018530 - SWITCH

Sustainable Water Management in the City of the Future

Integrated Project
Global Change and Ecosystems

D2.1.3 R/T/D: A technological modelling approach, which assists the identification and targeting of the most appropriate stormwater solutions at a catchment scale

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Dissemination Level		
PU	Public	PU
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
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SWITCH Deliverable Briefing Note

SWITCH Document: D2.1.3 R/T/D: A technological modelling approach which assists the identification and targeting of the most appropriate stormwater solutions at a catchment scale
Deliverable reference: D2.1.3 R/T/D
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Audience: This document is targeted to all people involved in urban stormwater management planning und urban development planning, that want to improve the stormwater related problems. The tool can by used by experts as well as "semi experts", e.g. municipality staff that on the one hand has a clear understanding of the problem but on the other hand no specific expertise in modelling.
Purpose: • To provide a tool for the placement of BMPs/SUDSs and for the assessment of their effects • To provide guidance and background information on the use of the tool • To facilitate the application of BMPs/SUDSs
Background: Switching a city's stormwater management strategy from a "disposal mentality" towards a more sustainable, source control oriented approach is a difficult task. Decision makers on the one hand need assistance for the placement of BMPs. On the other hand, decision makers also want to know how these BMPs improve the situation in a given catchment. This deliverable provides solutions to both problems stated.
Potential Impact: The tool supports planners in the application, placement und assessment of BMPs/SUDSs. BMPs/SUDSs have proven in many cases to be more efficient then conventional pipe and tank based solutions. However, they are often not applied because of a lack of knowledge or personal resentments. This tool helps to overcome these constraints and thus facilitates the application of BMPs/SUDSs.
Recommendations Use the tool to facilitate the application of BMPs/SUDSs in your projects.

Table of contents

1 Introduction

In D2.3.2a, a GIS based tool was developed to assist in the placement of BMPs (BMP-DSS-Tool). This tool accounts for parameters like land use, slope, soil, etc. in order to site-specifically suggest certain types of BMPs. However, it is not capable to assess the effects of the BMPs. Therefore, detailed modelling is needed. IPS has developed a rainfall runoff and pollutant load model called STORM. One of the specialties of this model is, that it can simulate a wide range of BMPs. STORM is therefore used to model the effects of the BMPs.

This document introduces the BMP-DSS-Tool and the STORM model. It then describes how the tools were linked together and provides guidance for their combined application.

2 The BMP-DSS-Tool

GIS systems are most commonly used to collate and manage spatial data required as essential input for stormwater models such as SWMM, MIKE Urban CS, InfoWorks SD or STORM whose comparative attributes and strengths have been reviewed in Deliverable 2.1.2, Part A (Scholes and Revitt, 2008). In the context of a typical urban development scenario involving multiple stakeholders having a wide variety of interests and concerns (Revitt et al., 2008), there is clear potential for the use of a central data integration and communication tool to act as a precursor to analytical modelling. The development of this type of specific GIS tool, which facilitates stakeholder involvement and interaction in the decision-making process of BMP selection and location, is an identified objective of SWITCH WP 2.3 (Task 2.1) and the development of this GIS tool has been reported elsewhere (Viavattene et al., 2008; Viavattene, 2009).

The Stormwater BMP support tool incorporates and extends the previously developed MCC approach (EU 5th Framework DayWater project) (Ellis et al., 2008) which in addition to site characteristics, also benchmarks the performance of BMPs against a range of technical, environmental, economic, operation and maintenance, and social and legal criteria. In addition, an up-dated methodology for assessing the comparative pollutant removal potentials of different BMPs (Scholes et al., 2008) has been included. Thus, the tool facilitates the integration of data from a variety of sources to investigate the potential benefits of BMPs. In addition, the Stormwater BMP support tool identifies appropriate positions for the installation of selected storm-water BMPs and add them to a dedicated layer which georeferences existing and new BMPs for further use in hydrological stormwater models.

