

Advisory guidelines for the environmental impact  
statement on gravel extraction and relandscaping in  
the area Stevensweert/Ohé en Laak

22 February 1990

254-70E

CIP-DATA KONINKLIJKE BIBLIOTHEEK, DEN HAAG

**Advisory**

Advisory guidelines for the environmental impact statement on gravel extraction and relandscaping in the area Stevensweert/Ohé en Laak / [Commission for Environmental Impact Assessment ; adapt. by S.A.A. Morel ; transl. from the Dutch]. - Utrecht : Commission for Environmental Impact Assessment  
Transl. of: Advies voor richtlijnen voor de inhoud van het milieu-effectrapport ontgrinding en (her)inrichting in het gebied Stevensweert - Ohé en Laak. - Utrecht : Commissie voor de Milieu-effectrapportage, 1990.  
ISBN 90-5237-756-1

Subject headings: environmental impact statement ; Limburg / gravel extraction ; Limburg / relandscaping ; Limburg.

# CONTENTS

	<b>Page</b>
<b>Summary of the advice</b>	1
<b>1. Introduction</b>	3
<b>2. Problem definition and objectives</b>	3
<b>3. Decision- making process</b>	4
<b>4. Proposed activity and alternatives</b>	4
4.1 General	4
4.2 Proposed activity	5
4.3 Alternatives	5
4.3.1 General	5
4.3.2 Location aspects	6
4.3.3 Implementation alternatives	6
4.3.4 Relandscaping alternatives	7
4.3.5 Zero alternative	8
4.3.6 Alternative most favourable to the environment	9
<b>5. Current state of the environment and autonomous development</b>	10
5.1 General	10
5.2 Abiotic aspects	11
5.3 Biotic aspects (flora, vegetation and fauna)	11
5.4 Archaeological, cultural and historic aspects	11
5.5 Landscape aspects	12
5.6 Other aspects	12
5.7 Autonomous development	12
<b>6. Environmental impacts</b>	12
6.1 General	12
6.2 Description of impacts	13
6.2.1 Overview of impacts	13
6.2.2 Impacts per partial activity	13
6.3 Removal of the top layer and deep gravel dredging	14
6.4 Sorting, crushing, sieving and washing	16
6.5 Removal and storage	17
6.6 Infrastructure	18
6.7 Relandscaping and secondary impacts	18
<b>7. Comparison of alternatives</b>	19
<b>8. Gaps in information</b>	19
<b>9. Post project evaluation</b>	19
<b>10. EIS style and presentation</b>	20
<b>Annex: Outline of the EIA procedure on gravel extraction and relandscaping in the area Stevensweert/Ohé en Laak</b>	

## SUMMARY OF THE ADVICE

This advice of the Commission for environmental impact assessment (EIA) contains recommendations for the environmental impact statement (EIS) for gravel extraction and relandscaping in an area in the southern part of the Netherlands.

**Definition of problems and objectives.** The EIS must indicate what objective the initiator wishes to reach with the proposed activity. The EIS must show how the various policy principles on a national, regional and local level have been taken into account.

**Decisions taken and to be taken** must be described in the EIS. Which publicly stated policy intentions can impose restrictions on the decisions for which the EIS is compiled or create conditions for these decisions? The Commission refers to the directive of the European Community as regards transboundary impacts of the gravel extraction (hydrological aspects and secondary effects).

**Proposed activity and alternatives to be taken into consideration.** The proposed activity consists of a number of partial activities. Variants on these partial activities can be seen as elements with which various alternatives can be composed. The EIS should pay attention to the following aspects: location and boundaries of the lakes; civil engineering work and operations during the construction; extraction speed, time schedule with number and types of equipment, phasing and termination of the extraction just as possibilities for adjustment; (phasing of) the relandscaping, gross and net volume of the alternatives; use and management of the areas where extraction has taken place.

The EIS must describe the **zero alternative** (no execution of the proposed activity). It serves at least as frame of reference for the comparison of the various alternatives. The Commission suggests that the province will determine its standpoint about the status of the zero alternative. If the Province considers the zero alternative as a real option, the Commission advises that the Province will offer information to include in this EIS the location and objective alternatives. The proponent cannot be expected to describe these alternatives himself.

