Conference of European Directors of Roads

PROPeR ROad runoff Pollution management and mitigation of environmental Risks

D4.2 Guidelines for the treatment of highway construction runoff

CEDR PROPER PROJECT

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Executive summary

This report is the second deliverable (D) of WP4 (Sustainable assessment of measures and treatment systems for highway runoff during construction work) of the CEDR PROPER project. This deliverable compliments PROPER D4.1 (A review of treatment systems for the management of runoff from highway construction sites) and PROPER D3.2 (Survey of guidelines for sustainable road runoff treatment systems) by presenting an overview of the available legislation and approaches to managing surface runoff (and associated pollutant loads) from highway construction sites.

Whilst the PROPER D4.1 review of the literature indicated a high level of awareness of the need for measures to manage highway construction runoff, legislation at a European and national level primarily exists at a 'generic construction sector level' only. For example, the EU Environmental Impacts Assessment (EIA) Directive (1985; 2011; 2014) identifies the construction of motorways as requiring an EIA as part of the planning application process, but does not set out any specific details on the types of mitigation measures to be installed or how their performance should be monitored.

At a national level, whilst most European countries have guidelines which identify good surface runoff management practice at a generic construction project level, little information exists which specifically address the unique characteristics of highway construction runoff treatment within the typically time-and space-limited environment in which it is generated. The development of guidelines which systematically support the selection and implementation of treatment systems to mitigate highway construction pollution loads is highlighted as a research need with the potential to make a substantial contribution to the sustainability of the European transport infrastructure network.

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Table of contents

1. Introduction

A recent review of the the sources of pollution within highway construction sites, their pathways to receiving water bodies and associated environmental impacts, identifies suspended solids (originating from substrates exposed during construction) as the key pollutant of concern (PROPER D4.1). Whilst most of the construction runoff literature refers to construction as a broad, generic category encompassing a range of types and scales of infrastructure projects, linear construction projects (which includes the development of highways, tunnels and bridges) are identified as a construction category of particular concern. This is a result of several factors characteristic of this type of construction activity, such as the number of different environments and catchments linear projects typically pass through (including crossing water bodies), occurrence of cumulative impacts (several discharges to the same water body) and the extended distances which require management. Further, linear construction projects are also often temporary, space-limited environments, posing further challenges for the managing the pollutant loads associated with highway construction runoff.

As identified in PROPER D3.2 (a review of guidelines for the use of sustainable treatment systems for the management of highway runoff during its operational phase), a range of treatment systems have also been used to manage construction runoff. However, whilst there is some overlap in the system types used to treat surface runoff generated during these two distinct phases of a highway's lifespan, there are some key differences. For example, guidelines for the treatment of runoff from highways in its operational phase focus solely on the treatment of the runoff and its associated pollutant loads, with system selection influenced by a range of site specific conditions e.g. soil type, depth to groundwater, runoff volumes and available land. In contrast, guidelines for the treatment of runoff from highways in their construction phase typically takes a two stage approach:

- Stage one: minimisation of the exposure of bare soils and opportunities for its mobilisation during rainfall events.
- Stage two: treatment of construction runoff within the construction site confines to mitigate its impact on receiving water hydrologies and ecologies

Drawing on information available at a European level, this Deliverable briefly reviews how highway construction is referred to within the EU EIA Directive (2014) and describes the key principles of erosion control and sediment management. This is supported by a case study example from Slovenia which illustrates how these generic principles are applied in practice.

2. EU Environmental Impact Assessment Directive

At a European level, the key piece of environmental protection legislation which refers to road construction projects is the EU Environmental Impact Assessment (EIA) Directive. In force since 1985 (with several revisions and amendments), a central aim of the EIA Directive is to ensure that projects likely to have significant impacts on the environment undertake an assessment of those impacts as part of the development consent application process (EU, 2017). All projects listed in Annex I of the EIA Directive (2011) are automatically assumed to have a significant environmental impact and therefore must undergo an environmental impact assessment. In specific relation to highway construction, projects listed in Annex I include the construction of motorways and express roads (both new and the realignment of existing roads) where the new / realigned section is >10km in a continuous length. The construction of roads is also included in Annex II (which lists types of infrastructure projects that may require to be assessed) indicating that any stretch of road construction (irrespective of length) is either required (under Annex I) or may be required to undertake an EIA as part of a development consent process. Undertaking an EIA includes the following key steps:

- Establishing the baseline (current environmental conditions at the proposed development site)
- Assessment of the direct and indirect effect of a project on humans, flora and fauns, soil, water, air, climate, the landscape, material assets and cultural heritage (both spatially and temporally)
- Identify and assess environmental impacts of reasonable alternatives with the selected project
- Identify structural and/or non-structural measures to 'to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment'
- Set out a monitoring plan to verify that mitigation measures provide level of protection envisaged