An extensive documentation on the tool is given in D2.3.2a. Figure 1 shows a screenshot of the tool.

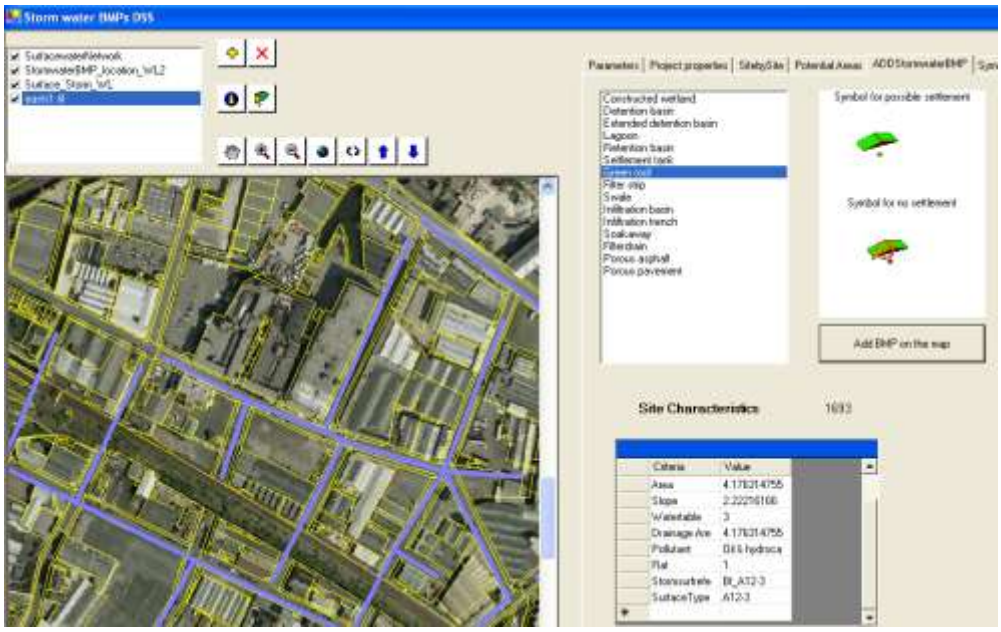

Figure 1: Screenshot of the BMP-DSS-Tool

3 The Storm Model

STORM is a fully-fledged hydrological rainfall runoff model for the calculation of pollutant loads and discharges on catchment level. STORM was developed by Ingenieurgesellschaft Prof. Dr. Sieker. The model is suitable for both urban and non-urban areas. Nearly all measures for centralized and onsite storm water management can be simulated and designed with STORM. The field of appliance reaches from the planning of single measures to entire drainage systems and catchment areas with on-site and central elements. The BMPs that can be calculated with STORM include the following: Surface infiltration, swales, infiltration swales, swale-trench systems, soakaways, green roofs, Innodrain©, rainwater retention tanks, central infiltration facilities, rainwater sedimentation tanks, cisterns for rainwater utilisation, combined sewage elements like rainwater overflows, rainwater overflow tanks in bypass and series, soil filters, etc.

STORM allows developing the rainwater management system based on GIS and AUTOCAD maps and/or aerial photos (Figure 2). One can lay out the basic data as an AUTOCAD dwg or dxf file, in the form of ARCVIEW shape-files or as raster data, e.g. in tif format. The drainage elements can then be placed true to the coordinates.

STORM has a long history and includes previous EU-project research result such as the pollutant load generator SEWSYS (Ahlman, 2006, Sommer et al. 2008) that was developed in the DayWater Project. Developments that were made during SWITCH include the completion of the English translation, full model export to and import from .mdb databases that was essential for the interaction with the BMP-DSS-Tool, realization of the coupling framework. STORM was introduced at a work meeting in Essen (Germany) in July 2008 organized by Theme 2 (IPS and MU) with participants from Theme 2, Theme 5, LA Hamburg, LA Birmingham, LA Lodz and a CD with the software was delivered to all participants. In April 2009, a workshop on STORM was held in Lodz.