**The alternative with the best current possibilities to protect the environment** must be included in the EIS. This alternative is the combination of construction and landscaping variants that either spare as much as possible environmentally important aspects or even improve them. The future use and management must also be considered.

The **current state of the environment** including its expected development must be described in the EIS insofar this is important for the expected impacts of the proposed activities. Attention must be paid to biotic and abiotic aspects, geomorphological, archaeological and cultural-historical aspects and landscape aspects. The extraction site with its immediate surroundings and the adjacent areas influenced by the proposed activity or the alternatives can be considered as the study area.

**Description of the impacts on the environment** of the proposed activity, with the help of an impact matrix. The impacts of the activity and the

alternatives must be determined and described on i.e. hydrological and geohydrological situation (groundwater and surface water, quantity and quality); conditions of the geomorphological condition; vegetation and fauna; landscape; cultural-historical and archaeological characteristics; sound; agriculture and other relevant aspects.

The EIS must contain a **comparison of the (autonomous) development of the environment with the impacts of the proposed activity and its alternatives**. The standards and target values of the environment policy must also be taken into account.

A overview of **gaps in information** that continue to exist after analysing the environmental impacts and that lead to incompleteness, must be listed in the EIS, as well as the reasons why these gaps continue to exist. Essential information to the decision to be taken may not be absent. These gaps can be seen as subjects of continuous study and will be involved in an programme that will evaluate the actual impacts on the environment. This programme needs to be compiled by the competent authority in a later stage.

## 1. INTRODUCTION

Stevol Ltd., initiator in this procedure, intends to extract gravel from an area of approx. 209 hectares in the former municipalities of Stevensweert and Ohé en Laak<sup>1</sup>) and the municipality of Echt (the so-called Stevol-area) to meet part of the national need for gravel. After completion of the gravel extraction the initiator will restructure the landscape of the area (relandscaping).

The EIA obligation is linked to the procedure of granting of a licence by the executive board of the province of Limburg.

For the advice the Commission has considered the written participation reactions, received through the competent authority.

## 2. PROBLEM DEFINITION AND OBJECTIVES

Environmental Protection Act, section 7.10, subsection 1, sub a:

An EIS shall contain at least: "*a description of the purpose of the proposed activity*."

The EIS must state within which policy scope the area has been designated as buffer facility for gravel extraction and to what extent this policy scope can still be considered as valid. What are the expectations with regard to the national policy regarding gravel extraction and what consequences might result for the Stevol project?

In view of a balanced and achievable relandscaping it must be indicated in the EIS to what extent the proposed relandscaping alternatives will fit in with the environmental policy advocated by the various municipalities. The basic policy points of the Province with respect to the relandscaping of the area must be included in this description.

The execution of the relandscaping and the use and management of the relandscaped area depends on the managerial organization. Therefore the EIS must give insight into how the future management will take place and which agency or agencies will be responsible for the eventual execution of the advocated relandscaping of the area. What is the economic feasibility of the implementation variants?

The EIS must indicate on which data the exploitation plan (with assumptions such as the minerals to be extracted, the depth of the excavation, the annual gravel production of Stevol and the duration of the exploitation) has been based.

It is stated in the exploitation plan that removal of sand will only be allowed if the ground balance sheet for the construction is and stays closed. This ground balance sheet must be elaborated in the EIS. It must be elucidated whether this rule is binding and to what extent sand (or other material to replenish the lakes) will have to be supplied. In addition, the EIS must show how the initiator plans to realize the proposed annual production.

---

<sup>1</sup> These municipalities have ceased to exist and are now part of the municipality of Maasbracht.

### 3. DECISION- MAKING PROCESS

Environmental Protection Act, section 7.10, subsection 1, sub c:

An EIS shall contain at least: *"an indication of the decisions in the preparation of which the environmental impact statement is to be drawn up, and a review of the decisions previously taken by government bodies relating to the proposed activity and the alternatives described"*.

The EIS must indicate for which decisions it has been compiled, the status of those decisions, the necessary steps in the decision-making procedure and the time schedule.

Governmental decisions and policy intentions made public will influence the decision for which the EIS is compiled or impose restrictions on it. It must be clearly explained in the EIS which restrictions and influences are at stake. Review criteria for the activity and the alternatives such as environmental standards must be rendered.

