12.0 SURFACE WATER

INTRODUCTION

12.1 This Chapter of the Environmental Statement discusses, firstly, the existing surface water regime in the Meenaboll area, secondly, the impact of the development on the quantity and quality of the surface water regime, and thirdly, how adverse impacts of the development can be mitigated against. The section outlining mitigation measures is based upon the guidelines prepared by the Environmental Protection Agency (EPA, 2000 and 2001). Datasets regarding the watercourses were gathered from Environmental Protection Agency and Donegal County Council water quality monitoring regimes, Ordnance Survey maps, hydrometric information (provided by the Office of Public Works and EPA), climate data (from Met Éireann) and on-site surveys and data collection exercises.

PHYSICAL CHARACTERISTICS – DRAINAGE, RELIEF AND SOIL COVER

12.2 The study area is drained by the Sruhanpollandoo stream, which flows in a north-westerly direction through the site. The stream is a tributary of the Cummirk River and is consequently within the Finn Catchment. The Sruhanpollandoo rises to the east of the site and flows through coniferous forest, hill land and a wooded glen at the downstream section (Figure 12.1).

12.3 The topography of the site varies between 215-260m AOD in elevation. The highest point is to the east of the site with the ground falling away to the northwest. The Sruhanpollandoo stream currently flows adjacent to the area proposed for landfill.

12.4 The surface water catchment of the Sruhanpollandoo Stream at the downstream limit of the site is 0.36 km^2.

12.5 The surface drainage of the proposed site naturally drains towards the Sruhanpollandoo due to surface gradients. However, the regime has been modified by provision of drainage channels during previous site development for agricultural/forestry activities. The watershed between the Gartan catchment and Finn catchment is illustrated in Figure 12.2.

12.6 Two detailed topographical surveys of the area were undertaken on the site in conjunction with existing maps and a visual inspection of the surface water flows at the site. Based on this information, no surface water originating within the boundary would naturally drain to the Gartan catchment. The proposed site has been strategically located to ensure that the landfill is not located within Gartan catchment.

12.7 The Sruhanpollandoo stream is a designated Salmonid Water Course under the Fresh Water Fish Directive (78/659/EEC).

12.8 The drainage of the soils within the Study Area is influenced by the high water table and the impermeable underlying drift deposits (boulder clay). The soil cover at the site is classified as a peaty podzol, which is characterised by high levels of saturation and poor drainage (i.e. low infiltration and predominantly surface runoff).

12.9 The Sruhanpollandoo and downstream watercourses are not used as surface water drinking supplies.

RAINFALL

12.10 Rainfall data for 56 stations within Co. Donegal are available from the Meteorological Office, Dublin. The location of each of the rain gauges is shown in Figure 12.3. The mean annual rainfall for County Donegal is mapped on Figure 12.4.

12.11 The average annual rainfall at the study area is generally within the range 1400 to 1600mm. Spatial variations in rainfall are noted across the County, with the highest rainfall expected to occur in the upland regions (>2600mm in the central plain area) and the lowest within the eastern area of the catchment (967mm at Newtowncunningham).

12.12 Met Éireann provided mean monthly potential evapotranspiration data, for the period 1968-1997, for Malin Head. The total mean annual loss is estimated at 577mm.

RIVER FLOWS

12.13 The river flows in the Finn Catchment are monitored at 2 automatic recording gauging stations. Gauging station records are processed at four sites in the vicinity of the study area. A summary of the available hydrological information is presented in Table 12.2(a-d). The Sruhanpollandoo stream is not gauged.

12.14 The hydrological characteristics of the nearest sites are assessed in terms of average, high and critical low flows. The flow characteristics resulting from the hydrological analysis are summarized in Table 12.3.

12.15 The allocation of effective rainfall between surface runoff and groundwater largely depends on the nature of the surface material and relief.

12.16 Consideration of the gauges located on the upper reaches of the watercourses generally exhibit conveyance of a high proportion of incident rainfall as surface runoff. Consequently the upper reaches of the river system is expected to respond rapidly to both rainfall and drought periods and are referred to as 'flashy' in character.

Table 12.1 Automatic Water Level Recorders

Station	River/Lake	Location	Operator	National Grid Reference	Catchment Area (km^2)	Period Processed
39006	Leannan	Claragh	DON	C202200	203	1977-85
39010	Crana	Illies	DON	C417336	36	-
39020	Glaskeelan	Insagh	ESB	C032183	8	1977-92
39021	Owennasop	Meanahernish	DON	C444368	12.5	1975-82

Table 12.2(a) Gauging Station Characteristics

River Leannan at Claragh		
Station 39006 (National Grid Reference C202200) Contributing Area 203km^2 Period Processed 1977-1985		
Flow Characteristics	1 Day duration (cumecs)	10 day duration (cumecs)
95 Percentile (Q95)	0.606	0.681
90 Percentile (Q90)	0.944	1.072
75 Percentile (Q75)	2.347	2.661
50 Percentile (Q50)	5.278	6.286
25 Percentile (Q25)	11.402	11.864
10 Percentile (Q10)	20.575	18.323
5 Percentile (Q5)	24.925	22.003
Baseflow Index (BFI) 0.448		

Table 12.2(b)