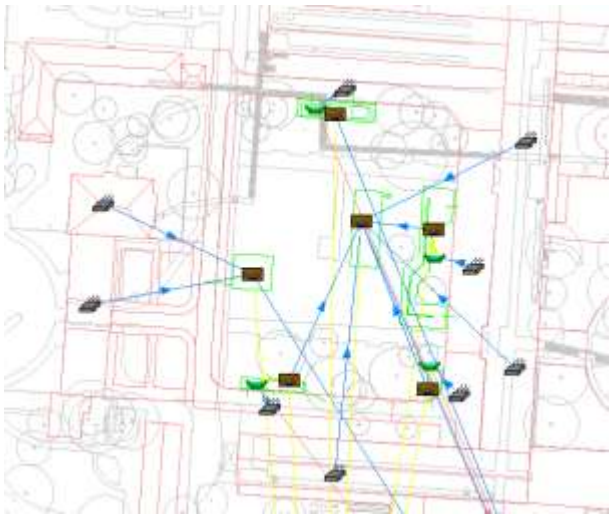

Figure 2: STORM model with GIS and CAD Data

4 Coupling of the tools

4.1 The approach

The idea behind the coupled use of the BMP-DSS-Tool and the STORM-model was to keep the application simple, so that the end user (e.g. municipality staff) can play with the tool and use it to evaluate the effects of certain measures. Nevertheless, a hydrologic model is a complex thing that needs expert knowledge to be applied correctly. The solution to this problem is a stepwise approach. In a first step the STORM-model is set up by experts that have sound knowledge of hydrologic modelling (Figure 4, red boxes = expert action). Once the model is built and the parameters are defined, it can be used by "semi experts" (Figure 3, green boxes), i.e. people that have an understanding of the problem, but not necessarily an education in hydrologic modelling.

