Waters of LIFE

Framework of Measures and Best Practice Guidelines for the Protection and Restoration of High Status River Waterbodies

Annex 4: Quarries

Tables of Measures for Mitigating Impacts from Significant Issues arising from Quarries in Catchment Areas where the Objective is Restoration

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1 Introduction

The Waters of LIFE is a European Union funded Life Integrated Project which aims to help reverse the loss of Ireland's most pristine rivers. The ongoing loss of high-status waters is a worrying trend for water quality in Ireland. The protection and restoration of these waters is one of the key underpinning principles of the EU Water Framework Directive.

The project aims to develop, test and validate effective catchment management measures to reverse this declining trend. Six project catchments have been selected, five demonstration catchments and one control catchment. These are:

- Avonmore, Co. Wicklow - https://www.watersoflife.ie/catchments/avonmore/
- Awbeg (Kilbrin), Co. Cork - https://www.watersoflife.ie/catchments/awbeg_kilbrin/
- Graney, Co. Clare - https://www.watersoflife.ie/catchments/graney/
- Islands, Co. Roscommon / Co. Galway - https://www.watersoflife.ie/catchments/islands/
- Sheen, Co. Kerry (Control Catchment) - https://www.watersoflife.ie/catchments/sheen/
- Shournagh, Co. Cork - https://www.watersoflife.ie/catchments/shournagh/

The measures in this document were identified in the context of mitigating the issues related to quarries acting on high status objective river waterbodies in general and the demonstration catchments in particular. However, these measures are equally applicable to river waterbodies which have been assigned a good status objective under the river basin management plan.

2 Context

More than 230 active quarries are recorded nationally by the Geological Survey of Ireland (GSI, 2014). Quarries are of two basic types: rock quarries and sand and gravel pit quarries. Rock quarries tend to be deep, and may involve dewatering so operators can access and extract materials from deeper "benches" rather than expanding laterally. Rock faces are often broken by mechanical or controlled blasting techniques. Large trucks subsequently transport materials to stone crushing machines where they are broken down into aggregates of different sizes. Sand and gravel pits are much shallower than rock quarries but may also involve dewatering operations. The material is excavated mechanically and carried by trucks or conveyor belts to a plant where it is crushed, washed and screened into different sizes.

The impacts arising from quarrying are mainly related to (LAWPRO/EPA (2022b):

- Sediment load to, and re-activation (erosion) of sediments in, streams at discharge locations;
- Release of pollutants to surface water and groundwater and;
- Abstractions from dewatering operations.

These activities can result in the degradation of physical habitats and environmental supporting conditions of surface waters and groundwater dependent wetlands, as well as the pollution of both surface water and groundwater receptors (e.g. public water supply wells). Lowering of groundwater levels from dewatering operations can furthermore affect the baseflow of streams (particularly during the drier summer months), groundwater levels beneath wetlands, and water levels in wells, if these are located within the zone of influence of quarry dewatering operations. The associated discharges of water from quarries can also cause or contribute to flood risk downstream of quarry sites.

3 Explanatory Comments

- A key principle in deciding on and establishing measures is **"right measure in the right place"**. Determining the 'right measure in the right place' for quarrying activities is based on a number of factors, such as the following:
  - i) The **issue of concern** (pollutants, hydrology, morphology). The main pollutants of concern arising from quarries are: sediment, hydrocarbon, ammonium, phosphate, BOD, FIOs and pH.
  - ii) The **pressure(s**) causing the issues of concern, e.g. washing, blasting, dewatering. In the case of pollutants, the relative **loading** from the pressure and the **likelihood** of the loading reaching the receptor are important factors that require consideration and assessment.
  - iii) Whether the objective is to **'restore' (improve) or 'protect' (maintain**), as more stringent and resource intensive measures are likely to be needed to achieve the restore/improve objective.

  Therefore, each of these factors needs to be taken into account in deciding on measures prior to their establishment, as a means of ensuring that they are efficient and effective in achieving their objectives. The catchment science and management process that encompasses these factors is shown in Figure 3-1.

