

IBOS Regenwater: the Dutch interactive decision support tool for sustainable storm water management

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ABSTRACT

In order to facilitate urban water managers developing alternative ways of dealing with storm water, an interactive decision support system has been developed. It is called “*IBOS Regenwater*” (Dutch abbreviation for: Interactive Decision Support System for Storm Water) and can be used on the Internet: <http://www.ibosregenwater.nl>. The decision support system focuses on local projects. It results in a well argued policy line for storm water management that is adapted to the specific local conditions. The main characteristics of *IBOS Regenwater* are the easy access of GIS-based information and a clear decision support concept, resulting in only four steps to be taken by the user.

IBOS Regenwater supports different ways of obtaining information related to the local possibilities. It provides access to databases for national legislation, regional policy guidelines, case studies, drainage methods and BMP's. The methodology is based on 5 principle mechanisms for dealing with storm water: usage, retention on the surface, infiltration, discharge to surface water or, as the last option, discharge to a WWTP. The DSS supports the water managers in creating alternatives. The DSS subsequently assessed the environmental effects and the resources needed to realise and maintain the specific alternative.

KEYWORDS

Geo information system; interactive decision support system; sustainable storm water management; local policy; sustainable urban drainage systems (SUDS).

INTRODUCTION

In The Netherlands water managers of municipalities and water boards have to decide how to reduce storm water discharges to the treatment plants. They want to maximise the local retention and infiltration. If the storm water is not too polluted it can be discharged locally to surface water. The water managers lack a good overview for the assessment of alternatives for sustainable urban drainage systems. Without well presented arguments they too often loose the debate with other interests in the (re-)development of urban area's. For a consistent storm water management the water managers need a commonly supported policy line on how to deal with the storm water.

About 70 percent of the Dutch sewer systems are combined. New systems are built as improved separate systems, in which the first flush of the collected storm water is drained off

to a WWTP. Both systems result in large quantities (50% - 90%) of storm water being treated unnecessarily. Keeping the relatively clean storm water separated from the waste water has great advantages, including energy savings, avoidance of polluting CSO's and the prevention of the flooding of streets with sewage (figure 1).



Figure 1. Flooding due to excessive storm water in sewer system

In The Netherlands other methodologies and guidelines have been developed to support urban water managers in dealing with waste and storm water (RIONED, 1998; RIONED, 2004; Stowa, 2000). The desired tool should be applicable for the Dutch situation. It was decided not to translate foreign decision support tools and methodologies like e.g. SWARD (Ashley et al., 2001) or Daywater (Förster, et al. 2004).

These methodologies have the disadvantage that the users have to assemble and analyze pieces of information themselves to complete their puzzle. Because the information is not easily accessible, the decision maker have a tendency to give up and carry on with customary practice. Furthermore, the available information is by definition not specific enough for local circumstances and sometimes not up to date.

Therefore, the easy access to actual, relevant information and local insights is crucial for the success of a tool like <http://www.ibosregenwater.nl>. If that information is ordered and the alternatives are realistic, we believe the water manager can be seduced into exploiting different and better solutions. In this way wise choices can be made for the management of storm water. Such a tool for sustainable urban storm water management did not exist, and therefore the IBOS has been created.

IBOS REGENWATER

BOS is the Dutch abbreviation for DSS (Decision Support System). The ‘I’ within *IBOS* stands for interactive. *IBOS Regenwater* as a web application is interactive because it responds specifically to the selections made by the user. *IBOS Regenwater* should support the user at two levels: firstly with feasibility studies (policy decisions) on how to deal with storm water at a district level (intermediate scale) and secondly with finding actual solutions at a local level (project scale).

IBOS Regenwater is essentially a roadmap for dealing with storm water (Ganzevles 2004). The following mechanisms are available for the storm water:

1. usage;
2. retention on the surface;
3. infiltration;
4. discharge to surface water;
5. discharge to a WWTP.

(see figure 2).