River Crana at Ilies		
Station 39010 (National Grid Reference C417336) Contributing Area 36km^2 Period Processed 1977 -1992		
Flow Characteristics	1 Day duration (cumecs)	10 day duration (cumecs)
95 Percentile (Q95)	0.094	0.104
90 Percentile (Q90)	0.144	0.176
75 Percentile (Q75)	0.288	0.459
50 Percentile (Q50)	0.691	1.110
25 Percentile (Q25)	1.692	2.043
10 Percentile (Q10)	3.566	2.983
5 Percentile (Q5)	5.083	3.605
Baseflow Index (BFI) 0.260		

Table 12.2 (c)

River Glaskeelan at Inagh		
Station 39020 (National Grid Reference C032183) Contributing Area 8km^2 Period Processed 1975 - 1982		
Flow Characteristics	1 Day duration (cumecs)	10 day duration (cumecs)
95 Percentile (Q95)	0.033	0.039
90 Percentile (Q90)	0.059	0.066
75 Percentile (Q75)	0.132	0.155
50 Percentile (Q50)	0.281	0.325
25 Percentile (Q25)	0.563	0.542
10 Percentile (Q10)	0.903	0.833
5 Percentile (Q5)	1.142	1.025
Baseflow Index (BFI) 0.441		

Table 12.2 (d)

River Owennasop at Meanahernish		
Station 39021 (National Grid Reference C444368) Contributing Area 12.5km^2 Period Processed 1991-1992		
Flow Characteristics	1 Day duration (cumecs)	10 day duration (cumecs)
95 Percentile (Q95)	0.042	0.049
90 Percentile (Q90)	0.060	0.090
75 Percentile (Q75)	0.123	0.207
50 Percentile (Q50)	0.313	0.544
25 Percentile (Q25)	0.843	1.051
10 Percentile (Q10)	1.638	1.521
5 Percentile (Q5)	2.307	1.861
Baseflow Index (BFI) 0.235		

Table 12.3 Comparison of River Flows

Station	**River**	**Mean Flow**		**Low Flow (Q95)**	
		(m^3/s)	(m^3/s per 100km^2)	(m^3/s)	(m^3/s per 100km^2)
39006	Leannan	8.04	4	0.606	0.3
39010	Crana	1.43	4	0.094	0.26
39020	Glaskeelan	0.424	5.3	0.033	0.41
39021	Owennasop	0.766	6.1	0.042	0.34

WATER QUALITY

Biological Water Quality

12.17 A detailed analysis of the aquatic ecology was undertaken within Section 10 of this report (10.108 – 10.124). The status of the aquatic ecology was used to make an assessment of the corresponding biological water quality based upon the Irish biotic score index, Q rating. (Flanagan and Toner, 1972; McGarrigle et al., 1992). Results of the analysis showed that biological water quality with a Biotic Index (Q value) of between 4 and 5.

Chemical Water Quality

12.18 Surface Water has been sampled by Donegal County Council on 6 occasions. Samples were taken from three locations as detailed on Figure 12.5. The results of these analyses are included in Table 12.3 below. The range of parameters sampled includes water pH, conductivity, temperature, Biological Oxygen Demand, Chemical Oxygen Demand, Nitrates, Ammonia, Dissolved Oxygen and Phosphates. The analyses show that the surface was found to be generally of good quality on the sampling dates. pH indicates acidic conditions which is characteristic of bog and surface water arising from plantations. Iron levels are also elevated which is characteristic in bogwater. COD and Manganese levels were elevated in August 2002, however when assessing all other parameters monitored it do not provide any indication as to the source of the elevated levels. Elevated COD can arise from sediments or fertilisers in surface water. Fertilisation of plantations can cause eutophication in surface water streams. Orthophosphate which is indicative of euthrophication was slightly elevated at times (>0.03mg/l). Further monitoring undertaken subsequent to the August 2002 has shown that these levels were not indicative of the water quality at the site. Chemical data was sourced from May 2002 to November 2003.