In the EIS attention must also be paid to the manner in which in the decision-making process article 7 of the **Directive of the Council of the European Communities concerning the environmental impact assessment of certain public and private projects** of June 27, 1985 will be executed:

Article 7. *"If a Member State establishes that a project may have considerable impacts on the environment in another Member State, or if a Member State that might experience considerable impacts requests this, the Member State on whose territory the project is proposed, will send to the other Member State the information gathered by virtue of article 5, at the same time as he makes this information available to his own subjects. This information will then serve as basis for the consultation possibly necessary in the scope of the bilateral relations of both Member States on the basis of mutuality and equal terms."*

### 4. PROPOSED ACTIVITY AND ALTERNATIVES

Environmental Protection Act, section 7.10, subsection 1, sub b:

An EIS shall contain at least: *"a description of the proposed activity and the manner in which it will be carried out, and of the alternatives which should reasonably be taken into consideration"*.

#### 4.1 General

The proposed activity and the reasonable alternatives must be developed and described in the EIS. In the EIS already, the initiator can pronounce a preference for one of these alternatives, the 'preferred alternative'. It will also be possible that the EIS only presents a number of equal alternatives. At the latest, one of these alternatives will have to be chosen in the licence application that will be submitted at the competent authority together with the EIS.

## 4.2 Proposed activity

The proposed activity is composed of a number of partial activities:

- a. removal of the top layer;
- b. extraction of sand and gravel with the help of a dredger or a deep grabber or a suction-dredger, and removal of the dredged material by ship;
- c. sorting, sieving, crushing and washing of the gravel and sand, including the use of a gravel crusher;
- d. removal (by ship) and (temporary) storage of part of the upper soil;
- e. breaking up and replacement of infrastructural facilities, also for opening up the area;
- f. relandscaping of the entire area.

The EIS must contain a description of these partial activities and must also pay attention to the following aspects:

- making a draft landscaping plan with water depths, shape of the water surface, also showing the location, size and nature of the agricultural zone and/or of the zone with potentials for nature development and/or zone for recreation;
- the civil engineering works and operations in the construction stage such as the water control, wet or dry infrastructure, excavation of the clay layer;
- the extraction speed, time schedule with number and kind of equipment, civil engineering works, phasing and termination of the excavation as well as the possibilities to adjust, and an idea about the chances that adjustment will be necessary;
- phasing of relandscaping possibilities during and after the gravel extraction.
- the gross and net volume of the alternatives, subdivided according to part consisting of water and part consisting of land (this relates to the demarcation of the gravel extraction lakes and so with the amount of gravel present and also to the relandscaping);
- the use and management of the extracted areas; who is responsible for a proper finishing and the management of the lakes and the newly obtained nature and/or agricultural areas; what is the financial feasibility of the alternatives, and how can these plans be executed?

## 4.3 Alternatives

### 4.3.1 General

The choice of the alternatives and variants must be accounted for in the EIS; they must be clearly related to the objective of the activity. The alternatives must be developed and described at the same level of depth, details and abstraction.

It will be possible to consider certain combinations of variants as alternatives.



#### 4.3.2 **Location aspects**

It must be described in the EIS which considerations led to the choice of the Stevol area as extraction site. In this description the environmental aspects are essential.

Relevant location alternatives might be sought within the planning area and should then concern the exact boundaries of the area of gravel extraction and the location and fitting in of the lakes and the intermediate area.

#### 4.3.3 **Implementation alternatives**

Implementation alternatives/variants must be developed in the EIS. Variants on the partial activities mentioned in 3.2 can be seen as elements or aspects with which various alternatives might be composed.

During the development of the alternatives it should be reminded that the re-landscaping of the location for the gravel extraction is not only determined by characteristics of the area, but also, to a large extent, by the manner of execution. This manner of execution is in its turn strongly determined by landscaping demands resulting from the nature of the final destination.