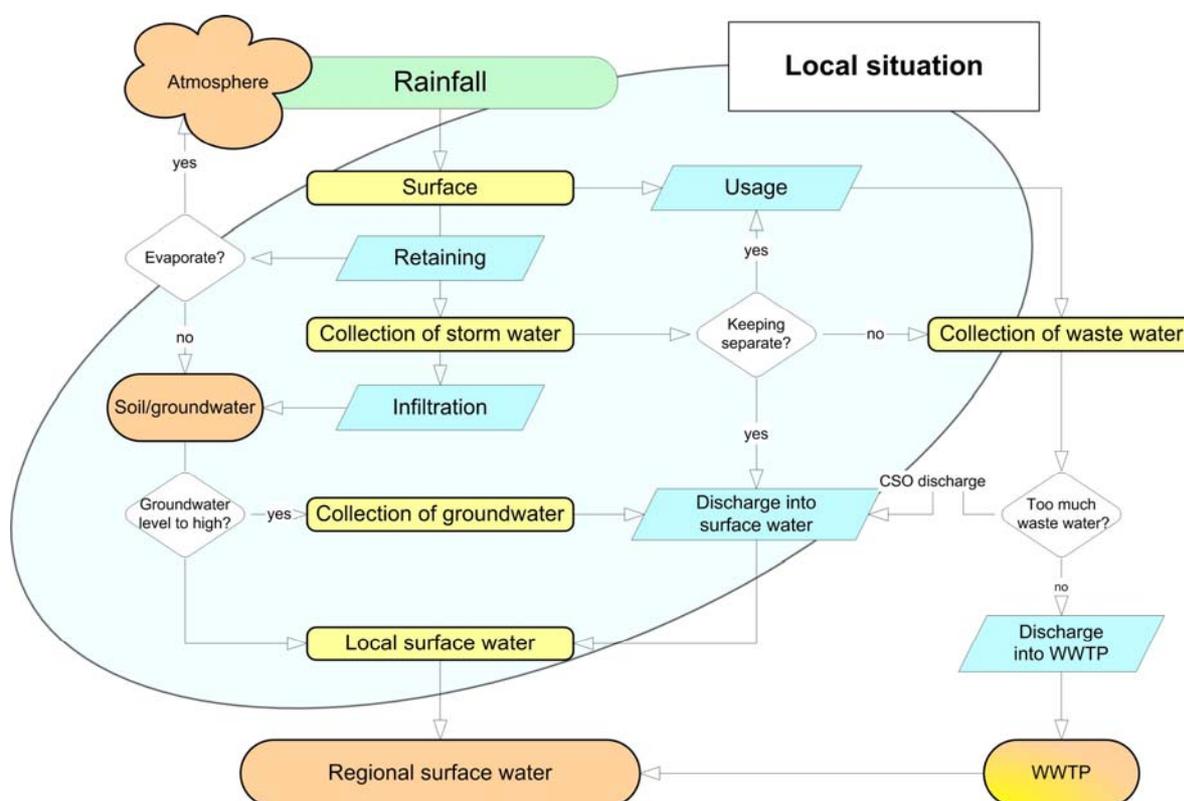


Figure 2. Generic roadmap with mechanisms for urban storm water treatment

The effectiveness of the different techniques available defines how the rainfall and pollutants are divided over the mechanisms. The starting point for the *IBOS Regenwater* approach is to teach the user the alternatives for dealing with storm water in his local situation. The ultimate goal is to keep storm water as much as possible within its own catchment (area). This is represented in a water balance indicating the amount of storm water retained. Figure 3 shows the water balance in relation to the decision support process.

Decision support

IBOS Regenwater provides decision support mainly by showing the effect of ones choices and not by telling him what is best to do (“learning by doing”). Another main advantage of this approach is that we don’t have to foresee every possible situation a user might come up with and decide on the answer in advance. This way of decision support has deliberately been chosen based on the experience in the European R&D project *Daywater*. In this project several ways of decision support have been investigated (Deutch et al, 2004 and Förster et al. 2004).