Table 12.3 Chemical Water Quality

Parameter	Units	Results																	
		SW2	SW2	SW1	SW2	SW3	SW2	SW3	SW2	SW3	SW2	SW3	SW2	SW3	SW2	SW3	SW2	SW3
		Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date
		29-May-02	30-Aug-02	11-Dec-02	11-Dec-02	11-Dec-02	27-Jan-03	27-Jan-03	13-May-03	13-May-03	07-Aug-03	07-Aug-03	17-Sep-03	17-Sep-03	20-Nov-03	20-Nov-03	01-Mar-04	01-Mar-04
pH		6.35	4.88	4.40	6.91	6.96	5.72	5.59	4.78	5.23			6.62	6.73	5.95	5.98	6.59	6.69
Temperature		13.30	17.10		4.50	4.20	10.6	11.3	12.43	13.29			16.30	16.20	9.30	9.40	6.3	6.3
Electrical conductivity EC		46.00	93.00		119.00	101.00	55	51	81.00	81.00			93.00	72.00	58.00	49.00	114	89
N	mg/l	<0.01	<0.01			0.01	0.03	0.02	0.02	0.04	0.018	0.015	0.02	0.02			0.06	0.02
Chemical oxygen demand	mg/l	49.00	151.00		22.00	15.00	47	27	27.00	31.00			87.00	92.00	68.00	45.00	30	37
demand	mg/l	1.14	3.78	9.24			1.02	0.74	1.12	0.74	2.17	1.92	0.54	0.52			1	0.61
Dissolved oxygen DO	mg/l	9.96	9.55		9.15	9.34	11.4	11.6	10.78	10.66	8.49	8.8	9.35	9.17			12.22	12.37
Chloride Cl	mg/l	21.00	18		23.00	25.00	19	17	24.00	23.00					20.00	20.00	26	28
Calcium Ca	mg/l		3.13				2.13	0.86	1.69	2.18								
Cadmium Cd	ug/l		<0.4				<0.4	<0.4	<0.4	<0								
Chromium Cr	ug/l		1.00				<1	<1	<1	<1								
Copper Cu	ug/l		<5				<5	<5	<5	<5								
Iron Fe	ug/l		1080.00				1892	300	423.00	519.00								
Lead Pb	ug/l		<5				<5	<5	<5	<5								
Magnesium Mg	mg/l		1.26				0.98	0.6	1.59	1.33								
Manganese Mn	ug/l		140.00				37	13	48.00	46.00								
Mercury Hg	mg/l		<0.05				<0.05	<0.05	<0.05	<0.05								
Nickel Ni	ug/l		<10				<10	<10	10.00	<10								
Potassium K	mg/l		0.80				0.4	0.3	0.20	<0.2								
Sodium Na	mg/l		9.00				<1	8.3	12.00	12.00								
Sulphate SO4	mg/l		24.00				9	7	8.00	9.00								
Zinc Zn	ug/l		19.00				5	<5	20.00	7.00								
Total alkalinity (as CaCO3)	mg/l		<2				<2	<2	2.00	2.00								
TON	mg/l	0.03	0.08				0.164	0.04	0.01	<0.01			<0.01	<0.01				
Total Organic Carbon	mg/l		36.00				10	7	14.00	15.00								
Nitrite NO2	mg/l	0.05	<0.03				0.05	0.03	0.03	<0.03	<0.03	<0.03	<0.03	<0.03				
Nitrate NO3	mg/l	0.07	0.35				0.66	0.13	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04				
/100mls)	(per 100mls)		ND				ND	4	7.00	12.00								
Total coliforms (/100mls)	(per 100mls)		10				33	24	12.00	27.00								
Phosphate PO4	mg/l	0.06	0.07				0.9	0.5	0.03	0.04			0.13	0.13				
Residue on evap	mg/l	2.00																

POTENTIAL IMPACTS

12.19 This section identifies the predicted impact of the development of the proposed landfill facility in comparison to the 'do-nothing' scenario. The impacts of the quantity and quality of surface waters are considered in accordance with guidelines prepared by the EPA. Mitigation measures with regard to surface water are discussed in the following section. The impact of leachate leakage on surface water is considered in Chapter 13. Surface water assessment considers the portion of incident rainfall that falls upon the landfill cap or lining system and drains to the surrounding watercourses. The landfill has been designed on a cellular basis to minimise the quantity of rainfall which comes in contact with the waste. Additional detail in relation to this is provided in Section 6 of the EIS with the Water Balance Calculation. The portion of rainfall, which will infiltrate the landfill system, is separately collected as leachate and treated prior to disposal.

COMPARISON OF IMPACTS

Do-Nothing Impacts

12.20 The existing land-use of the proposed landfill site is Forestry managed by Coillte.

12.21 Forestry plantations can potentially have a significant influence on the physical and chemical characteristics of adjacent watercourses influencing water quality, water yield and fishery status. The nature and extent of the effects alter throughout the lifetime of one crop. Potential impacts can include increase in runoff, increase in sediment yields due to site preparation, drainage and ploughing, soil drying, shading, contamination from fertilisers and, in upland regions, potential acidification.

12.22 The upper reaches of the Finn River Catchment are not designated as acid sensitive watercourses.

12.23 The Forestry Service has issued a set of Guidelines for the management of forestry to reduce the potential impact on the aquatic environment. The Meenaboll site is presently well managed in accordance with the current guidelines.

12.24 The increased load of phosphorus in streams derived from artificial fertilisers is of particular concern to water quality in Ireland. Environmental quality standards and objectives have been proposed in "Managing Ireland's Rivers and Lakes" (DoE, 1997) to reverse this trend in declining water quality in freshwater courses.

Predicted Impacts

12.25 The predicted impacts from the proposed landfill development are considered with respect to the short-term and long-term consequences.

12.26 The proposed landfill will be developed as a containment site. The proposed facility will be developed, operated and restored on a phased basis. It is proposed that the first phase of the development will include the clearance, excavation and engineering of Phases 1 and 2 as illustrated in Figure 12.6. The clearance and excavation work for this first phase is likely to take approximately 8 to 10 weeks after which cells shall be progressively lined, filled, capped and permanently reinstated. Prior to completion of phases 1 and 2, the engineering Phase 3 will commence to ensure landfill capacity is available prior to reaching final levels in Phases 1 and 2. The total size of the site is 45,000m^2 with the maximum area exposed at any one time not exceeding 15,000m^2 at any stage.

Short-Term Impact *(Construction and Operation)*

12.27 During the initial construction stage of each phase when the soil will be exposed, incident rainfall could, as a worst case, collect sediment from the overburden/rock material, which forms the base of the site. To ensure minimal sediment transport from the site settlement lagoons will be constructed at the area shown on Figure 12.6. These surface water holding lagoons will be developed at the commencement of the construction of the landfill facility.

12.28 These surface water settlement lagoons will be designed to carry flows (including the 1:25 year design event) from areas except the operational landfill cells.

12.29 An additional road drainage settlement lagoon will be constructed at the area shown on Figure 12.6. Surface water collected from the site roads will be directed to road gullies, then pass through an oil interceptor prior to entering the road drainage settlement lagoon.