- Table 3-1 outlines measures for mitigating the impacts from quarries.

- In Table 3-1, the assumptions are:
  - i) The receptors are surface water ecosystems.
  - ii) Desk-based and field-based assessments have been undertaken in advance of decisions on measures. Therefore, the following factors are known, thereby providing the basis for decision-making on measures: a) the issues of concern arising from pressures that are impacting on the ecosystems (such as phosphate, nitrate, ammonium, BOD and FIOs), and b) the 'story' of the catchment.
  - iii) The effectiveness ratings are based on measures needed in the catchments of waterbodies in 'Areas for Restoration' where, for instance, significant reductions in pollutant loads may be needed.
  - iv) The High (H) rating has been reserved for measures that on their own will make a significant difference to improving the water quality.
  - v) To achieve receptor restoration and the desired aquatic ecosystem objective, a suite of measures will generally need to be established.

- Some general guidance on the measures in Table 3-1 is provided in Section 4.

- It is recommended that this report be considered in conjunction with the Waters of Life Measures Framework report[1], which provides the background catchment science understanding on which the measures are based.

[1] https://www.watersoflife.ie/app/uploads/2023/08/Measures_Framework.pdf

Sources of information on prevention of water pollution from quarries

EPA (2006). Environmental Management Guidelines Environmental Management in the Extractive Industry (Non-Scheduled Minerals). https://www.epa.ie/publications/licensing--permitting/industrial/ied/EPA_management_extractive_industry.pdf

LAWPRO/EPA (2022b). Pressures and catchment walks. A Guidance Handbook. Section 9, Volume 2. Local Authority Waters Programme and Catchment Science and Management Unit, Environmental Protection Agency. https://lawaters.ie/app/uploads/2022/09/Print_CSM-Volumes-23_April-2022.pdf

GSI (2014). Directory of Active Quarries and Pits in Ireland. https://www.gsi.ie/en-ie/publications/Pages/Quarry-Directory.aspx

ICF (2005). Environmental Code. Irish Concrete Federation. https://irishconcrete.ie/wp-content/uploads/2017/01/Environmental-Code.pdf

While quarrying itself is not a scheduled activity under the EPA Act, the following guidance note provides useful information on materials storage:
https://www.epa.ie/publications/licensing--permitting/industrial/ied/IPC_Guidance_note_Materials_storage.pdf

