Dingle GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
22 Kerry Co. Co.	**Rivers:**.Owenalondrig, Gloushavanowen, Milltown, Garfinny, Owenascaul, Balyheabought, Emlagh, Groin, Langdon, Glanageenty, Maine, Little Maine, The Brown Flesk. **Loughs:** Anscaul, Thuairin, Bhearna na Gaoithe, Ablockaun, Mount Eagle.	Ventry Dunes and Marshes (001384)	347

Topography		This GWB occupies uplands, slopes, sea cliffs and coastal sections on the south side of the Dingle Peninsula. It is elongated east west along the south side of the ridge formed by the Slieve Mish Mountains. Ground elevation ranges between sea level and more than 850 m OD. The top of the ridge which runs along northern boundary of this GWB (the centre of the peninsula) ranges from 600-850 m OD. The highest point is 850 m in the Slieve Mish Mountains at the northern boundary of the body. The edges of the GWB next to the sea are often high cliffs, particularly in the west of the body. The terrain is very steep and mountainous, with numerous rivers incising valleys into the bedrock. Drainage density is high, with lots of small channels; most streams flow generally to the south, at right angles to the seaward boundaries of the groundwater body. Ground elevations are lower (<50 mAOD) around Dingle and in the east of the body towards the south and southeast. Ground elevations in the east of the body in the vicinity of the River Maine are 20-30 m OD
Geology and Aquifers	**Aquifer categories**	**Ll:** Locally important aquifer, moderately productive only in local zones. **Pl:** Poor aquifer, generally unproductive except for local zones. *(0.02km2 mapped as Tuff – Volcanics provisionally classed Lm* ***Locally important which is generally moderately productive.)***
	Main aquifer lithologies	The majority of the GWB is composed of Devonian Old Red Sandstones. There are also some areas of Ordovician Metasediments and Silurian Metasediments and Volcanics. *(An extremely small area (0.02km^2) of Tuff is mapped (Basalts & other volcanic rocks) on Slea Head.)*
	Key structures	The major structures in this GWB are three large anticlines with an ENE-WSW orientation. Strata dip roughly NNW and SSE, at right angles to the fold axes. The bedding dips generally range from 10-40^o NE-SW. WNW to ESE trending faults cross-cut the fold axis; there are also many major faults parallel to the fold axes. In addition to fault-related fracturing, folding also caused some fracturing and jointing of the rocks, particularly on the axes of the anticlines.
	Key properties	Permeability generally decreases rapidly with depth in all aquifers. In general, the ORS and Lower Impure Limestone aquifer transmissivities will be in the range 2-20 m^2/d, with median values occurring towards the lower end of the range. However, 'Excellent' yielding wells (>400 m^3/d) are known in some of the ORS units – these yields are usually associated with boreholes being situated on fault zones. Summer yields are sometimes unsustainable. Silurian, Ordovician rock unit group transmissivities will be lower. Aquifer storativity will be low in all rock units. Groundwater gradients are likely to be in the range 0.01 to 0.04.
	Thickness	The Devonian ORS, Silurian and Ordovician rock unit groups reach maximum thicknesses of more than 100's of meters. In this vicinity, the Dinantian Lower Impure Limestones rock unit group is approximately 200 m thick at its maximum. However, in all aquifers within this GWB, most groundwater flow occurs within the top 15-20 m of the aquifer, in the layer that comprises a weathered zone of a few metres and a connected fractured zone below this. Deeper flows occur along generally isolated faults or significant fractures. Springs occur on fault zones, indicating that these major structures are responsible for conducting the groundwater flow.
Overlying Strata	**Lithologies**	The GWB is generally covered by Devonian sandstone till at the lower elevations (<150 m OD, approximately). Above this height, Blanket Peat is the predominant soil cover. There are also extensive areas of bare or shallow rock. There are also areas of cutover peat in the east of the GWB. In areas underlain by or adjacent to Silurian and Ordovician rocks, the subsoil comprises Sandstone and Shale (Lower Palaeozoic) Till. Undifferentiated Alluvium occurs in small patches along river courses throughout the body. *Subsoil Types identified in Dingle GWB by Teagasc Parent Material Mapping (Draft): Alluvium (A); Blanket Peat (BktPt); Cut Peat (Cut); Lake Sediment (L); Made Ground (Made); Beach/raised beach sands and gravels (Mbs); Estuarine sediments (silts/clays) (Mesc) Rock outcrop and rock close to surface (Rck); Scree (Scree); Till – Devonian Sandstone Till (TDSs), Lower Palaeozoic Sandstone and Shale Till (TLPSsS), Limestone Till (TLs) & Namurian Shale & Sandstone Till (TNSsS); Blown sand (Ws); No data available (No data).*
	Thickness	Over most of the GWB, subsoil thickness is expected to be < 10 m. Outcropping and shallow rock is very common, particularly in the upland areas and near coastal cliff sections. Outside these areas subsoil thickness generally ranges 3-8 m. In the easternmost parts, subsoil is thicker; recorded depth to rock varies 4-21 m although small isolated areas of outcrop and shallow rock also occur.
	% area aquifer near surface	
	Vulnerability	There is no Groundwater Vulnerability Map available for Co. Kerry at present. Due to the large areas of outcrop and shallow rock in the body, a large percentage of the body will be designated as Extreme vulnerability. In the east of the body, and in other areas where the subsoil cover is >3 m vulnerability will range from High to Low, depending on the permeability and thickness of the subsoil.