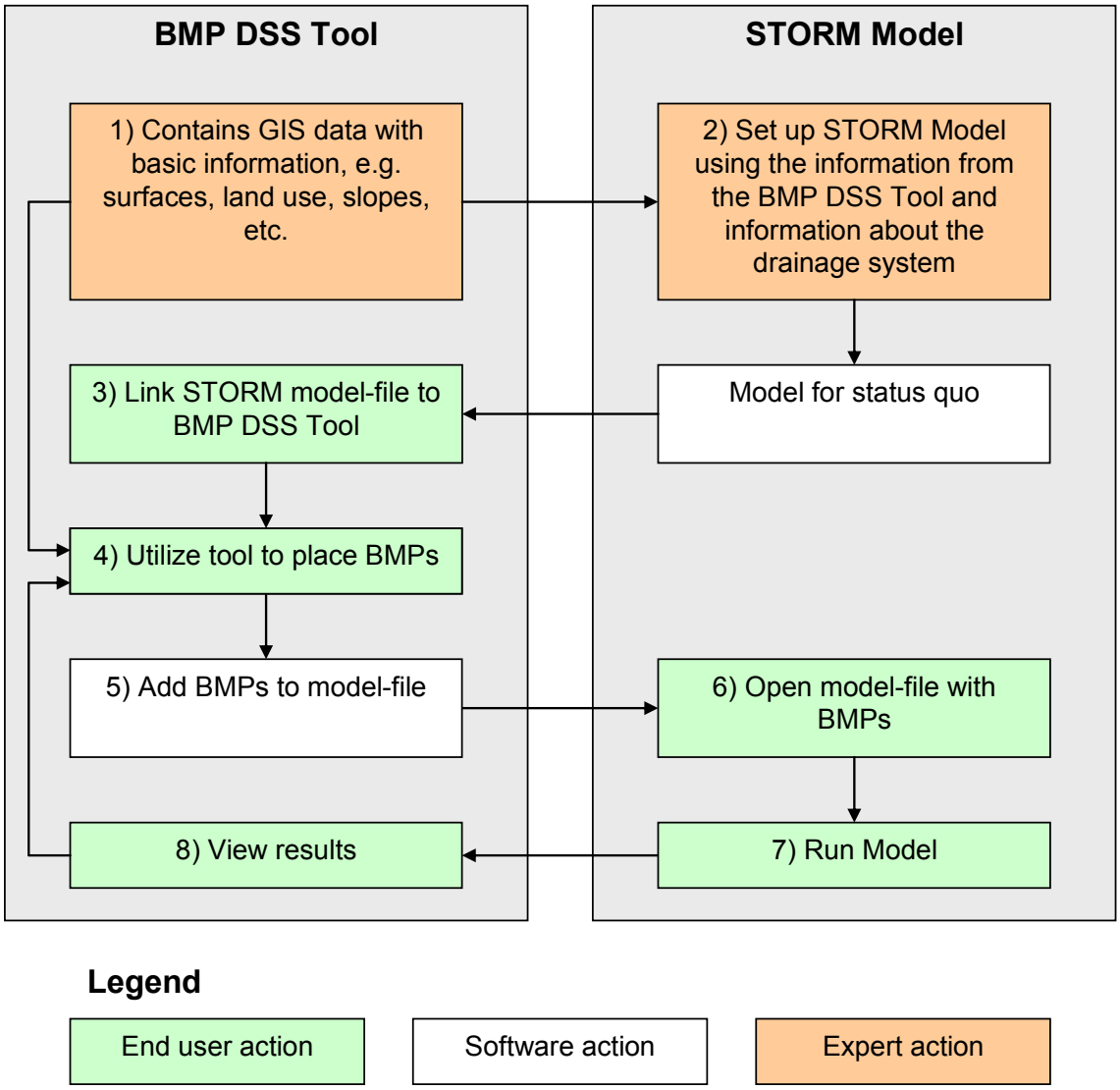

Figure 3: Coupling of STORM and the BMP-DSS-Tool

4.2 Manual

In the following text, a short description for each box in figure 4 is given:

1) As described in D 2.3.2.a

2) Setting up the Storm model using the GIS data is requiring a pre-processing within a GIS. We recommend a GIS expert to do it. The first operation consists in defining the different urban catchments in relation to the surface or combined pipes. Then the name of the related catchment has to be added for each parcel in the land use shape file (column StormArea in Figure 4). The result is depicted in Figure 5. In STORM, the parcels are not represented individually but are grouped by land use type and by

catchment. For each parcel, information on this group is also required (column StormSurf in Figure 4). We recommend naming the group based on a simple land use code (example in Table 1) and the StormArea name. Thus, the StormSurf column can be calculated automatically by combining the landuse and the StormArea column. Once the data is prepared like described it is possible to calculate the total area of each group.

The BMP DSS tool is not creating yet automatically these surfaces within STORM. It may be part of future development. Therefore, the creation of the initial data in Storm requires working with STORM directly. In addition to the surfaces, the drainage system has to be added. This again is expert work as stated in chapter 4.1. Further information on these issues can be found in the STROM user manual. Figure 6 shows the completed STORM-model.