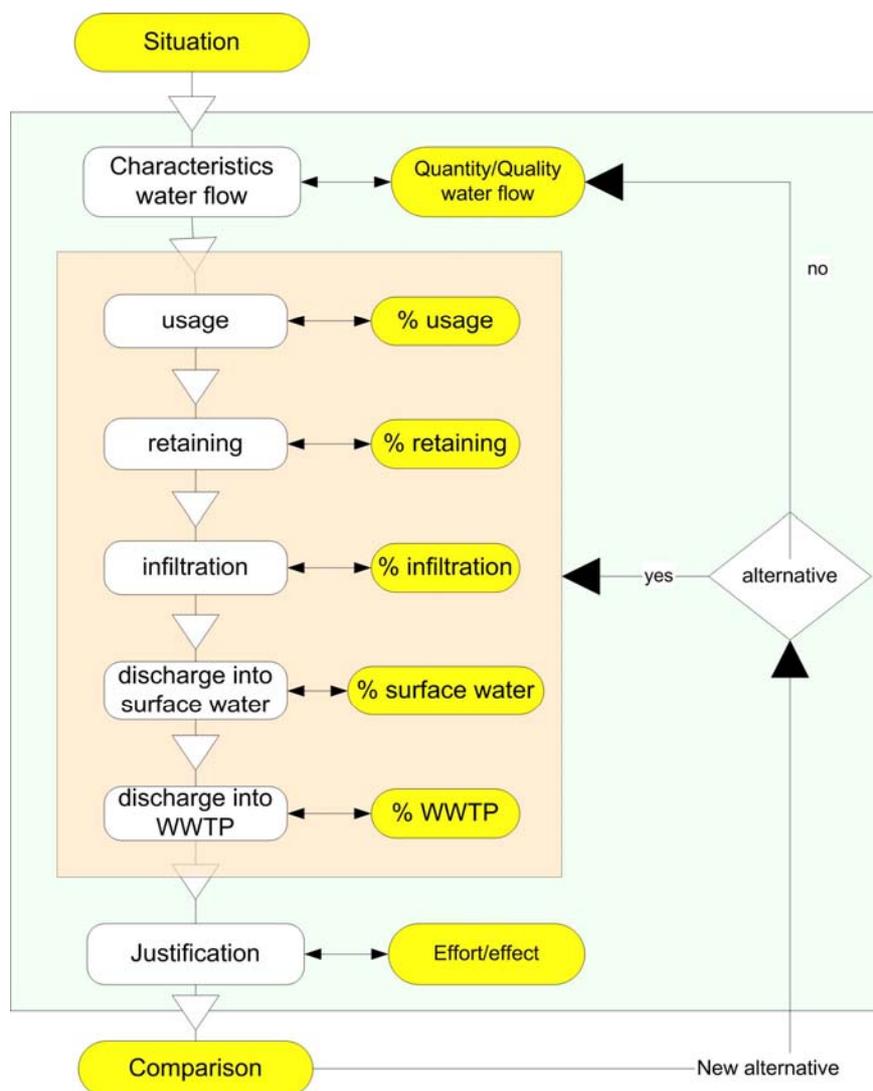


Figure 3. Assessment of alternatives

Information

IBOS provides the water manager with 3 types of information:

1. information on the national and regional policy guidelines;
2. information on solutions and examples of other projects;
3. local information.

It is important to keep all information up to date. The choice for a web application makes this possible. The first two groups of information have been gathered and presented in other

projects. The method of access to the third type of information, in the way *IBOS Regenwater* does it, is new.

By entering a zip-code or postal area code the user can access a range of essential local data, extracted from GIS-based databases:

- Size of area, divided into 6 types of ground use:
 - o Flat roof;
 - o Tilted roof;
 - o Busy road;
 - o Quiet road;
 - o Unpaved;
 - o Water;
- Infiltration capacity;
- Relevant WWTP;
- Local surface water characteristics;
- And so on.

The user can adjust data presented by IBOS to suit the project specific situation. In order to customize *IBOS regenwater* it features the 'My-IBOS'-mode in which the user can add local information and integrate the decision support system in the daily routine of work.