12.30 The outflow from the surface water lagoons will be regulated using a floating arm draw off arrangement. This arrangement will allow the clarified water to be drawn from the top of the lagoon while settlement continues towards the bottom of the lagoon. A minimum depth of water of 2m will be retained in the lagoons at all times for fire fighting purposes.

12.31 Constructed Wetlands shall be constructed at the location shown on Figure 12.6. All water from the surface water lagoons will pass through the Constructed Wetlands prior to discharging to the adjacent Sruhanpollandoo stream. This will act as a final measure to ensure the quality of the Sruhanpollandoo stream.

12.32 During the operational phase surface water run-off from the site is expected to be negligible. Incident rainfall will infiltrate the landfill material where it shall be collected by the leachate collection system.

12.33 As the cells are finally capped, topsoil and grass seed will initially be applied as the final surface finish. Grass establishment will depend upon the time of year that the cell is completed. It is also planned that a buffer zone of existing forestry plantation will be maintained around the perimeter of the site. Again, as a worst case scenario, it is estimated that a maximum of one cell (60x140m) will be capped in any one year. Slightly increased levels of suspended solids are likely until grass/pasture is established. All water from these areas will pass through the settlement lagoons and Constructed Wetlands.

12.34 The soil cap and surface gradient will produce similar surface run-off characteristics to the present condition. Manning's equation was used to model the effect of the proposed landfill on stream water levels. Results indicated an additional 30mm of stage during the design event compared to the existing regime. However, the loss of cover will slightly reduce evapotranspiration loss and 'on-branch' storage resulting in moderately increased peak run-off rates until the grass/pasture and soil structure becomes well established. The overall impact upon surface water quality is therefore not considered to be significant.

Long-Term Impacts

12.35 Once the grass/pasture land is established post operation there is likely to be minimal long-term impact. Sediment/suspended solid levels will be low level and runoff characteristics will be similar to the existing regime. The settlement lagoons and Constructed Wetlands will continue to be utilised until such times as the restoration of the site is complete.

Worst Case Scenario

12.36 The most extreme event which could significantly impact upon the quality and quantity of surface water would be a severe rainfall event during the initial site clearance operations. This would generate high suspended solids concentrations in run-off towards the stream. Surface water from these areas will pass through the settlement lagoons and Constructed Wetlands. In addition the stream flow itself will have increased during the event yielding adequate dilution of suspended solids. The mitigation measures detailed below will be designed to cope with a severe design storm event.

12.37 A high rainfall event during the filling of a cell would infiltrate the landfill material and be collected by the leachate collecting system thus resulting in a minimal adverse impact.

12.38 With the case of drought conditions low flows in the river will coincide with low run-off from the site. This will result in low suspended solid concentrations in the stream. Mitigating measures to reduce suspended solid concentrations from the site are discussed below.

MITIGATION MEASURES

12.39 An improved surface water management system will be established in the vicinity of the site to minimise the impacts on water quality and quantity in the adjacent watercourses and downstream in the River Finn. Design of the surface water management system will also consider the need to minimise adverse impacts on the National Heritage Areas in the vicinity of the site. Similar measures have successfully been developed at recently established designed landfill facilities to protect adjacent watercourses.

12.40 Prior to any construction work commencing on site settlement lagoons and Constructed Wetlands will be developed at the location shown on figure 12.6. This will assist with ensuring sediment transport off site is minimised. A flow gauge will be installed downstream of the Constructed Wetlands prior to the development of the wetlands. The Constructed Wetlands and associated system will be maintained and operated by Donegal County Council.

12.41 The Sruhanpollandoo stream, which runs adjacent to the landfill area will be culverted through the site to prevent the possibility of sediment entering the stream.

12.42 A cut-off drain will be excavated around the perimeter of the entire site. It will be designed to collect the clean surface water, which will run-off from both the capping layers of the landfill and the surrounding catchment.

12.43 During the construction period it will be necessary to install a storm water collection system. The system will be designed to carry flows (including the 1:25 year design event) from the landfill cells to the storage lagoons. The system will be designed for 1:25 year design events and will fulfil two purposes:

- During storm events the outflow from the site will be controlled so that the storage lagoons and collection system will provide storage volume so as to reduce peak flows to the adjacent watercourse; and
- In average/low flows the storage lagoons and collection system will retain flows allowing sediments to settle out, reducing loadings to the watercourse.

12.44 Post-operation the lagoons will not be required as the site will be returned to its original condition, run-off characteristics will be similar to the existing regime.

12.45 The ongoing monitoring of surface water quality at the landfill site will be continued, ensuring the effective management of the drainage system. The programme will be agreed with the EPA.

12.46 The facility will be managed and operated so that capping and permanent grassed reinstatement will be carried out as soon as possible after completion of the cell. This will reduce the unreinstated area, which may create suspended solid load to the river. Material from the newly excavated cells will be recycled and used to form the capping layer.

12.47 Earth-bunds will be constructed between the site and the adjacent cut-off drain to prevent surface water flooding of the facility due to increased storm water levels in the cut-off drain. Surface water run-off from paved areas will be directed to the settlement lagoon.

12.48 The drainage system will be designed to ensure that surface water from paved maintenance/parking/fuelling areas will pass through oil interceptors, prior to entering the settlement pond and Constructed Wetlands system.