Recharge	**Main recharge mechanisms**	Diffuse recharge will occur via rainfall percolating through the subsoil or areas of outcropping rock. The proportion of the effective rainfall that will recharge the aquifer is determined by the permeability of the soil and subsoil, and by the slope. Due to the generally low permeability of the aquifers within this GWB and the high slopes, a high proportion of the recharge will discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively reducing further the available groundwater resource in the aquifer.
	Est. recharge rates	
Discharge	**Large springs and high yielding wells (m^3/d)**	Ballyheabought (Kerry Fish Ltd) Trial Well 1 (895 m3/d) Trial Well 2 (491 m3/d) Dingle WSS Borehole (1136 m3/d) Ballymore WSS-Spring (545 m3/d)-abstraction value) Dingle Creamery, Grove (436 m^3/d)
	Main discharge mechanisms	The main discharges are to the gaining rivers and streams crossing the sandstones, shales and impure limestone rock units and to generally small springs and seeps. Groundwater will also discharge at the coast. Localised seepages may develop on the cliff faces. Cross-flow may occur from the aquifers in this GWB to the adjacent karstic Castlemaine GWB.
	Hydrochemical Signature	Only data from three points in the Dingle Peninsula are available to assess the hydrochemistry of this GWB (Ballinloghig WS and boreholes at Kerry Spring Ltd – Brandon Head GWB; Anaslcaul WS – Dingle GWB). All three sources occur in the Devonian ORS. At the Kerry Spring Water borehole, groundwaters have a calcium-bicarbonate type signature, are generally Moderately Hard (185-275 mg/l as $CaCO_3$) with alkalinities in the range 165-260 mg/l as $CaCO_3$, and Lab pH's in the range 6.77-7.5. Chemical analyses from the Kerry Spring boreholes are relatively consistent. In contrast, at Ballinloghig WS, groundwater is Soft (55-80 mg/l as $CaCO_3$) with low alkalinity (< 40-65 mg/l as $CaCO_3$) and lab pH of 6.1-6.7. At Anaslcaul WS, groundwater is soft (18-38 mg/l as $CaCO_3$) with low alkalinity (12-33 mg/l as $CaCO_3$), and lab pH of 6.1-7.4. At Ballinloghig and Anascaul the available data suggests that the hydrochemical signature varies at different times of the year. At Ballinloghig the hydrochemical signature varies between Ca-HCO_3 (calcium-bicarbonate) in summer and Mg-SO_4 (magnesium-sulphate) in winter (see Figure 1). Since summer 1999, concentrations have been relatively stable, and groundwater has an Mg-Ca-HCO_3 signature. The groundwater chemistry at Anascaul is much more variable and it is difficult to identify any consistent seasonal variation (Figure 3). In general, high iron (Fe) and manganese (Mn) concentrations can occur in groundwater derived from ORS, due to the dissolution of Fe and Mn from the sandstone/shale where reducing conditions occur. It has been demonstrated that at low pumping rates water does not reside long enough in the well for oxidation to occur, thereby resulting in elevated Fe and Mn in small domestic supplies (Applin *et al*, 1989). No other data are currently available for this GWB. In the impure limestones, groundwater will be Hard to Very Hard, with corresponding high alkalinities. In the Silurian and Ordovician rock units, groundwaters will be relatively soft (24-88 mg/l as $CaCO_3$) with low alkalinities. pH will be neutral. Background chloride concentrations in all aquifers will be higher than in the Midlands, due to the proximity to the sea. Where the influence of sea water incursion is responsible for high chloride levels pumping rates in such areas may need to be kept below a level with could cause sea water to be drawn into the boreholes. Chloride concentrations of 250 mg/l (Chloride MAC is 250 mg/l) have been recorded in Valentia (Conlon & Wright 1998).
Groundwater Flow Paths		These rocks are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. The rocks are dependent on fracturing and fissuring to enhance their permeability. Permeability is highest in the upper few metres but generally decreases rapidly with depth. In general, groundwater flow is concentrated in the upper 15 m of the aquifer, although deeper inflows from along fault zones or connected fractures can be encountered. Significant yields can be obtained where boreholes are drilled into known fault zones. However, yields are not necessarily sustainable, as the fracture networks are generally not extensive or well connected but primarily concentrated in the vicinity of the fault zones. Springs are noted to occur in some instances on fault zones. Groundwater levels are about 1.5-15 m below ground level, and will generally follow the topography. Close to the rivers and streams, water levels will be near ground level. Surface water features are considered to be in hydraulic continuity with the water table. Groundwater flow will be of a local nature. Groundwater flow paths are generally short, typically from 30-300 m, with groundwater discharging to small springs, or to the streams and rivers that traverse the aquifer. Flow directions are expected to approximately follow the local surface water catchments. Overall, groundwater flows south to the coast from the topographic high in the north of the body, and east to the River Maine in the east of the body. Groundwater is generally unconfined in this groundwater body.
Groundwater & Surface water interactions		Groundwater will discharge locally to streams and rivers crossing the aquifer and also to small springs and seeps. Owing to the poor productivity of the aquifers in this body it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is likely to be relatively low. Ventry Dunes and Marshes NHA (001384) comprises Ventry Strand, a small sand dune system, a small lake, wet grasslands and an extensive Common Reed (Phragmites australis) reedswamp which may be locally dependent on groundwater.