The following aspects must be elaborated for the above-mentioned aspects:

- the boundaries, form, depth and size of the gravel extraction lakes;
- with respect to the removal of the top layer:
  - amount, nature and composition of the ground to be excavated;
  - manner of excavation (dry/wet), steepness of the underwater slopes and the like;
  - method and place of (temporary) storage;
  - amounts to be deposited, removed, redumped or used for re-landscaping.
- with respect to the gravel dredging:
  - manner of excavation, steepness of underwater slopes;
  - amount, nature and composition of the material;
  - manner of sieving, crushing, washing and loading;
  - storage, removal (manner of transport, destination).
- location and type of the sorting and sieving equipment and crushing installations;
- methods of transport of all materials and equipment in the study area;
- opening up the gravel extraction lakes and connection of the gravel extraction lakes to the waterways, both temporarily and permanently (if relevant);
- measures to minimize groundwater level changes in the surroundings. Measures to reduce sound and dust emission into the surroundings and to prevent traffic hindrance. Therefore possibilities such as the following need to be considered:
  - (local) screens and noise protection dams;
  - screening of/or arrangements to the mobile sound sources;
  - organizational measures at the use of installation;
  - infrastructure avoiding the residential areas;
  - covering of the underwater slopes or screens;
  - excavation order.
- phasing of the extraction and possibilities to establish the final destination entirely or partially in this stage.

#### 4.3.4 **Relandscaping alternatives**

The initiator mentioned in the notification of intent two relandscaping alternatives, without mentioning a preference:

- the agricultural alternative: main function agriculture in the entire intermediate area, recreation for the eastern lake and nature for the western lake;
- the nature alternative: main function nature in the eastern and western lakes, and agriculture and nature in the intermediate area.

These alternatives must be elaborated in the EIS. It must also contain some background information why the so-called recreation alternative will not be taken into consideration<sup>2</sup>].

The relandscaping covers a number of phases, the construction/landscaping stage, the management and the use of the new destination, which will partially coincide with the execution of the gravel extraction.

If in the plan different functions have been included alongside each other (nature, agriculture, recreation) it must be shown how this will be realized in a technical and managerial sense and who will bear the responsibility for this. Will the proposed structure and ownership situation fit in with that of the current gravel extraction projects?

It must also be stated in the EIS what the mutual influence of the various functions will be within the planning area and it must be verified to what extent (conflicting) functions can be combined.

Shape, location, depth, surface and profile/slope angle as well as the orientation of the various biotopes (deep water, shallow water, grass banks, reed/-brushwood, forest and, if relevant, steep edges) are of essential importance to the direction of the nature development after relandscaping. The relandscaping plan must give a qualitative and quantitative description of these qualities by means of maps and cross-sectional profiles.

The above also applies to:

- the nature of the materials to be used (soil type, food richness);
- in case of bringing in material foreign to the area: which are the impacts on the vegetation development?
- the nature of the final destination and the location and size of the various structures such as agricultural zones, small islands in the lakes, recreational zones, parking facilities;
- location of these structures as regards residential areas, nature reserves and the like;
- necessary infrastructure for opening up the new destination;
- possibilities to fit into the current landscape structure.

The notification of intent states that, depending on the technical and financial possibilities, the new lakes will be partially replenished, for which sand from below the gravel package and covering land will be used.

---

<sup>2</sup> Apparently the intention is to keep recreational use very limited. The Commission wishes to express its view now that changes to increase recreational use cannot be made without a (new) EIA.

- What are the technical and financial possibilities to replenish with sand from below the gravel package and covering land?
- How and when will replenishment take place?
- Will there be sufficient sand available from below the gravel package and covering land to replenish the lakes (and thus create agricultural land)? In case material from elsewhere must be used:
  - What material will be used for replenishment?
  - What amounts are required?
  - What is the origin of this filling material?
  - In what manner does supply of the material take place?
- Does the filling material satisfy the legal soil quality demands?
- What will the agricultural value of the land be?

Taking into account uncertainties such as settlement, amount and nature of the available materials it must be indicated with what accuracy the re-landscaping plan will be executed.

If the proposed nature development depends on the management conducted after landscaping the EIS must say who will be responsible for that management.

Expected disturbing influences (such as a bicycle path and a footpath in areas with a nature function) and the possibilities to prevent disturbance, must be described in the re-landscaping plan.

#### 4.3.5 **Zero alternative**

The zero alternative, which means that the proposed activity will not be pursued, must always be considered in the EIS. At least it will serve as reference frame for the comparison of the various alternatives.

If the Province considers the zero alternative as a real alternative, not just the zero alternative, but also alternatives for *location* and for *project objectives* have to be considered in the EIS.

For considering *location alternatives* locations that already have been considered in an earlier stage might be reconsidered.

