Department of Environment, Food and Agriculture
Government Laboratory

The water quality of rivers flowing into monitored bathing beaches, as measured by microbiological parameters related to the 1976 and 2006 EU Bathing Water Directives

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Introduction and methods

Unlike point source pollution, which enters a watercourse at a specific identifiable point such as a pipe discharge, diffuse pollution occurs when pollutants leach into surface waters and groundwater due to rainfall, infiltration and surface runoff. A catchment area is land bounded by features such as hills or mountains, from which all runoff water flows to a low point and this can be a river, or indeed the mouth of a river where the water enters a bay. Diffuse pollution usually originates due to a recent or past land based activity, with the widespread inputs of contaminants of many types, which in respect of microbiological parameters includes those found in farming slurry and silage, animal faeces (from farmed animals, wild animals and pet animals), and any leaks or overflows from sewage or foul water drainage systems, whether of human origin or from farms or other industries.

During Summer/Autumn 2016, 21 river sites (Figures 1 and 2) had water samples taken and analysed for microbiological parameters (two bacteria groups, coliforms and faecal streptococci) relevant to grading sea bathing water quality for both the 1976 and 2006 Bathing Water Directives. (Directives 76/160/EEC and 2006/7/EC)

The vast majority of river sites used in the survey were from the established routine river water quality monitoring programme sampling, supplemented with additional sites close to areas of concern with regard to potential sea pollution. All river sites chosen were as close to the coast as practical in terms of sampling, with some sites less than 100 metres away from monitored bathing waters. This study was not intended to be a comprehensive assessment of diffuse pollution of the Island's rivers but rather to provide a 'snapshot', indicating the microbiological water quality of rivers flowing into monitored sea bathing waters. The sampling was not tied to the normal monitoring of bathing water quality, most taking place after the end of the bathing season

Tests undertaken on river samples relevant to Bathing Water Directives

Two bacteria groups, coliforms and faecal streptococci are commonly used as indicators of possible sewage contamination, because they are commonly found in human and animal faeces. Although generally not inherently harmful themselves, they can indicate the presence of pathogenic (disease causing) bacteria and viruses that also live in human and animal digestive tracts. In addition to a general health risk such as stomach upsets and skin infections, high levels of faecal bacteria can also cause cloudy water, unpleasant smells and oxygen depletion.

Total coliforms are a group of bacteria widespread in nature and present in human faeces but also animal faeces/manure and soil. The usefulness of total coliforms as a specific indicator of faecal contamination from human sewage is limited.

Escherichia coli (*E.coli*) is a species of faecal coliform (a subset of the total coliform group more specific to faeces). *E. coli* is specific to faecal matter from humans and other warm-blooded animals. Relevant to bathing water is that seagulls are a source of faecal matter containing *E.coli*.

Enterococci are a type of faecal streptococci (bacteria occurring in the digestive systems of humans and other warm-blooded animals). Enterococci can survive much better in salt water than the other bacteria and so in this respect they more closely mimic many human

pathogens than the other groups. In addition, enterococci are usually more human specific than the other groups.

The 1976 Directive, the water quality standards of which have been adopted as an objective by Tynwald, makes use of both total coliforms and faecal coliforms to assess bathing water quality samples, while the 2006 Directive specifically focuses on the use of *E.coli* and Enterococci for quality assessment.

Results and Discussion

Of 21 river sites surveyed during Summer/Autumn 2016, 5 would be rated 'poor' (or failed) under 1976 Bathing Water Directive microbiological parameters and 13 would be rated 'poor' (failed) under the 2006 Directive (see Table 1; Figures 1 and 2). In other words, if the sites sampled were bathing waters, 24% would have failed under the 76 Directive and 62% (the majority) would have failed under the 2006 Directive. This contaminated water is flowing directly into sea bathing water sites.

For the remaining sites, 2 were rated as excellent (9.5%) and 14 as good (66.5%) in terms of the 76 Directive and 4 sites were rated excellent (19%) and 4 as good (19%) in terms of the 2006 Directive. This relatively uncontaminated water is also an input to bathing areas and so could have a positive influence on the water quality gradings where the sea is more contaminated, depending on relative quantity/dilution etc.

For the purposes of this report and on the basis of the known point source discharges, the microbiological contamination is assumed to be primarily the result of diffuse pollution from land run-off.

In summary, this report shows a variable picture of microbiological quality in rivers arising from diffuse pollution, with some of a very poor standard (as defined using bathing water parameters). As these rivers flow directly into monitored sea bathing sites, high levels of microbiological contamination will be likely to have a negative impact, however the significance with regard to sea bathing water quality grades at monitored beaches is beyond the scope of this brief study, and would depend on factors such as volumetric flow and rate of dispersal in the sea. Indeed, it should be noted many of the beaches did have good sea bathing water quality during the season, despite this evidence of poor water quality in the rivers flowing directly into them, though it is also noted that the river monitoring was not keyed to the bathing water monitoring in 2016, with the majority of samples taken after the end of the bathing season.