Conceptual model	• The groundwater body is bounded to the west and southwest by the coast, to the northeast by the contact with karstic limestones of the Castlemaine GWB. The northern boundary is formed by the topographic high and surface water divide which coincides with the groundwater divide. • The topography of this body is mountainous, with ground level continually rising from the coast to the highest elevations in the centre-west and north of the body. In the extreme east of the body the topography is more subdued with a gentler slope in the vicinity of the Maine River Valley. • The groundwater body is comprised of rocks with low transmissivity and storativity, although localised zones of enhanced permeability occur along fault zones. • Flow occurs along fractures, joints and major faults. Flows in the aquifer are generally concentrated in a thin zone at the top of the rock, although deeper groundwater flows along faults and major fractures. • Diffuse recharge occurs across the GWB through the subsoils and rock outcrops. Due to the generally low permeability of the aquifers within this GWB and the high slopes, a high proportion of effective rainfall will runoff, or discharge rapidly to surface water courses via interflow and shallow flow. Where water levels within the unconfined aquifer are high, potential recharge will also be rejected. • The water table can vary between a few metres up to more than 10 m below ground surface, depending upon topography. Groundwater is generally unconfined, except where blanket peats overlie the aquifer. Flow path lengths are generally short, ranging from 30-300 m. Local groundwater flow directions are controlled by local topgraphy. Overall, groundwater flows south to the coast from the ridge along the north of the body, and east and southeast from the topographic highs in the east of the GWB. • Groundwater discharges to the numerous streams and rivers crossing the aquifer, which are gaining, and to springs. Seepage zones may exist on the cliff faces. A small volume of groundwater may cross-flow into the adjacent karstic Castlemaine GWB.
Attachments	Hydrochemical Signature (Figure 1); Groundwater Hydrograph (Figure 2)
Instrumentation	**Stream gauges:** 22003*, 22015, 22021, 22022*, 22023, 22025, 22026. * Adjusted Dry Water Flow available. **EPA Water Level Monitoring boreholes:** None **EPA Representative Monitoring points:** Anascaul WSS (KER 1)
Information Sources	Applin KR, Zhao N (1989) The Kinetics of Fe(II) Oxidation and Well Screen Encrustation. *Ground Water*, Vol 27, No 2. Conlon V, Wright G (1998) *County Kerry Aquifer Classification (draft)*. Geological Survey of Ireland Report to Kerry Co. Co., 18 pp.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