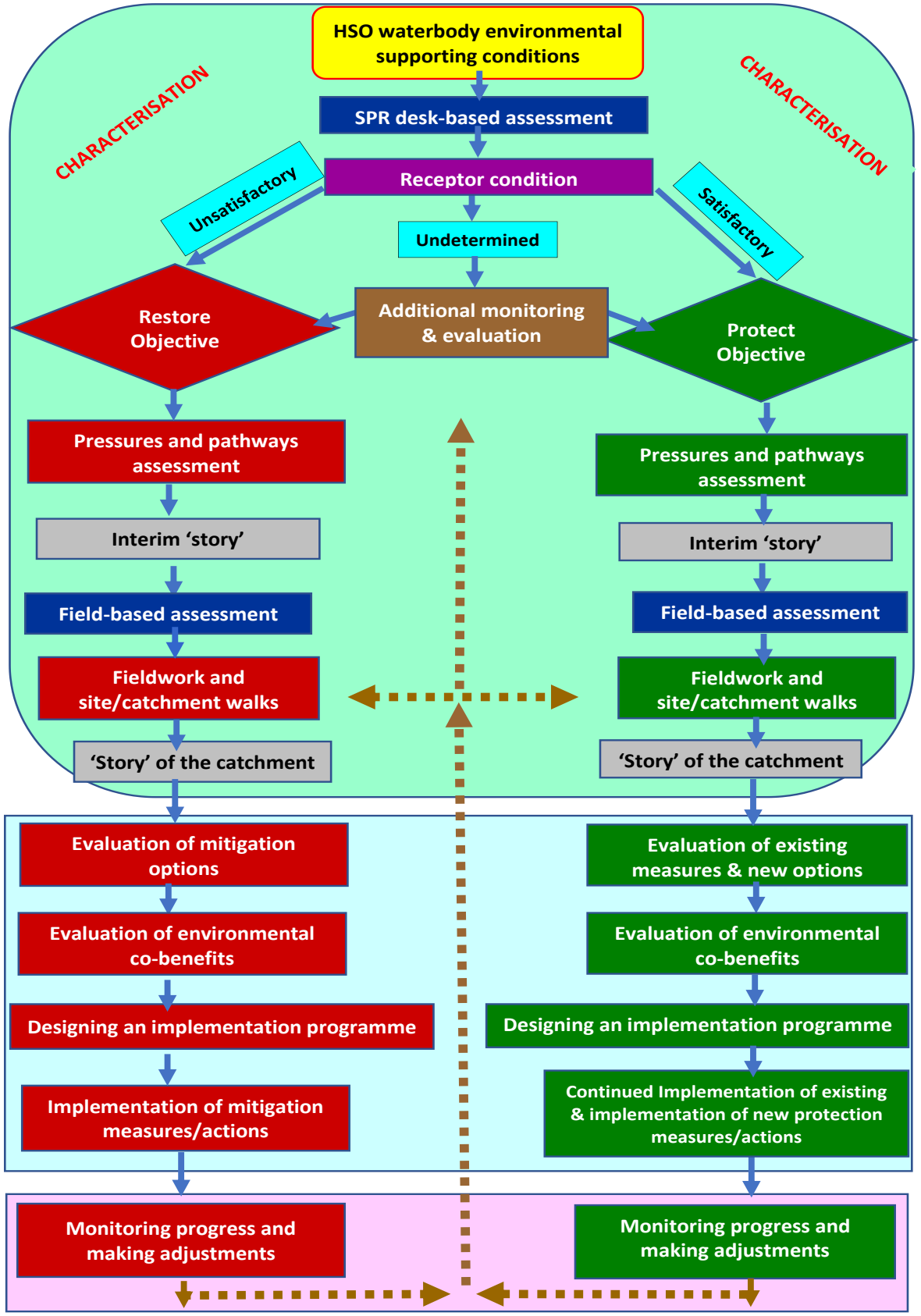

Figure 3-1: Process flowchart for evaluation of measures in HSO waterbody catchments

Table 3-1: List of measures for Quarries, with guidance on estimated effectiveness potential for pollutants and hydrology, where the objective is restoration to the required waterbody status or condition.

			Measures Effectiveness (High (H), Medium (M), Low (L), Insignificant (-)							
No.	**Cat.**	**Measure**	**Sediment**	**Hydrocarbon**	**NH_4**	**PO4**	**BOD**	**FIOs**	**pH**	**Hydrology**
E17	Source reduction & Control	Compliance with licence conditions	**H**	**H**	-	-	-	-	-	**H**
E18		Properly constructed and functioning on-site wastewater system in compliance with relevant EPA Code of Practice	-	-	**M**	**M**	**M**	**L**	-	-
E19		Regulation of unlicenced/unregulated quarries	**H**	**H**	-	-	-	-	-	**H**
E20		Care with machinery used in vicinity of discharge points, streams and ditches to reduce erosion and sediment generation.	**L**	-	-	-	-	-	-	-
E21		Maintenance of drainage channels before heavy rainfall events to prevent washing of silt into streams.	**L**	-	-	-	-	-	-	-
E22		Installation of bunding and spill pallets – fuel and chemical storage and handing areas.	-	**H**	-	-	-	-	-	-
E23		Safety, spill control and clean-up protocols are in place	-	**M**	-	-	-	-	-	-
E24		Dosing, if required, to reduce pH	-	-	-	-	-	-	**H**	-
E25		Signposting of prohibition on discharge or dump of solid or liquid waste.	**L**	**M**	**L**	-	**L**	**L**	**L**	-
E26		Limiting erosion of soil and subsoil from erosion by rapidly vegetating exposed areas, planting the surfaces of overburden and topsoil mounds, progressively restoring worked-out areas (where practical) and limiting the areas of topsoil/overburden stripping exposed at any one time.	**H**	-	-	-	-	-	-	-
E27	Pathway Intercepti	Properly designed and maintained sediment/silt control (ponds and/or tanks)	**H**	-	-	-	-	-	-	-
E28		Engineered discharge mechanism to break energy of discharged water prior to entry into stream.	**L**	-	-	-	-	-	-	-