The possible alternatives for *project objectives* could be to extract gravel from the North Sea, to export gravel from abroad, to extract gravel from the upper courses of the Northern rivers and to manufacture artificial gravel for instance from flue gas.

It would not be fair to expect the initiator to include above-mentioned alternatives in this EIS. If the Province wants to consider the zero alternative as a real alternative, it must itself undertake the task to describe the location and alternatives for project objectives as part of this EIS.

#### 4.3.6

#### **Alternative most favourable to the environment**

Environmental Protection Act, section 7.10, subsection 3:

*"The alternatives to be described in accordance with subsection one, under b, shall in any case include the alternative which makes use of the best means available for protecting the environment".*

In any case this so-called alternative most favourable to the environment must be described in the EIS. This alternative is a combination of the execution and re-landscaping variants that save as much as possible or even improve the environmental aspects. The Commission asks to reconsider in this alternative also the future use and management.

Specifically, this alternative might consist of the type of execution and re-landscaping of the gravel extraction site (lakes) that would cause minimal harm to the environment or would even offer the best possibilities for technical nature development. Assume that the final destination will be based on a method of landscaping that will result in a good ecological system, and do not exclude landscaping as a nature reserve.

In developing the alternative most favourable to the environment elements such as mitigating measures with respect to the negative impacts and nuisance will have to be considered.

The Commission specifically suggests mitigating measures as regards groundwater level decrease in (very) sensitive nature areas and agricultural land. Based on the groundwater level demands required for biocoenoses or agricultural crops mitigating measures can be elaborated. The question for sensitive nature areas is for instance: what is less worse; a 'small', but long-standing decrease of the groundwater level, or rather a short-lasting 'larger' decrease? By a survey on these questions the most favourable scheme and layout of the excavation compartments, the working schedule for the entire gravel extraction and the planning of bank coverage as protection from erosion.

With respect to nature development it might be examined whether it would be possible to deliver the lakes with large bank lengths and shallow parts. Lagoons without a connection to open water would also be an option. In case of partial filling up of the lake, if nature development is the emphasis, one might think of a certain compartmentalisation, discouraging surfers to use the area.

## 5. CURRENT STATE OF THE ENVIRONMENT AND AUTONOMOUS DEVELOPMENT

Environmental Protection Act, section 7.10, subsection 1, sub d:

An EIS shall contain at least: *"a description of the current state of the environment in so far as the proposed activity or the described alternatives may affect it, and the expected developments in the said environment in the event that neither the said activity nor the alternatives are undertaken"*.

### 5.1 General

The current state of the environment must be described insofar as significant to the prediction of the environmental impacts of the proposed activity and alternatives and the comparison with these impacts.

The Commission notes that already several years ago the Stevol area has been destined as *'gravel extraction area'*; therefore the area has developed rather strangely in these past years. The agricultural development has more or less stagnated, other developments, such as nature development did take place. The Commission thinks that, in addition to the current state of the environment, the environmental situation could be described as reference that would exist, had the area developed without the intention to extract gravel. Any uncertainties in the descriptions must be indicated.

It is important to present the inventory of the study area in such a way that the scale of the maps corresponds with the details to be rendered.

As study area will be considered the extraction site with its immediate surroundings and the adjacent areas that might be influenced by the proposed activity or the alternatives. The size of the area of influence will differ per environmental aspect (soil, groundwater, noise). The description must include those parts of the area where measurable or detectable changes in the environment can be expected as a result of the proposed activity or the alternative solutions. Areas with important hydrological or ecological relations (forage, resting areas) with the direct area of influence must be included in the study area<sup>3</sup>].

Sensitive objects in the area must be indicated in a map while stating nature, size, number, place and distance to the extraction site. Sensitive objects might be:

- houses and other buildings;
- areas where (levee) groundwater and/or drinking water is extracted, with the corresponding extraction areas and protection zones; agricultural and horticultural crops;
- vegetation and biocoenoses in nature reserves;
- valuable cultural, historical, recreational and landscape objects.

The description of the current state of the environment and its autonomous developments must pay attention to the following aspects, if relevant to the decisions to be taken:

---

3 In connection with the international aspects that the gravel dredging might entail, in particular the hydrological impacts and the follow-up impacts, the Commission draws the attention to the European Community Directive regarding EIA. In the scope of this Directive the Belgian authorities must be informed about the project and its possible impacts on the environment in the adjacent areas.