The sources of diffuse pollution can be many, and by their very nature are often difficult to identify, quantify or locate. As hydrological systems, rivers are inextricably linked to the sea, and this report serves to emphasise the fact that point sources of pollution, as presently subject to control in the form of discharge licencing, is only one aspect of a complex issue, and that limiting or even the complete removal of point sources will not prevent contaminants entering rivers and sea. To what extent such contamination is significant in terms of, for example, bathing water quality is as yet uncertain, however on the basis of this 'snapshot' survey, it appears possible that assessment and in significant cases, control of sources of diffuse pollution will be needed to ensure that the water quality in rivers doesn't degrade to an unacceptable degree, and consequently doesn't have an adverse impact on bathing water quality.

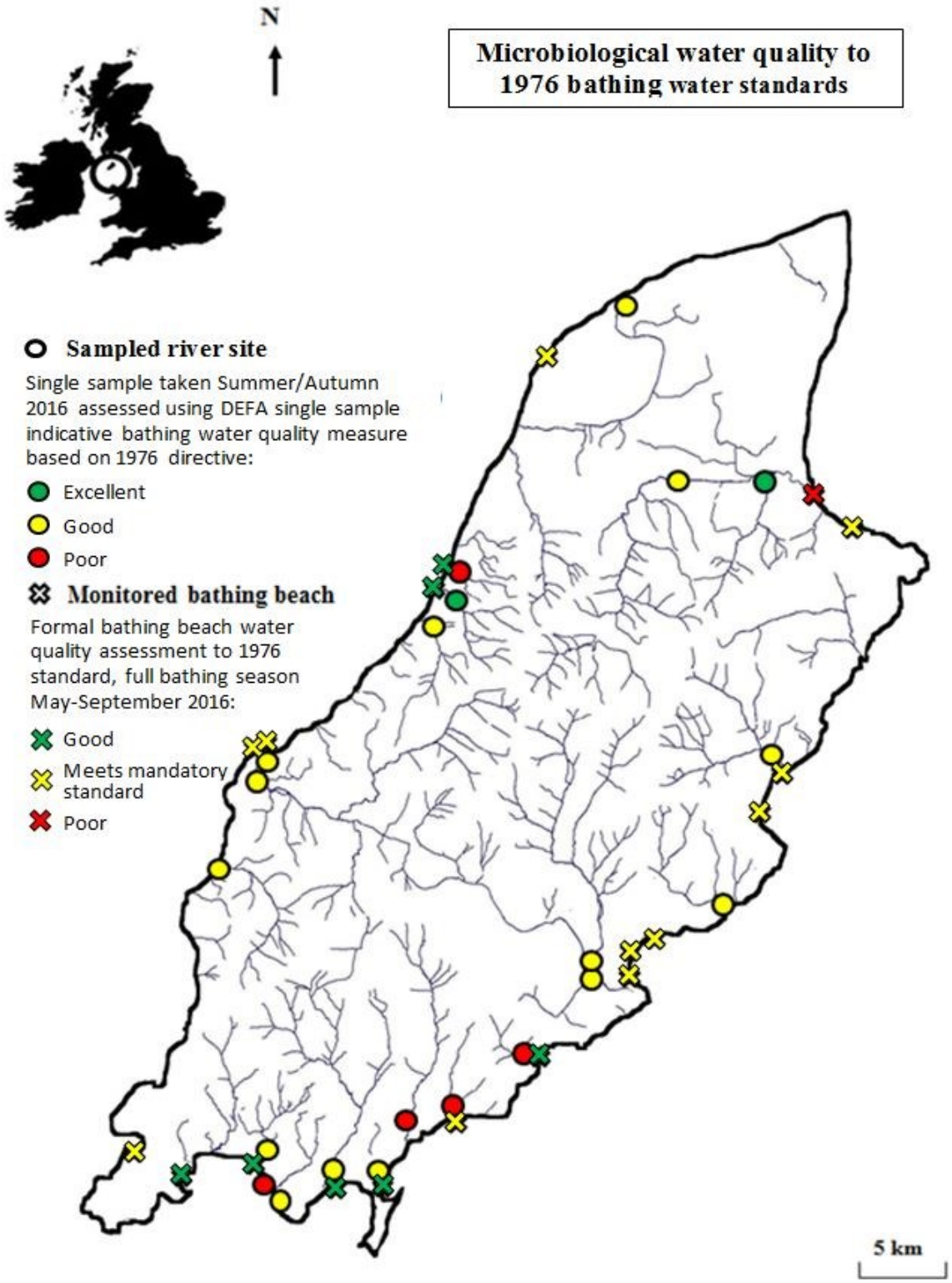

Fig. 1. River sites assessed against the microbiological parameters of the 1976 Bathing Water Directive, also showing bathing beaches for reference
(rivers and beaches not sampled at the same time, and beach results are whole season)

