall pipe will be laid at the low tide period, sediments will not impinge on the oysters which will be out of the water during those periods. Impacts to these fisheries will be minimised by ensuring that the extent and duration of disturbance of the silts are minimised.

5.5.5 Sedimentation should only have a minor effect on demersal and pelagic fish populations as these fish will generally avoid areas where unsuitable conditions prevail. However, as the pipe will be laid during the winter months, the impacts on these fish will be minimised during the peak smolt migration period of March-May.



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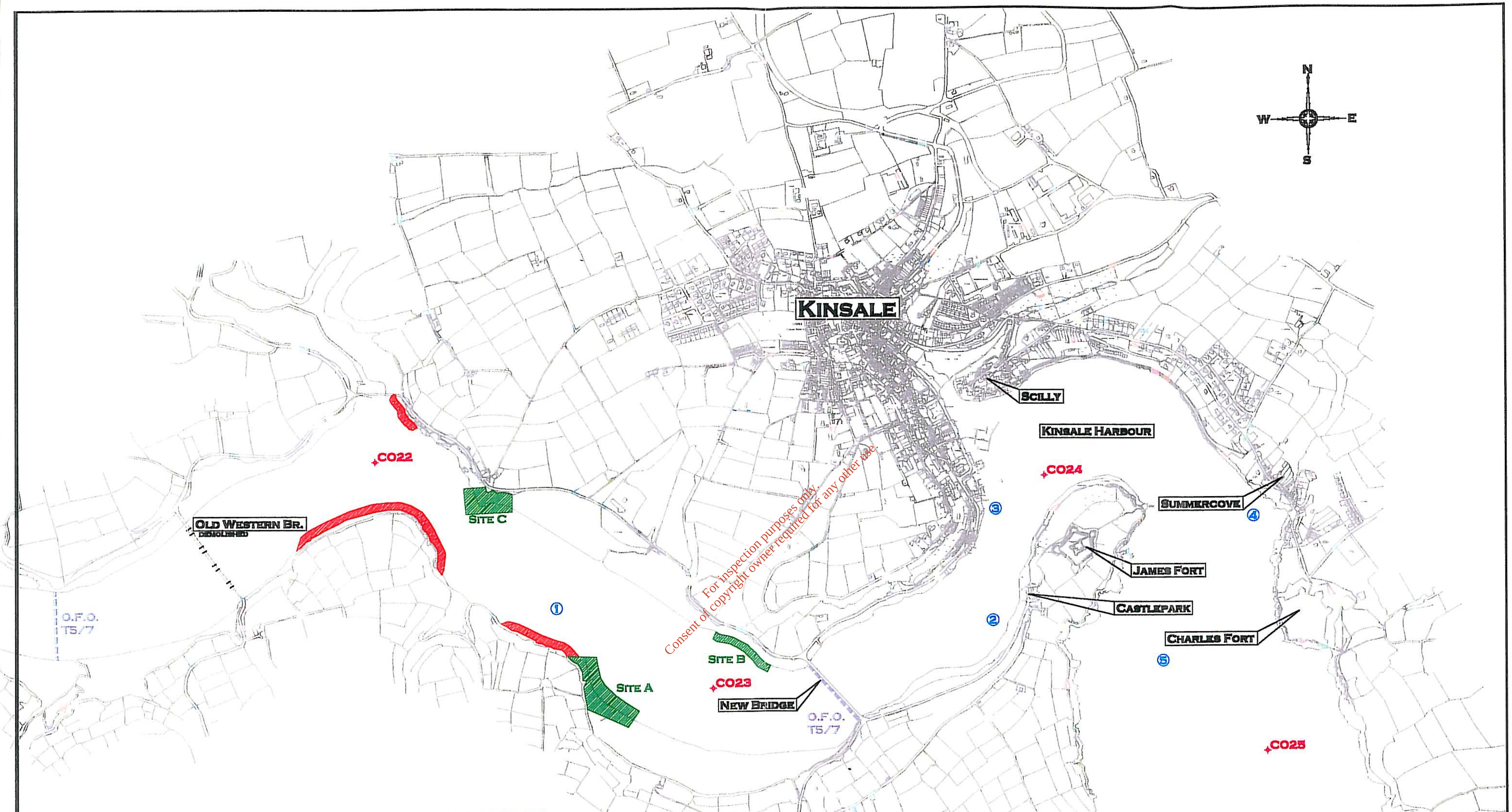
Project
Kinsale Sewerage Scheme. E.I.S.
Kinsale, County Cork

Title
Harbour Activities

Scales	1:15000	Drg. No. 2328/EIS 7	
Drawn		Fig. 5.1	
Ch'd(D.O.)			
Ch'd(Eng.)			
Approved		rev.	A



PRELIMINARY REPORT SAMPLING STATIONS 1-5

EPA SAMPLING LOCATION SCO22-CO25

OYSTER FISHERY ORDER T5/7

(KINSALE HARBOUR COMMISSIONERS)

EXISTING LICENCES

SITES A&B KINSALE SHELLFISH LTD.