## 5.2 Abiotic aspects

- soil: types, stratification, qualities (amongst others hygroscopic capacity), groundwater steps;
- geology: in particular the stratification of the Holocene sedimentation layers and their variation, and the thickness of the upper aquifer;
- geomorphological elements and patterns, such as meanders, channels, oxbows of the river Maas, ridges, natural levees, river dunes, dikes and quays and their ecological significance;
- geohydrology and geochemistry: geohydrological stratification, geohydrological parameters (permeability, resistance), groundwater tables and fluctuations in these levels, isohypses maps, groundwater quality (macro-parameters, such as chloride contents, nitrate contents etc.);
- surface water:
  - river/canal water: levels, level fluctuations, depths, ranges in quality and fluctuations in quality;
  - water management state: water discharge, supply and storage.
- relation between surface water and groundwater:
  - river/canal/groundwater; soil resistance;
  - drainage resistance, areas and amounts of seepage and infiltration.

## 5.3 Biotic aspects (flora, vegetation and fauna)

The following aspects must be considered (for instance by means of the provincial environmental inventory):

- occurrence of both aquatic and terrestrial flora, vegetation and fauna (amphibians, reptiles, summer birds and migratory birds, etc.);
- occurrence of special biotope types;
- number of species, rare species, indicator species;
- ecological relations within the planning area and with the surrounding area (ecohydrological, breeding, forage, resting and moulting areas);
- does the area belong to the main ecological structure?

If the quality of surface water and groundwater will influence the aspects mentioned before, this must be indicated.

The value of the current flora, vegetation and fauna must be shown in a regional, national and international context.

Special attention must be paid to the presence of groundwater dependent biotopes (such as seepage areas and moist grass lands) which might be influenced by hydrological changes. This applies also to areas outside the project planning area.

## 5.4 Archaeological, cultural and historic aspects

- archaeological and geoscientific objects;
- cultural-historical elements and structures.

## 5.5 Landscape aspects

- visual and spatial characteristics of elements and structures in the landscape, including land use;
- illustration and description of the points of observation (situations before sand extraction).

## 5.6 Other aspects

- current traffic pattern, if relevant;
- the background levels of industrial noise, traffic noise and air traffic noise (including peak levels) for the acoustically sensitive destinations and a number of representative points in the study area;
- presence of pollution (for instance as a result of legal or illegal landfills, or by previous inundations with polluted water (from the river Maas) or by sedimentation of washed coal dust).

## 5.7 Autonomous development

This description must be based on the situation without gravel and sand extraction, but with the other developments than can be anticipated.

The description of the autonomous environmental development must include the possible (lagging) impacts of activities (such as hydraulic activities, land dredging, recreation) that have now been completed, of activities that are currently still being executed and of activities of that are planned for this region.

# 6. ENVIRONMENTAL IMPACTS

Environmental Protection Act, section 7.10, subsection 1, sub e:

An EIS shall contain at least: "*a description of the effects which the proposed activity or the described alternatives may have on the environment, and an explanation of the manner in which the said effects have been determined and described*".

## 6.1 General

The description of the environmental impacts of the gravel extraction must take into account that the landscape is more than the sum of the partial aspects. Attention must be paid to an interpretation on a landscape level.

The general guidelines in this section of chapter 6 refer to the impacts mentioned in the following sections of this chapter.

- The methods by which the environmental impacts have been determined and described must be accounted for. This concerns in particular the reliability and accuracy of both the basic data and the methods used to predict environmental impacts. In case of uncertainty, the worst conceivable situation should be considered.
- Special attention must be paid to those kinds of environmental impacts that differ per alternative/variant.