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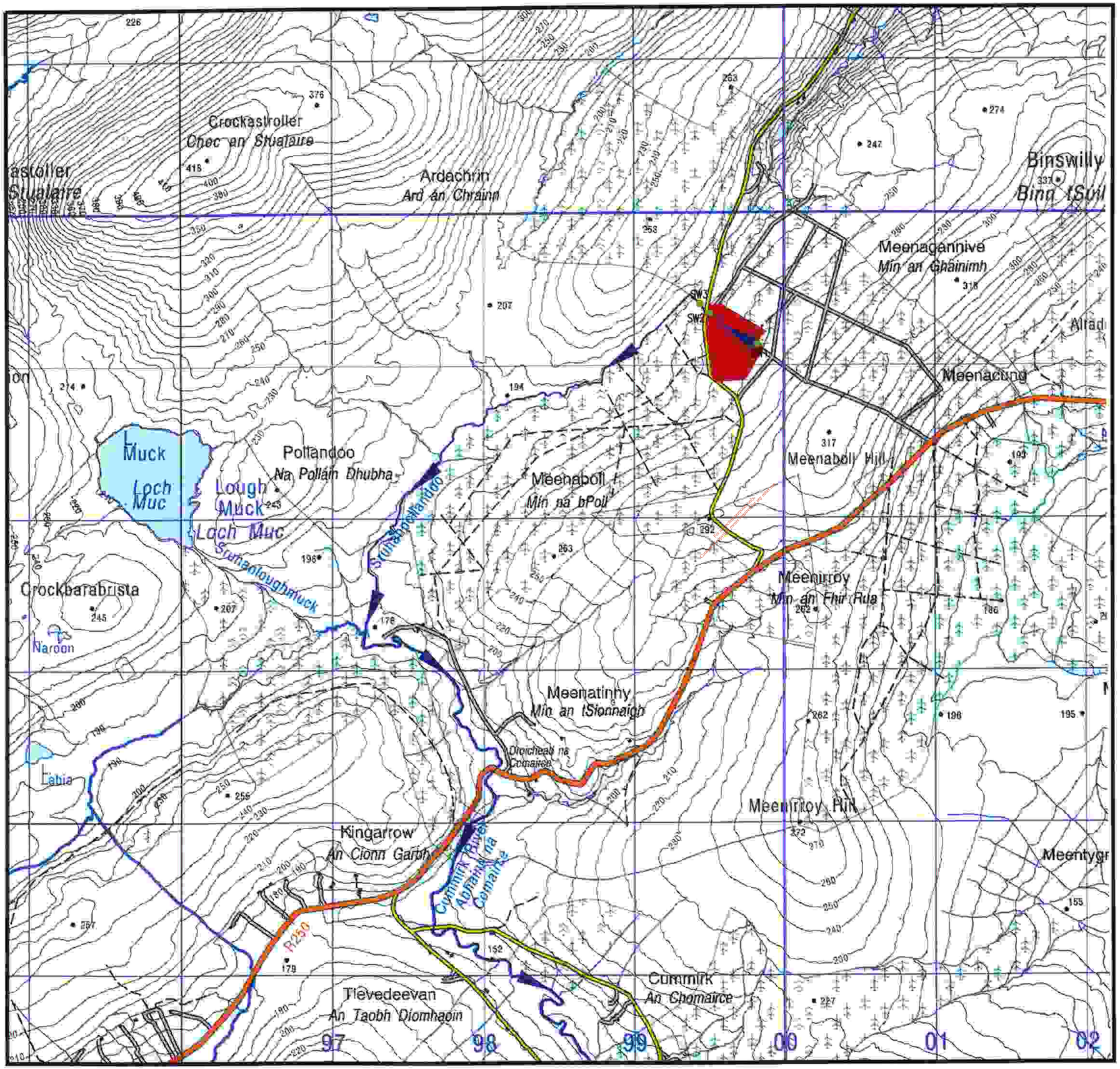
FIGURES