SITE C KINSALE SEAFOODS LTD.

LICENCE APPLICATIONS PENDING

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Project: Kinsale Sewerage Scheme. E.I.S.
Kinsale, County Cork

Title: Water Quality Location Plan

Scale	1:15000	Drg. No. 2326/EISB	
Drawn		Fig. 5.2	
Ch'd(D.O.)			
Ch'd(Eng.)			
Approved		rev. A	

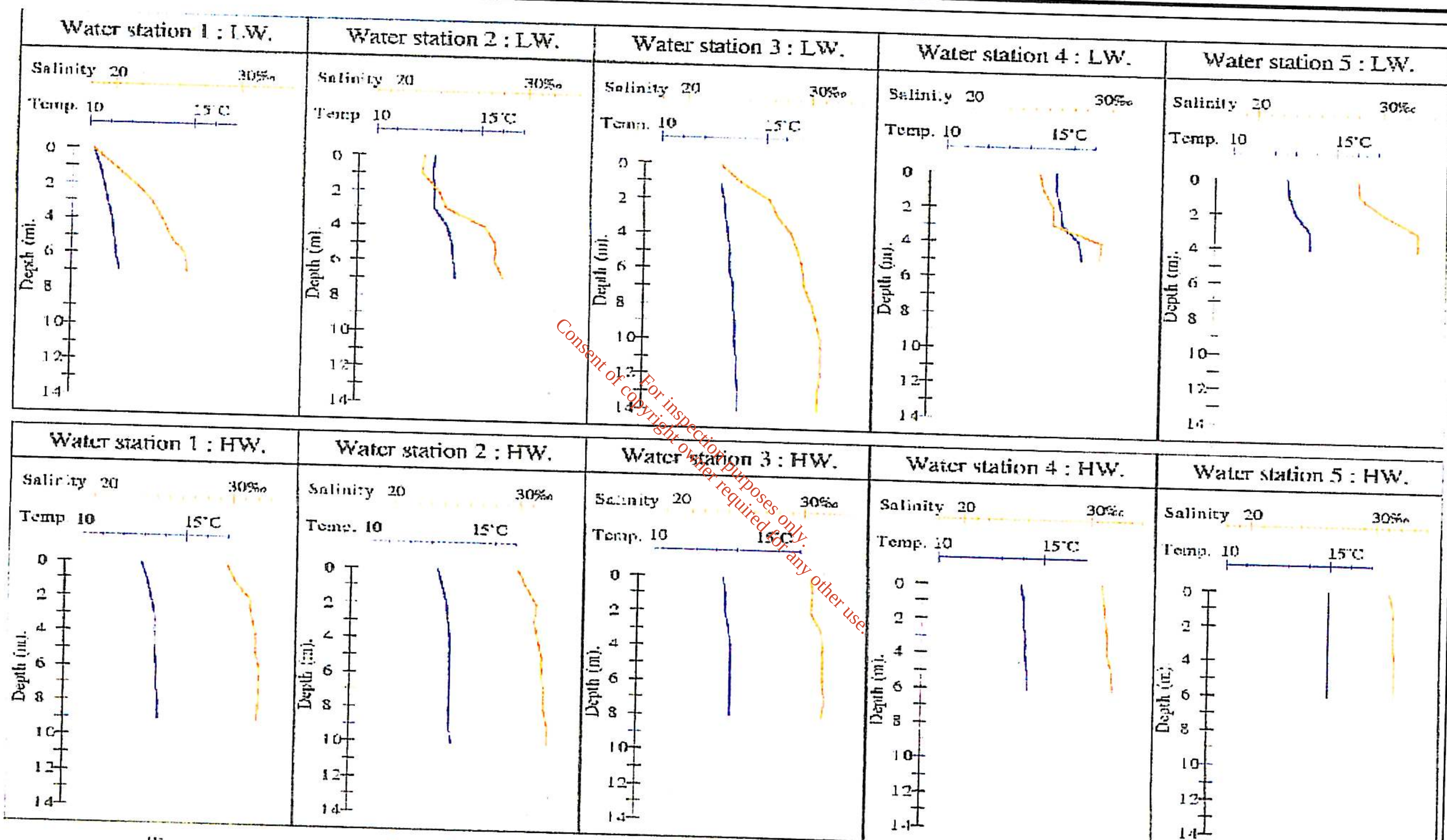

FIGURE 5.3 Temperature and salinity data from the five water sampling locations in Kinsale Harbour as part of the Kinsale SewerageScheme, 10/93. See Figure 5.2. for sampling locations.