This coupled to local graphical information makes for a good basis for finding what to do with the storm water other than discharging to the sewer.

How to drain off your storm water?

"How to drain off your storm water?" is the main question the water manager should ask himself. The alternatives are limited and have different benefits.. *IBOS Regenwater* supports the water manager by the way it presents the alternatives. They are arranged in the 5 principal control mechanisms. These mechanisms are ranked by preference:

- Local usage
 - o The retention and use of rain water in the house and garden is mainly beneficial in reducing the amount of drinking quality water used where water of a lower quality is acceptable.
- Retain on surface
 - o Local depression and storage on roofs with vegetation can retain large amounts of water that eventually evaporate instead of being channelled into the sewer. Pervious surface areas allow infiltration of large proportions of the total rainfall.
- Infiltration
 - o Infiltration of collected rain water in an above or below ground facility requires an overflow to surface water.
- Discharge into surface water
 - o Discharge to surface water may require a facility to prevent pollution. A combination of storage volume and run-off capacity is needed to prevent excessive water levels after heavy storms.
- Discharge into WWTP
 - o This is the last resort of the model.

Primarily *IBOS Regenwater* presents a basic water balance as a reference. This balance represents the standard situation in which almost all the water is discharged to the treatment plant. For this reference situation *IBOS Regenwater* also presents a reference score. Next it is up to the user to create alternatives with a better score. The users do so by activating and

applying facilities using the different mechanisms. E.g. he selects to infiltrate a certain amount of the storm water of a certain surface type. The DSS presents the effect of these kind of choices and compares it to the standard and other alternatives. For each alternative created by the user, the water balance and score are given.

By looking at the extreme solutions the water manager gets insight into all the possibilities and the limiting factors. In the end this will provide him with arguments to implement a policy for sustainable storm water management.

Water quality and source control

The alternatives for using the water, for infiltration and for discharging into the surface water are limited quality of the runoff water. Runoff water is assigned a certain standard water quality for each surface type. This quality can be improved by the water manager by selecting source control measures. E.g. by excluding zinc from roof elements the quality of the roof water will improve or by choosing street sweeping instead of chemical weed management the run-off water will improve. A higher water quality will increase the down stream alternatives and will reduce the need for additional facilities such as oil separators. The effect of source control measures is in this way translated into more and hopefully also into cheaper solutions.

Scoring and comparison of alternatives

In order to compare alternatives, *IBOS Regenwater* presents the water balance and a score for each alternative. For your local situation the water balance is determined for each surface type. In addition also a balance of certain pollutants is calculated. This offers the opportunity to calculate the dispersion of pollutants for each alternative. The scoring of an alternative is on the one hand based on the environmental effect and on the other hand based on the resources needed to create and maintain the alternative. The effects and resources are:

Effects. The effects on the environment are of course difficult and arbitrary to define. We have chosen to build it up of:

- dispersion of pollutants;
- waste of resources and energy;
- land take;
- noise and smell nuisance;
- threats to safety and health;
- threats to the groundwater or the environment in general;
- production of waste.

This is presented positively by dealing with the prevention of the above mentioned subjects.

Resources. This deals with the input required to build and maintain a facility and is subdivided into costs and manpower. For each element both the construction and maintenance are important.

To make the evaluation of the alternatives for discharging the storm water, a database has been filled with reference values for effect (environmental impact) and resources for each BMP and alternative. The final score is then a product of these reference values and the water balance calculations.

Contributions of the end-users

In order to develop a useful tool, the developments have been discussed in several workshops with water managers of water boards and municipalities. The latest workshop concluded that it would be a useful tool in deciding on source-control. The availability of so

much information is very attractive to users. The main improvements are looked for in the presentation and comparison of alternatives. Clear and simple figures backed up by detailed information are required. Furthermore, the users stressed the importance of communication in the success of a urban water project and requested additional information on this aspect. This has been dealt with by adding support on communication and on managing the planning process for the implementation of sustainable storm water techniques, as has been done in the European R&D project *Daywater (Valkman en Lems, 2004)*.