Figure 1: Hydrochemical signature
(EPA Representative Monitoring)

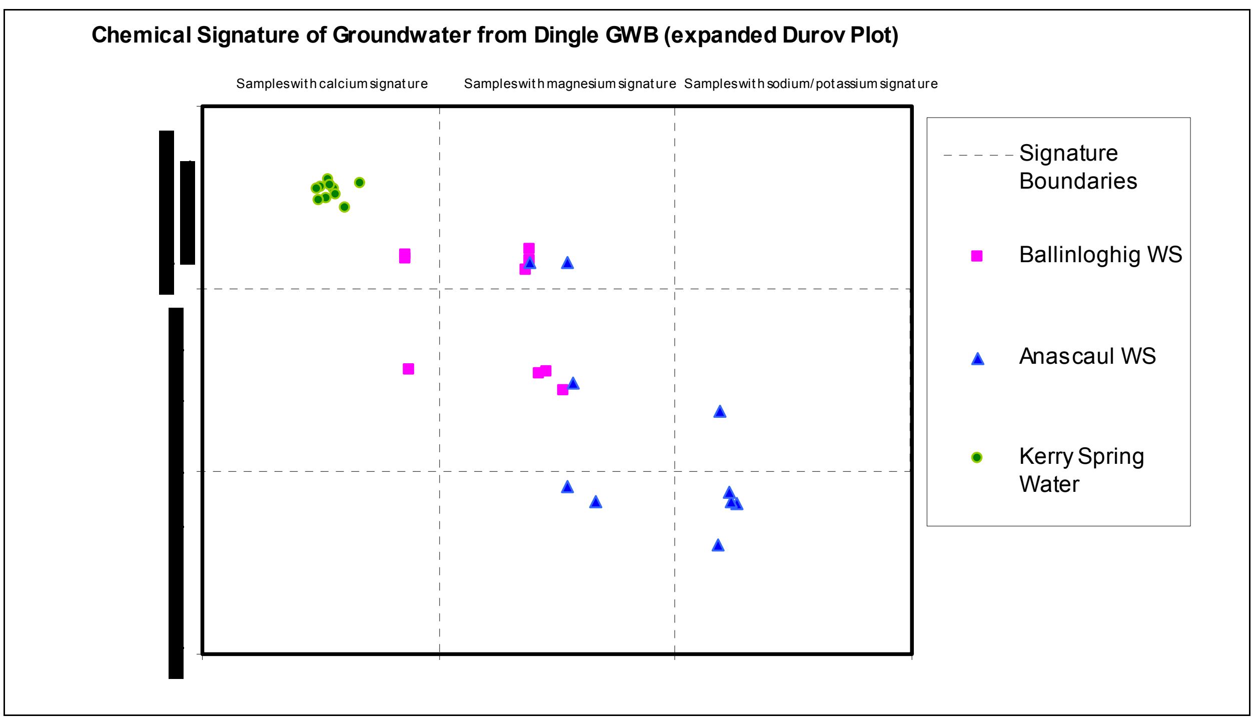


Figure 2: Seasonal variation of major hydrochemical parameters at Ballinloghig WS (KER 005)