KEY

SITE AREA

WATERCOURSES

SW1 PROPOSED SURFACE WATER MONITORING POINTS

SCALE: 1:25,000

KIRK McCLURE MORTON
CONSULTING ENGINEERS

Comhairle Chontae Dhún na nGall
Donegal County Council

PROJECT

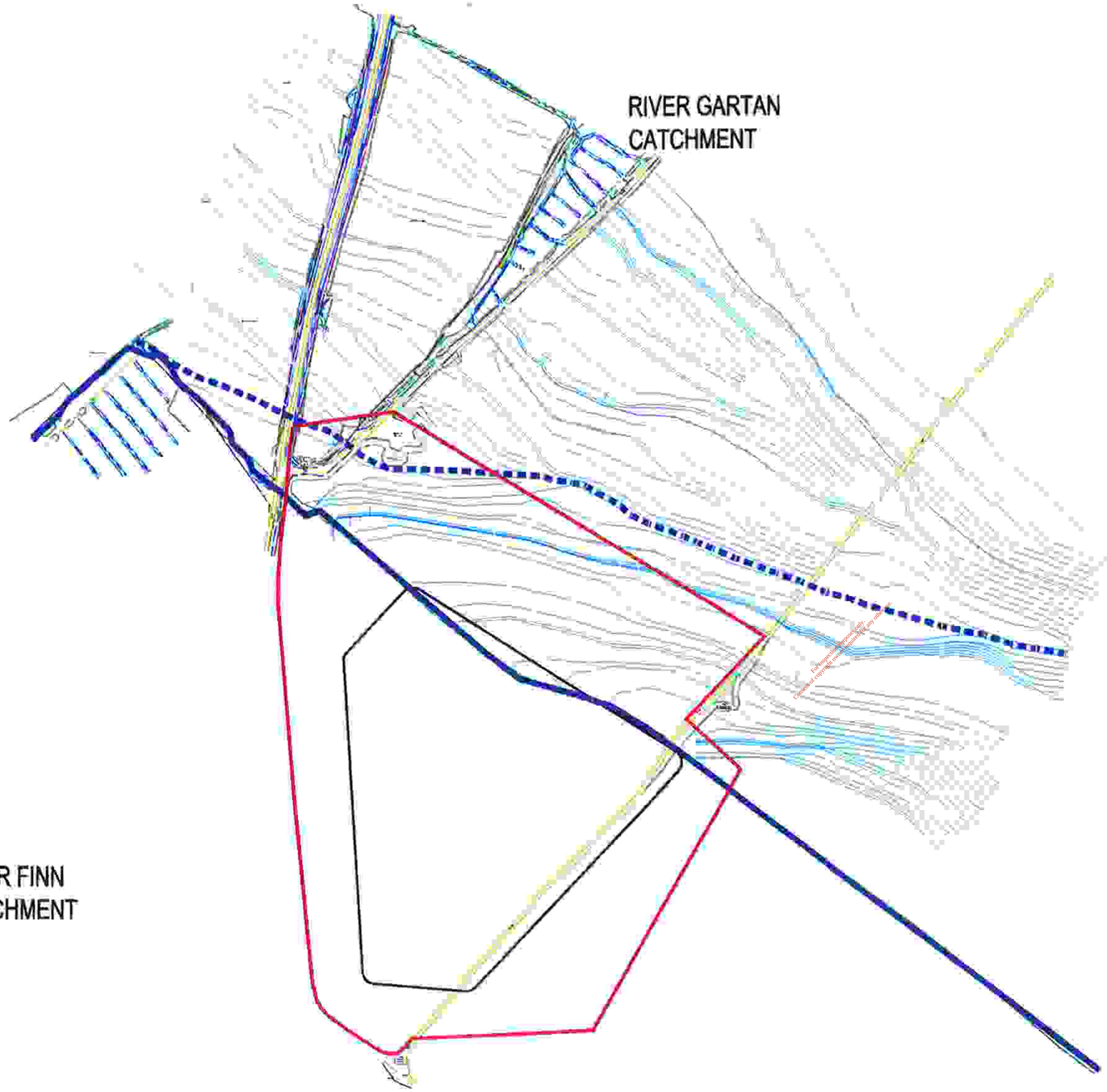
MEENABOLL LANDFILL PROJECT

TITLE

SURFACE WATER DRAINAGE

FIGURE

12.1



KEY:

- WATER SHED
- SITE BOUNDARY
- LANDFILL BOUNDARY
- SURFACE WATER FLOW LINES
- SURFACE TOPOGRAPHICAL CONTOURS
- SRUHANPOLLANDOO STREAM