FURTHER DEVELOPMENTS

At august 2005 *IBOS Regenwater* is almost ready to be used. In some workshops in 2005 a selection of the end-users will test the decision support system. On a national conference in October 2005 the version 1.0 will be launched and demonstrated. Furthermore support for the users will be arranged. In small groups training sessions will be given and a helpdesk will be made available.

The RIONED Foundation (the Dutch centre for sewerage and urban drainage) and InfoMil (an agency of the ministries of Housing, Spatial Planning and the Environment and Economic Affairs) will keep *IBOS Regenwater* up to date. InfoMil maintains the information on policies and RIONED maintains the more technical related information.

One of the major benefits of using *IBOS Regenwater* is the 'My-IBOS'-mode. Users can store their local information and in that way customize the decision support system. In that way it can be integrated in the daily working routine. The functioning of 'My-IBOS'-mode will be evaluated and further developed.

CONCLUSIONS

- Dutch water managers lack an overview of adequate information to develop and assess possible alternative roadmaps for dealing with urban storm water.
- Existing sources of information and tools for decision support are rarely specific enough or up to date in a fast changing environment.
- A web based tool for generating well argued local policies on urban storm water management has been developed and is called *IBOS Regenwater*.
- *IBOS Regenwater* combines the storm water mechanisms with local GIS information, national and regional policies, practical solutions and assesses the resources and effects of the possible alternatives .
- *IBOS Regenwater* doesn't give the optimum solution but places arguments for and against in order to allow the water manager to make informed decisions.
- To encourage the water manager to use *IBOS regenwater*, it has been simplified down to four basic steps :
 1. By entering a simple zip-code or the name of the municipality the user will have access to relevant information, including: type and size of surface, infiltration capacity, local surface water characteristics.
 2. The user specifies source control measures local surface use and risks for pollution, such as markets, ways of weed control methods, etc.
 3. Next the system presents the resources needed for the discharge of the rainwater via a combined sewer system and environmental impact of this discharge.
 4. Finally, the user can iteratively create a better solution by choosing the differing mechanisms for dealing with the water. E.g. he selects to infiltrate 70% of the rainwater on a certain surface type to be infiltrated. The DSS calculates the effect of his choices and compares it to the standard and the other variants.

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REFERENCES

- Ashley R, Blackwood D., Buttler D, Jowitt P., Oltean-Dumbrava C., Davies J., McIlkenny G., Foxon T., Gilmour D., Smith H., Cavill S., Leach M., Pearson P., Gouda H., Samson W., Souter N., Hendry S., Moir J. and Bouchart F. Making more sustainable decisions for asset investment in water industry - Sustainable Water Industry Resource Decisions - The Sward Project, 2002, Conference proceedings on CD-ROM, 9th ICUD, Portland
- Deutch J-C., Deroubaix J-F., Chouli E. and Carré C., (2004). How far and how the computer can support the decision making process, DMUCE Porto.
- Förster M., Thevenot D., Geldof G.D., Svensson G., Mikkelsen P.-S., Revitt M., Aftias E., Krejcik J., Sieker H., Legret M. and Viklander M., Decision-making processes in the context of urban stormwater source control management within European countries: DayWater project; DMUCE Porto.
- RIONED 2004, Leidraad Riolerings module C1200 Afwegen, prioriteiten stellen en beslissen, Stichting Rioned, www.riool.net
- RIONED 1998 PRIONED, methodiek voor het prioriteren van rioleringsmaatregelen in Nederland, Stichting Rioned, www.riool.net.
- STOWA 2000 IPEA: Interactieve Planvorming voor effectiviteit en acceptatie, STOWA, www.stowa.nl.
- Valkman R. and Lems P. Contextual water management: From necessity to opportunity, Novatech 2004.
- Ganzevles P.P.G., Kluck J. and BECO, IBOS hemelwater, Interactieve BeslissingsOnderSteuning voor weinig verontreinigd afvalwater, fase 1, februari 2004, Projectnummer 4266863, Tauw bv Utrecht, The Netherlands.