As part of a quality assurance process, the 2014 amendments to the EIA Directive states both that EIA reports be carried out and reviewed by competent experts on behalf of both the developer and the planning authorities, respectively. In terms of implementing mitigation measures, the EIA Directive also notes the opportunity to link these with other legal requirements (e.g. EU Water Framework Directive, 2000; the EU Habitats Directive 1992) and that care should be taken to avoid any duplication of efforts (see PROPER D2.3 for an overview of environmental legislation in relation to highway construction building). However, whilst the EU EIA Directive provides a legal framework for identifying and mitigating significant environmental impacts associated with construction projects, it is a high level strategy

document which inevitably will be interpreted in varying ways. Whilst guidance is available (e.g. EU 2017), key terms such as ‘significant environmental impact’ are subjective and no specific information is given on types of mitigation measures, performance standards, compliance monitoring etc. at either a generic construction- or sector specific- level. Hence with specific regard to highway construction, whilst many highway constructions are likely to fall under the EIA Directive as an Annex I or Annex II activity, specific requirements on how mitigation measures should be identified, installed, operated, monitored and their performance reported is addressed at a national level.

3. National guidelines

At a national level, the need to implement measures to mitigate runoff from highways during their construction phase appears widely recognised (PROPER D4.1). However, approaches to developing and sharing technical information on how to do so varies greatly; from no specific guidelines (e.g. Slovenia, Netherlands, Finland, Denmark; *pers comm* with respective PEB members), to the development of regional (e.g. Norway; Kroglund, 2019) and national highway construction drainage guidelines (e.g. England; DMRB, 2019). Alternative approaches to addressing the issue include references to the need to manage highway runoff construction runoff within national construction site drainage standards (e.g. Switzerland; SIA431 1997), technical guidelines for linear construction projects (of which highways are a category) (CIRIA, 2006) and the need to apply for a specific license when construction activities cross/discharge to water bodies (Portugal; Decree Law 236/98) or exceed a road length of 5km (Scotland; Water Environment (Controlled Activities) (Scotland) Regulations 2011).

3.1 General principles of construction erosion and sediment control

Many, if not all, pollution incidents are avoidable and the risk of the pollution of surface waters and/or groundwaters can be minimised through use of a systematic planning approach. Recommended planning stage considerations include (adapted from SEPA, 2009):

- Identification of the location of all surface waters, groundwaters and drainage path
- Identification protected habitats and species.
- Assess potential flood risks and sources of pollution
- Consider timing of works in relation to weather and other sector needs
- Make space for treatment system
- Train staff in routine and accidental pollution prevention
- Develop emergency procedures.
- Develop and implement a pollution control monitoring programme.

As described in PROPER D4.1, the key pollutant in a highway construction environment is suspended solids, arising as a direct result of the clearance of vegetation and the associated exposure of native soils. The general principles of construction erosion and sediment control are as follows:

- Apply erosion control measures to prevent the movement of sediment
- Apply sediment control measures to prevent off-site sediment release in the event of sediment movement

For a review of a range of alternative approaches to erosion control and on-site treatment of suspended solids, the reader is referred to PROPER D4.1. An example of how these generic approaches to managing construction site runoff are applied to a highway construction project is described in the following section.

3.2 Case study example: Slovenia

Whilst there are no official guidelines or technical rules in Slovenia for managing stormwater runoff during highway construction activities, it is clear from the superior environmental legislation (e.g. EU EIA Directive, 2014) that adequate protection measures must be put in place to protect water resources. Currently in Slovenia, all planning applications (including those for highways) must include a plan for the protection of water resources throughout construction activities. The preparation of this plan can be divided into two main phases;

- the planning permit application phase (led by the road designer)
- the construction phase following the granting of planning permission (led by the contractor)

Requirements of the construction design phase, include development of a hydrogeological report (addresses the physico-chemical aspects of groundwater and surface water/ groundwater interaction zones) and an environmental impact assessment (EIA) report which assesses ecological aspects of receiving waters and identifies mitigation measures. The hydrogeological report is an integral part of the geological-geotechnical evaluation of the road construction (informing the technical elements of the road and its constituent structures) as well contributing to the EIA report. As over 90% of Slovenia's drinking water is sourced from groundwater, groundwater protection is a national priority. The potential for road runoff during construction and operation phases is considered in detail in the pre-planning hydrogeological report which includes an assessment of both aquifer vulnerability and other water sources which would be crossed by the proposed road. In this analysis, the route of the road is divided into a series of intervals classified in relation to levels of water resource vulnerability, with the results of this classification process informing the selection of mitigation measures. In addition to this assessment of site conditions, the implications of legislative requirements are also considered e.g. location of drinking water protections zones etc. A report outlining the technical measures to be implemented for the protection of water resources and to meet legislative requirements during both the highway construction and operation phases, is then submitted as part of the planning application. If planning permission is granted, the need to use the identified protection measures will be included as part of the consent requirements and will be referred to during any inspections related to compliance/investigation of negative impacts.