- For the various stages of the activity (before, during and after the gravel extraction and relandscaping) the environmental impacts must be described separately (and, if possible, quantitatively).
- It must be indicated whether the impacts will be temporary or permanent, reversible or irreversible and whether the impacts will occur immediately or after a long term. The EIS must also show whether interaction (accumulation) might occur between the current activity and activities outside the project area, and if so, which interactions these might be. Any proposed projects abroad must be included. The Commission can think of impacts such as the hydrological changes by the proposed lignite extraction in western Germany.
- It must be shown how probable the impacts are and how the decisions to be taken<sup>4]</sup> can affect the probability or the size of the impacts.
- The EIS must indicate whether synergy of impacts (which means combinations of impacts causing extra environmental damage) may occur. In this scope the EIS must also pay attention to the question to what extent the environmental impacts of this proposed gravel and sand extraction will enhance or weaken the impacts on the environment of previous extractions.
- The expected results of mitigating measures must be indicated, as well as their effectiveness to limit or compensate the negative impacts.
- The EIS must describe what the environmental impacts will occur in the worst conceivable case and in case of a calamity, such as oil spills from the floating dredges and inlet of polluted water.

## 6.2 Description of impacts

### 6.2.1 Overview of impacts

Just as the activity can be analyzed as a series of partial activities, the environmental impacts can be arranged into a large number of aspects. The EIS must provide insight into the whole of activities, partial activities, sources, and environmental impacts, at which an impact matrix must be adopted.

An impact matrix is a cross table, in which numbers, keywords and/or symbols offer a well-organized summary of the outcome of the environmental impact analyses. The information included in the matrix must be explained in the text and must be substantiated (possibly in appendices) in an accessible manner. Per impact a conclusion must be drawn as regards the alternatives and variants being up for discussion. At least for the various stages of the project (during gravel dredging, after full (or maximum) excavation and after full complete relandscaping), separate impact matrices must be compiled. In these matrices a comparison needs to be made with the situation that would occur if no dredging would take place in the area (autonomous development of the environment).

### 6.2.2 Impacts per partial activity

The impacts of the various partial activities<sup>5]</sup> must be predicted in the EIS.

---

4 See chapter 6 of this advice.

5 See section 5.2 of this advice.



During the various stages of the gravel dredging sources of pollution and hindrance may occur, such as visual hindrance, noise and traffic nuisance and leakage of oil. The most significant impacts will occur as a result of the excavation of the various layers themselves, causing the inherent values and potentials to be lost for ever. A description of the impacts of the changes of the groundwater level and the changes of the groundwater flow pattern, which might cause excessive drainage, mineralization and eutrophication, are important, too. Finally, special attention must be paid to the fact that the quality of ground and surface water in the area will change, which might have impacts on the possibilities to use the groundwater and to preserve nature. Not only negative impacts must be indicated (in words and pictures), but the EIS should also show which potentials for positive natural and landscape developments are to be expected. The next sections contain draft guidelines for the environmental aspects to be considered, in the form of questions.

### 6.3 Removal of the top layer and deep gravel dredging

In addition the description of the impacts of the removal of the top layer and of deeper layers, which will be asked below in detail, a description must be included of the impacts of putting the upper soil in depot or processing elsewhere in the Stevol area and of opening up the dredging site.

- What will happen to surface minerals (clay, sand) that might not be removed as there would not be demand for them and what will be the consequences?
- To what extent do the various landscaping alternatives contribute to the objective of an economical use of raw materials, in other words will the exploitation of the geological appearance be optimal?

#### **Soil and groundwater**

- What will the hydrological impacts be (as regards action radius and size)? Attention must be paid to groundwater levels, hydraulic gradients and (horizontal) flows in the aquifers, vertical flows through confining or semi-confining layers, and the moisture contents of the soil profile. The hydrological impacts will strongly depend on the size and the depth of the pits and on the relation between the surface water and the groundwater in the area.
- What quality changes will occur in the groundwater?
- What will be the consequences for future use of (levee) groundwater? Reference must be made to the Groundwater Plan.
- What are the impacts on the water management of the area? (water discharge, level control, discharge capacity, quality of the surface water).
  - How will the river Oude Maas be diverted and what will be the consequences?
  - How will the groundwater and surface water levels be maintained during dry periods? What is the origin and the quality of the supplementary water?
- The predictions must use a groundwater flow model that satisfies the following demands:
  - more layers model, in view of the geohydrological structure;
  - the relations between the (large) surface water and the groundwater must be modelled.
- What is the mathematical deviation in the prediction output caused by uncertainties in parameters and input data? Include in this analysis the impacts of maximal depth.