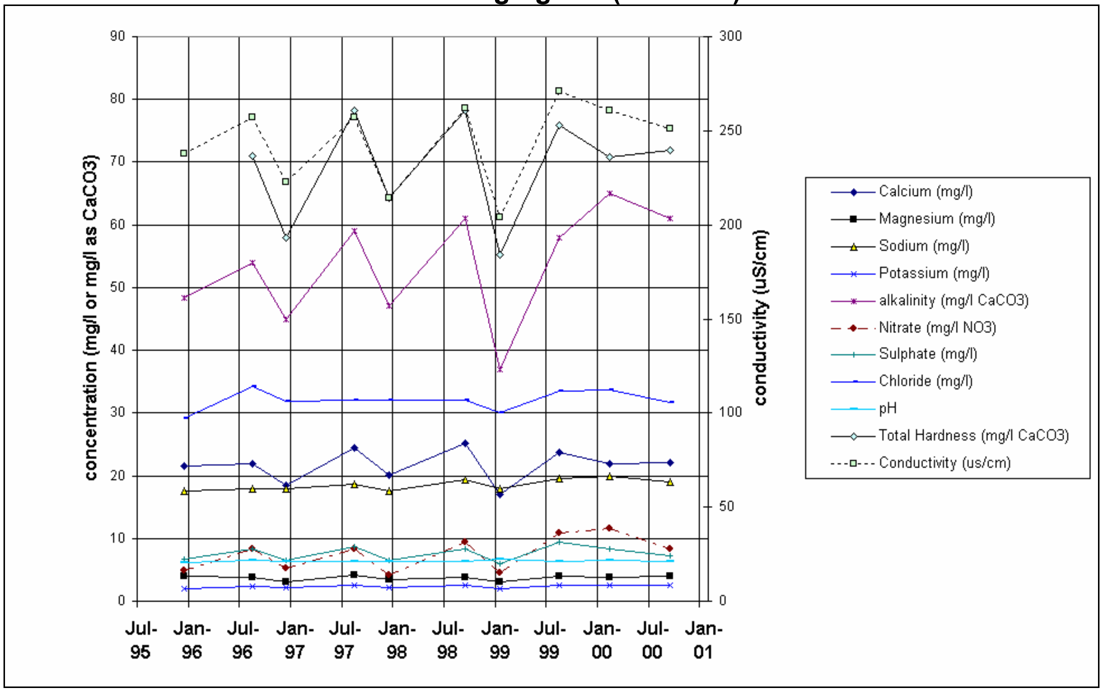
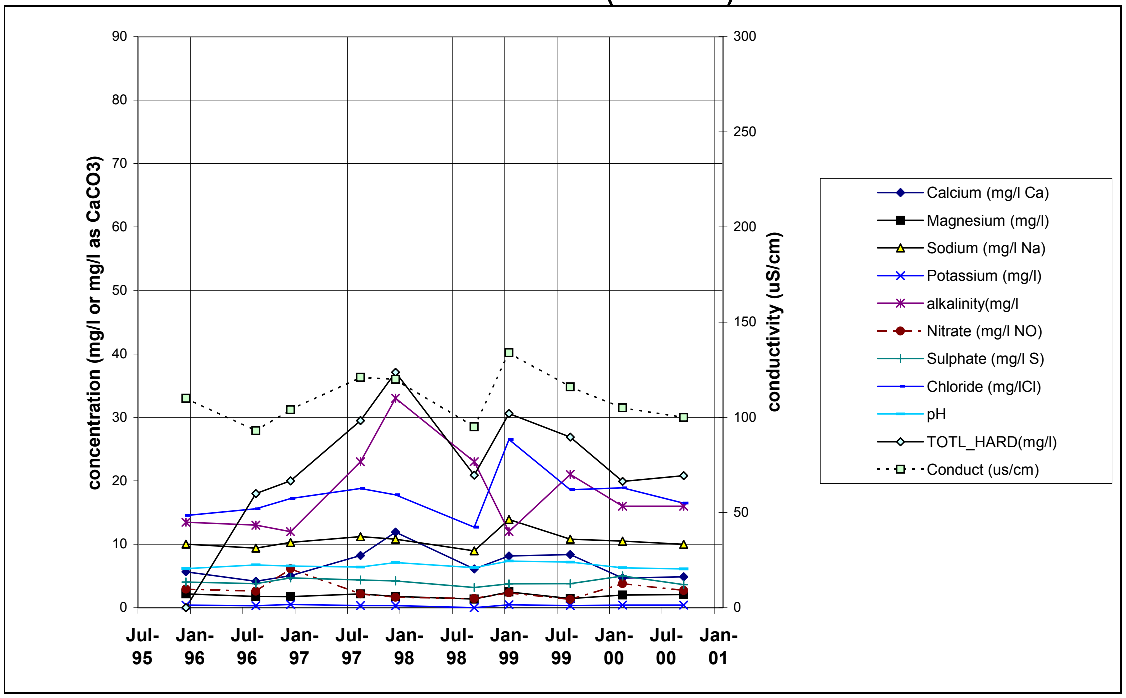
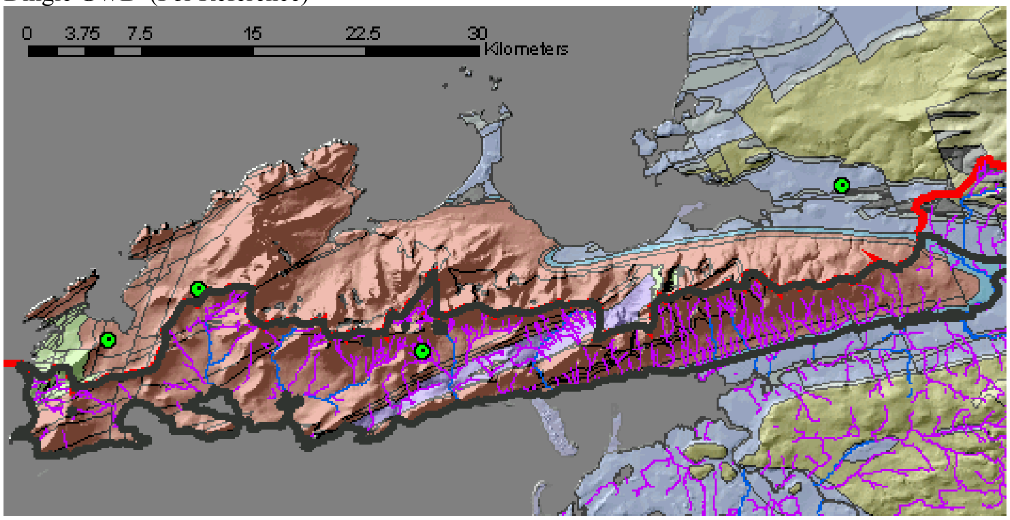