SCALE: 1:4000

KIRK McCLURE MORTON
CONSULTING ENGINEERS

Comhairle Chontae Dhún na nGall
Donegal County Council

PROJECT

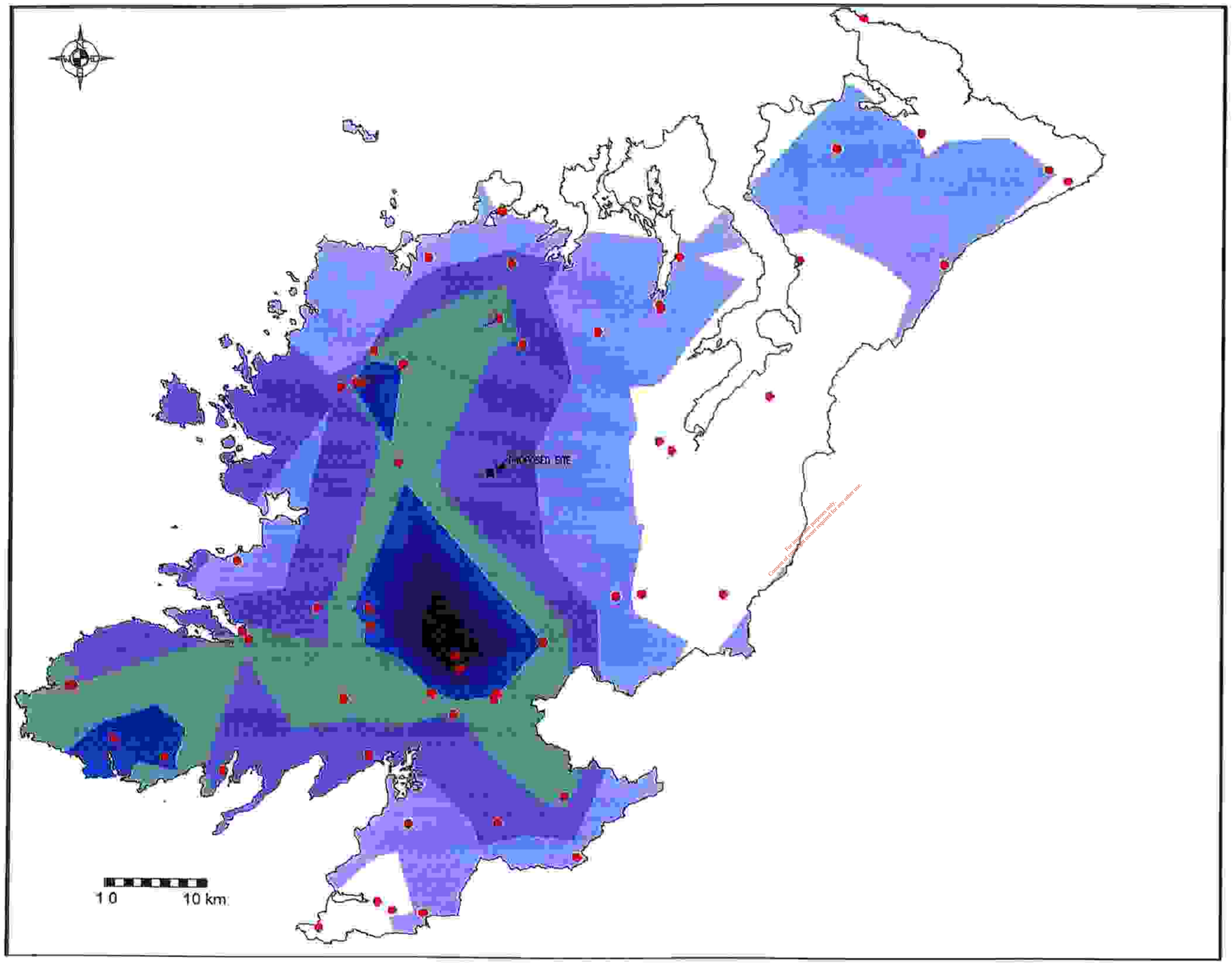
MEENABOLL LANDFILL PROJECT

TITLE

SURFACE WATER FLOWLINES

FIGURE

12.2



KEY

- 1000 – 1199
- 1200 – 1399
- 1400 – 1599
- 1600 – 1799
- 1800 – 1999
- 2000 – 2199
- 2200 – 2399
- 2400 – 2599
- 2600 +
- RAIN GUAGE STATIONS

SCALE:NTS

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CONSULTING ENGINEERS

Comhairle Chontae Dhún na nGall
Donegal County Council

PROJECT

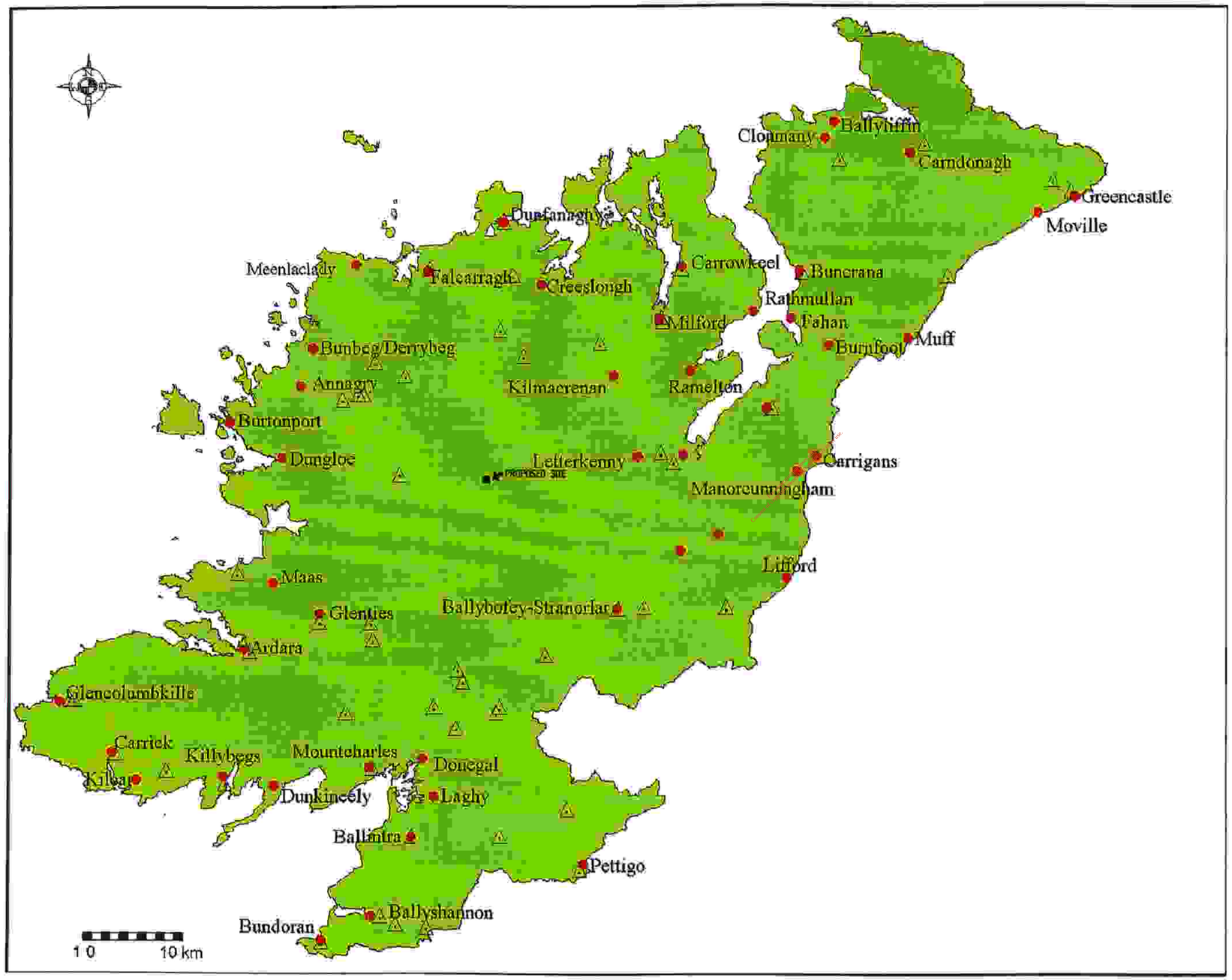
MEENABOLL LANDFILL PROJECT

TITLE

MEAN ANNUAL RAINFALL FOR Co DONEGAL

FIGURE

12.3



KEY

- RAIN GUAGE STATIONS
- TOWNS
- PROPOSED LANDFILL SITE (BALLYNACARRICK)