Following the granting of planning permission, the road construction contractor must prepare a site report which identifies how, when and where runoff mitigation measures will be installed and monitored. In preparing this construction site protection plan, the contractor generally summarises the measures into the following sections:

- Initial activities

Water resource protection needs during construction can be viewed as a function of the site conditions together with the nature of the planned highway infrastructure, the receiving water (e.g. surface water or groundwater) and the characteristics of any pollutants that may be released during construction. If highway construction is taking place in a vulnerable water resource area, then measures to collect and treat stormwater runoff should be installed at the start of construction activities. It is good practice to also plan for the maintenance of runoff control systems as required during the construction process, and to consider their potential to additionally provide runoff treatment during the subsequent operational phase of the highway. When commencing highway construction, initial activities are site clearance of vegetation, the removal/disturbance of primary soils (i.e. A and B soil horizons) and preparation of highway foundations. The removal/disturbance of primary soils often acts to increase the infiltration capacity of soils, with an associated increase in the risk of contamination of underlying/neighbouring aquifers. At this stage, primary sources of pollution are the loss of fuels and lubricants from construction machinery (both operational and accidental). Where highways cross ditches, construction is effectively taking place in unsaturated – or possibly – saturated – parts of the aquifer increasing risks of pollution even further. The impacts of the construction on water sources depend on the design and implementation of engineering barriers (e.g. geotextile, clay charges, etc.). If their implementation is foreseen, the risk of an impact on the water sources progressively decreases to a level equivalent to that posed by the highway in its operational phase.

The construction of tunnels is a special case of water resource protection. In addition to the storage and use of explosives, many other chemicals are used during their construction either in materials intended for injection, enforcing and anchoring of native rocks or as substances used in spray concrete used to line tunnels post-construction. Despite planning, not all such chemicals are fully utilised within building materials and are thus mobilised and transported by drainage waters. This runoff can be defined as wastewater with the regulation dependent on both the nature of the rock through which the tunnel passes and the nature of the support measures that follow the front of the excavation. A further factor is the potential for the movement of groundwater into the tunnel during excavation. If the rocks crossed by the tunnel include vulnerable aquifers, this wastewater must be discharged separately at the tunnel portal

within a closed drainage system. Typically tunnel runoff and associated drainage waters are initially captured in storage tanks where, if required, their pH is neutralized. Following pH adjustment they are pumped out from the basins and taken to appropriate treatment plants. In specific cases where a tunnel crosses an aquifer which is used for water supply neutral and degradable chemicals must be used. The requirements to use neutral chemicals are also made when the foundations of bridges are constructed inside of aquifers.

- On site protection measures

Development of a safe construction site - a key driver behind the organisation of a safe construction site is that the likelihood of contamination (from accidents or routine construction activities) is minimised. Contractors, supervisory staff, workers and site visitors must be familiar with water protection measures with responsibility of undertaking these activities allocated to designated person. Rules for all foreseeable activities must be established in advance e.g. if a highway construction involves crossing a recharge area of a drinking water source, this activity must be co-ordinated with the operator of that water source and all relevant events are to be recorded in the construction log (diary). All machinery on the construction site must be regularly inspected and fuel and construction material storage zones an properly secured and periodically inspected. An emergency response plan must also be drawn up.

Highway construction runoff treatment systems - for a review of the construction erosion and sediment control treatment approaches, see PROPER D4.1.

Monitoring - an important part of on-site protection measures is the active monitoring carried out during the construction phase of the site. Monitoring of any construction site impacts and the execution of works which impact on/discharge to water resources must be planned in advance, preferably at the design stage of the road. The extent of monitoring to be undertaken is determined by the characteristics of the water source that may be affected by the construction. The monitoring parameters are subdivided into on-going measurements (e.g. conductivity and water gauge measurements) that can be performed in-situ and periodic parameters requiring laboratory-based analysis. The results of monitoring should be kept up to date with results used to inform ongoing monitoring and mitigation activities.

4. Conclusions

Whilst the risk to receiving waters from highway construction activities is recognised at a European Directive level, it has yet to be robustly considered at a national level in many EU Member States. National construction site drainage guidelines are available in many countries but these are highly generic in nature, and do not recognise the diversity of catchment site characteristics that highway construction projects typically must pass through, under both spatially- (narrow development corridors) and temporally-limited environments. Hence the development of guidelines which systematically support the selection and implementation of treatment systems to mitigate highway construction pollution loads is highlighted as a research need with the potential to make a substantial contribution to the sustainability of the European transport infrastructure network.

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