- The impacts of dispersion of contaminants from possible groundwater or surface water pollution must be indicated. This also applies to possible emissions from soil pollution during excavation and dredging.
- Will the nearby canal leak or will there be any risk of leakage from this canal in future? What will the effects of such leakage be?
- Can the storage of the upper layers of the soil or a change of water pressure in the subsoil cause subsidence and what will be the impacts?
- Which hydrological impacts (and secondary impacts, such as subsidence) will be caused by the replenishment and the slopes of the lakes, connection canals and engineering structures?
- It will be inevitable to monitor the groundwater levels, hydraulic gradients in the aquifers, the quality of the surface water and the groundwater during and after the activity. The EIS should state for how long after the activity monitoring must continue.

#### **Surface water in the extraction pits**

- What quality will the water in pits have?
- Will in one of the stages of execution (for instance by supplementing water from the river Maas to keep up the water level in the extraction pits), the surface water be mixed? In that case, what will be the influence on the quality of the water of the lakes?
- To what extent will a later mixing with surface water be possible as a result of for instance flooding in case of high water in the river and what will be the (possible) influence on the quality?
- The water quality in the lakes partly depends on the shape and depth of the dredging. How will this quality be taken into account in the plans/alternatives?
- How will chemical and thermic stratification be taken into account in the plans/alternatives, in particular where maximum depth will be reached?

#### **Geomorphology**

- Which geomorphological patterns or elements will disappear or will be affected through the gravel dredging? (Meanders, blind arms, ridges, natural levees, bowls, river dunes.)
- What new temporary or permanent shapes will be created by the dredging?

#### **Archaeology and national heritage**

- Which archaeological, cultural and historical characteristics [such as archaeological sites, cultural and historical elements (farms, windmills etc.) and patterns (allotment patters, types and patterns of land and waterways, dikes)] will be lost through excavations and dredging?
- Which cultural and historical monuments can be affected by the dredging (for instance by ruptures in buildings as a result of changes in the groundwater level)?

#### **Landscape**

- How far does the visual sphere of influence extend?
- What visually important elements and structures will be lost or changed?
- What will the area look like during and after sand extraction, as seen from the previously chosen standpoints (observation points) (photomontages, simulation drawings? (In particular attention should be paid to the impacts of ground embankments to reduce sound emissions towards, if relevant.)
- What shape and design of the lakes would offer the best prospects for fitting in the landscape and how does this fitting in take place?

### **Vegetation**

- How much surface of which types of vegetation will disappear or may arise? What influence might this have on the other vegetation in the area and its surroundings?
- If phreatic decline or a decrease of seepage (eutrophication, excessive drainage, mineralization) or a change of the water quality is expected, which change of the (terrestrial and aquatic) vegetation and important biotopes (for instance for tree frogs) in the surroundings will occur?

### **Fauna**

- To what extent will biotopes be lost and for which animal species? What is the significance of these biotopes on a national/regional scale?
- Will the gravel dredging lakes and the accompanying transport roads cause any barrier effect?
- Which ecological relations do exist between the surrounding area and the gravel dredging site and to what extent will these be damaged?
- Will the previously considered impacts (such as eutrophication and excessive drainage) cause a change of the food supply in the surroundings of the lake and an increase of certain species (for instance as a result of changes in vegetation)?
- What ecological relations will be influenced to what extent? (Attention for main ecological structures.)
- Will the animals suffer any physical disturbance during the execution of the activities? Are these impacts temporary or permanent?

### **Sound**

- To what extent will the excavation cause extra noise for the acoustically sensitive destinations? This nuisance must be expressed by calculation of contours. The maximal sound levels should be included.
- How will the use of different equipment affect these contours (as approximately fifteen companies are involved in the activities)?
- To what extent does the equipment comply with the current state of technique?
- Which mitigating measures will be feasible (screening, organizational measures and the like)?
- Will it be possible to use a (limited) number of (silent) tools instead of the combined equipment each gravel extracting company owns?
- What are the variations in noise exposure for the houses; in particular between the various project stages?

### **Agriculture**

- Will farms be relocated? Which environmental and landscape impacts will this have?

## 6.4 Sorting, crushing, sieving and washing

### **Surface water**

- To what extent will the quality of the river water be affected by suspending small dust particles?

### **Vegetation**

- How will roiling and subsequent a temporarily or permanently decreased penetration of sunlight in the surface water (gravel dredging lakes and river)