No.	Cat.	Measure	Measures Effectiveness (High (H), Medium (M), Low (L), Insignificant (-))							
			Sediment	Hydrocarbon	NH_4	PO4	BOD	FIOs	pH	Hydrology
E29	Receptor works	Embankment rip-rap at discharge location.	**L**	-	-	--	-	-	-	-
E30		Planting of suitable plants to stabilize stream banks, e.g. willow.	**L**	-	-	-	-	-	-	-
E31		Ensure water transmitting capacity of stream into which discharge occurs (also a sediment control item).	**L**	-	-		-	-	-	-

Notes:

Mandatory measures in the Regulations

4 General Guidance on Mitigating Water Quality Issues

Water quality issues associated with quarrying include sediment, hydrocarbon, nutrients, pH, and hydrology (water levels and flows):

- Sediment is probably the most significant water quality issue associated with quarrying. Planning and/or discharge licence conditions will normally specify control measures to minimise sediment levels in surface waters discharged from the facility. Measures include use of adequately sized and appropriately maintained settlement ponds, planting or covering surfaces of subsoil and topsoil mounds, progressively restoring worked-out areas (where practical) and limiting the areas of topsoil/subsoil stripping exposed at any one time. Drainage channels should be maintained and protected before heavy rainfall events to prevent washing of silt into streams.
- Sediment issues can also arise where high discharge flows result in bank erosion in receiving waters. Use of embankment riprap at the discharge location can help minimise scouring in high flow situations.
- Hydrocarbon emissions can arise as a result of fuel spills on site or from contaminated runoff from high risk areas such as fuel storage and refuelling areas. Runoff from all paved areas where likelihood of hydrocarbon spills or leaks exists should be passed through appropriate and properly maintained hydrocarbon interceptors. Refuelling should not be permitted on the quarry floor. Fuel and other chemical storage tanks should be appropriately bunded. Spill kits should be maintained, and clean-up protocols should be in place with trained staff available to respond in the event of a spill on site.
- Nutrient and microbial pathogen impacts can arise where sewage effluent from staff facilities is treated and discharged within the quarry site if the treatment system is not designed, installed or maintained in accordance with best practice.
- Blasting has the potential to release ammonium and nitrate to groundwater.
- Planning conditions may include a requirement for groundwater wells to be installed around the facility and for periodic groundwater nutrient monitoring to be undertaken.
- pH issues can arise in limestone quarries with elevated pH in quarry discharge. Depending on volumes discharged and on whether dewatering is taking place, adjustment may be required to bring pH below 9.
- Impacts on surface water hydrology can arise particularly where quarrying is taking place below the water table because the dewatering process can result in i) large volumes of groundwater being discharged to watercourses and ii) reductions in stream flows upstream of the quarry. The discharge should normally be licensed under Section 4 of the Water Pollution Act (1977-1990). Recycling of process water within the facility (e.g. using closed water systems for wheel wash and process water and using recycled water for dust suppression in dry weather) can help to reduce volumes discharged.
- Dewatering can impact groundwater hydrology, altering flow regimes and reducing groundwater levels. Where quarrying is proposed below the water table, planning (and discharge licence) conditions will normally include a requirement for groundwater wells to be installed and periodic monitoring (including measurement of groundwater level) to be undertaken.