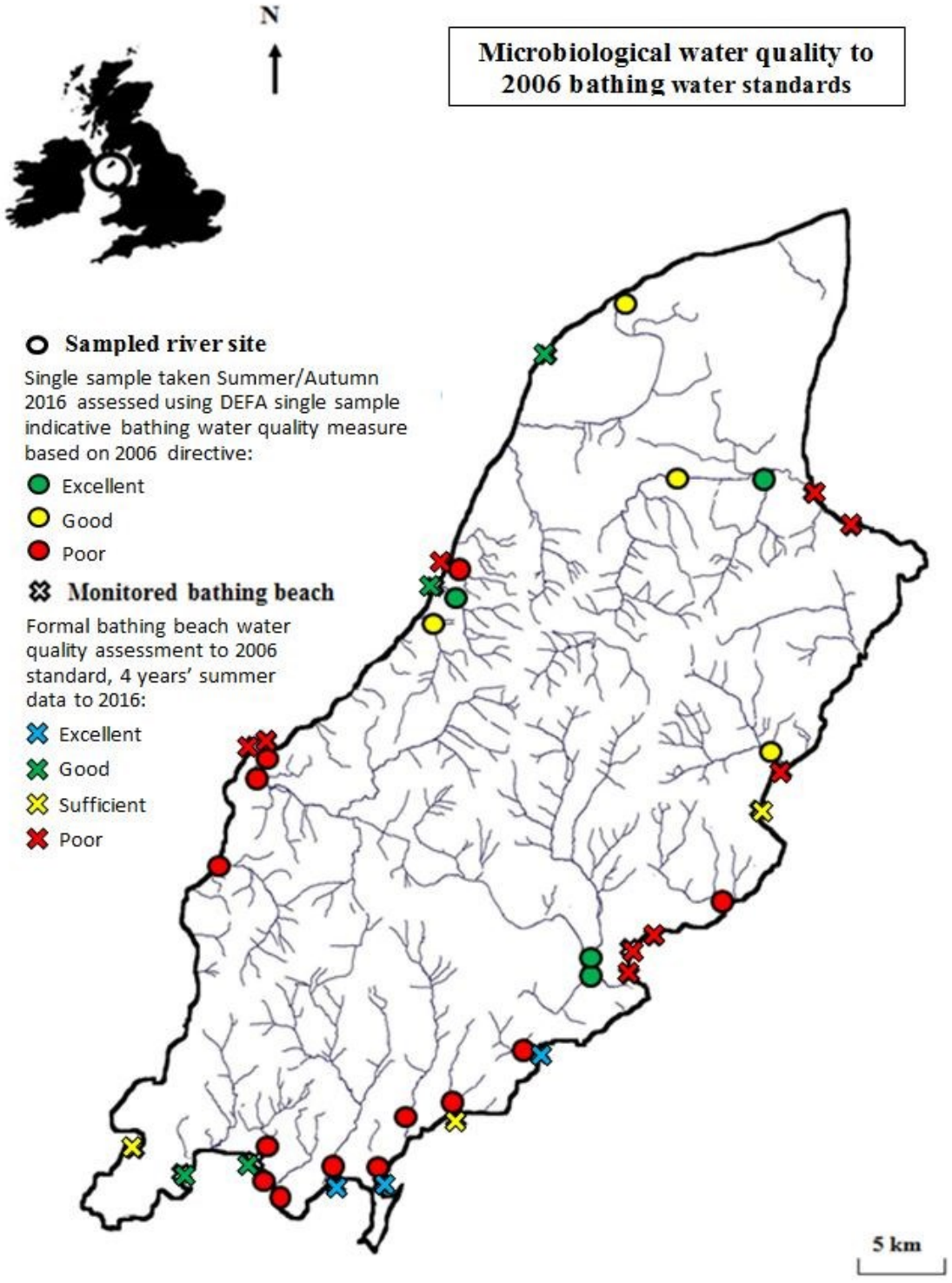

Fig. 2. River sites assessed against the microbiological parameters of the 2006 Bathing Water Directive, also showing bathing beaches for reference
(rivers and beaches not sampled at the same time, and beach results are from four summer seasons combined)