SCALE:NTS

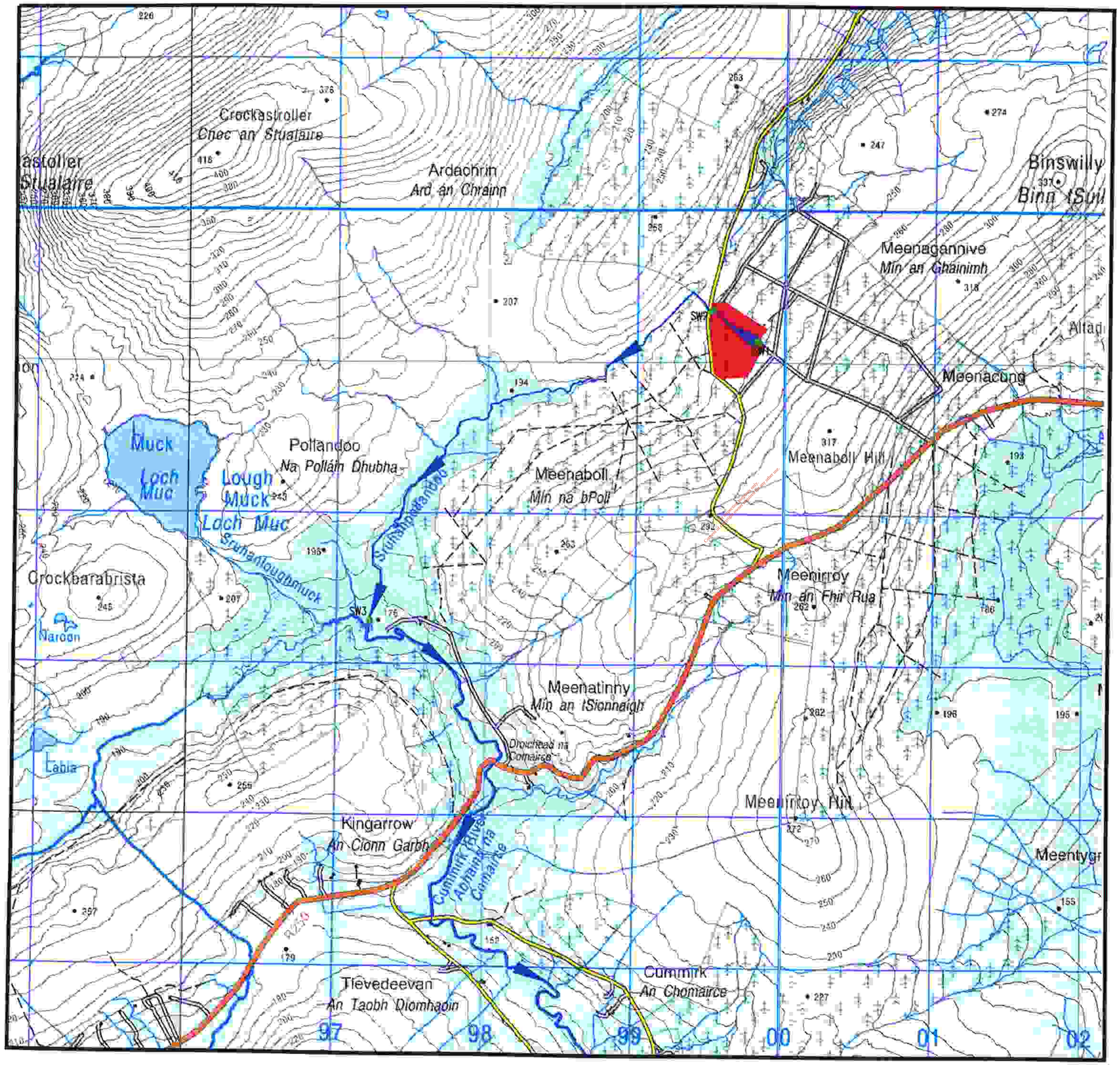
KIRK McCLURE MORTON
CONSULTING ENGINEERS

Comhairle Chontae Dhún na nGall
Donegal County Council

PROJECT
MEENABOLL LANDFILL PROJECT

TITLE
LOCATION OF RAIN GUAGES

FIGURE
12.4



KEY

SITE AREA

WATERCOURSES

SW1 SURFACE WATER MONITORING POINTS FOR HYDROLOGY STUDY

SCALE: 1:25,000

KIRK McCLURE MORTON
CONSULTING ENGINEERS

Comhairle Chontae Dhún na nGall
Donegal County Council

PROJECT

MEENABOLL LANDFILL PROJECT

TITLE

SURFACE MONITORING POINTS

FIGURE

12.5

KEY

- GENERATOR
- PHASE 1
- PHASE 2
- PHASE 3
- PHASE 4
- PHASE 5

SCALE: 1:2000

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Comhairle Chontae Dhún na nGall
Donegal County Council

PROJECT

MEENABOLL LANDFILL PROJECT

TITLE

SITE PHASING

FIGURE

12.6