Figure 3: Seasonal variation of major hydrochemical parameters at Anascaul WS (KER 001)



Dingle GWB (For Reference)



List of Rock units in Dingle GWB

Rock unit name and code	Description	Rock unit group
Ballysteen Formation (BA)	Fossiliferous dark-grey muddy limestone	Dinantian Lower Impure Limestones
Lack Sandstone Formation (LK)	Micaceous sandstone and siltstone	Devonian Old Red Sandstones
Cappagh Sandstone Formation (CA)	Purple cross-bedded sandstone	Devonian Old Red Sandstones
Lough Slat Conglomerate Formation (LS)	Quartz-pebble conglomerate	Devonian Old Red Sandstones
Pointagre Group (PGG)	Conglomerate, sandstone and siltstone	Devonian Old Red Sandstones
Kilmurry Sandstone Formation (KM)	Aeolian sandstone	Devonian Old Red Sandstones
Inch Conglomerate Formation (IC)	Conglomerate with metamorphic clasts	Devonian Old Red Sandstones
Trabeg Conglomerate Formation (TC)	Conglomerate and sandstone	Devonian Old Red Sandstones
Ballymore Sandstone Formation (BM)	Rhythmically bedded sandstone	Devonian Old Red Sandstones
Ballymore Sandstone Formation & Tuff (tuBM)		Basalts & other Volcanic rocks
Slea Head Formation (SH)	Pebbly sandstone and conglomerate	Devonian Old Red Sandstones
Coumeenoole Sandstone Formation (CO)	Cross-bedded sandstone	Devonian Old Red Sandstones
Eask Sandstone Formation (EK)	Purple sandstone and siltstone	Devonian Old Red Sandstones
Bulls Head Formation (BH)	Red sandstone and siltstone	Devonian Old Red Sandstones
Ballynane Formation (BN)	Limestone, siltstone and shale and volcanics	Silurian Metasediments and Volcanics
Drom Point Formation (DP)	Grey siltstone with trace fossils	Silurian Metasediments and Volcanics
Mill Cove Formation (MC)	Siltstone with pyroclastic rocks	Silurian Metasediments and Volcanics
Clogher Head Formation (CH)	Ignimbrite, lavas and siltstone	Silurian Metasediments and Volcanics
Ferriters Cove Formation (FC)	Fossiliferous siltstone and pyroclastics	Silurian Metasediments and Volcanics
Annascaul Formation (AL)	Mudstone, siltstone and breccia	Ordovician Metasediments