Id	Landuse	StormArea	StormSurF
427	Building	A11	Bf_A11
428	Impermeable	A12-1	I_A12-1
429	Building	A12-1	Bs_A12-1
430	Building	A1-2	Bf_A1-2
431	Impermeable	A1-2	I_A1-2
432	Impermeable	A11	I_A11
433	Impermeable	A11	I_A11
434	Impermeable	A11	I_A11
435	Impermeable	A11	I_A11
436	Impermeable	A1-2	I_A1-2
437	Impermeable	A12-1	I_A12-1
438	Building	A11	Bs_A11

Figure 4: Exchanged data between BMP DSS tool and STORM Model

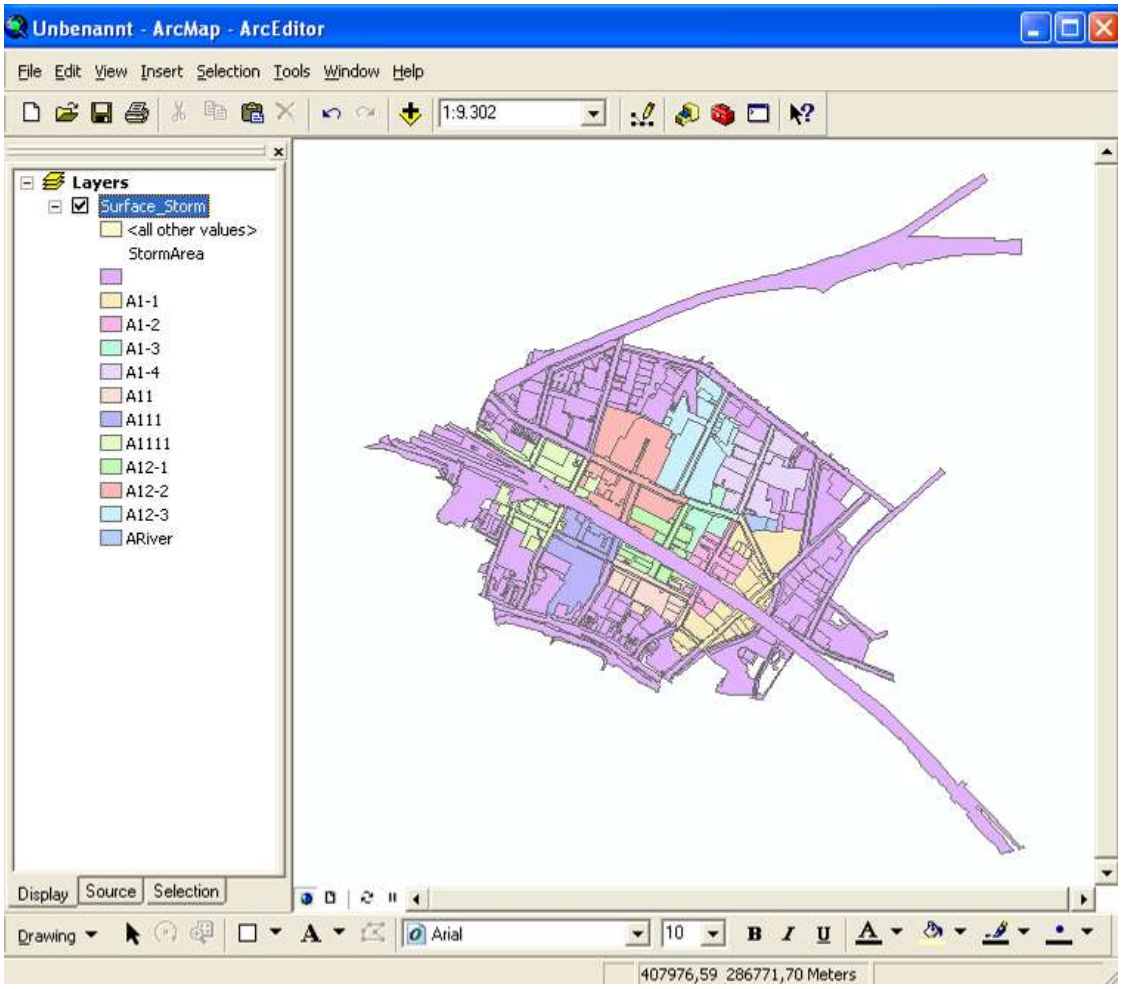

Figure 5: Catchment areas for the STROM model

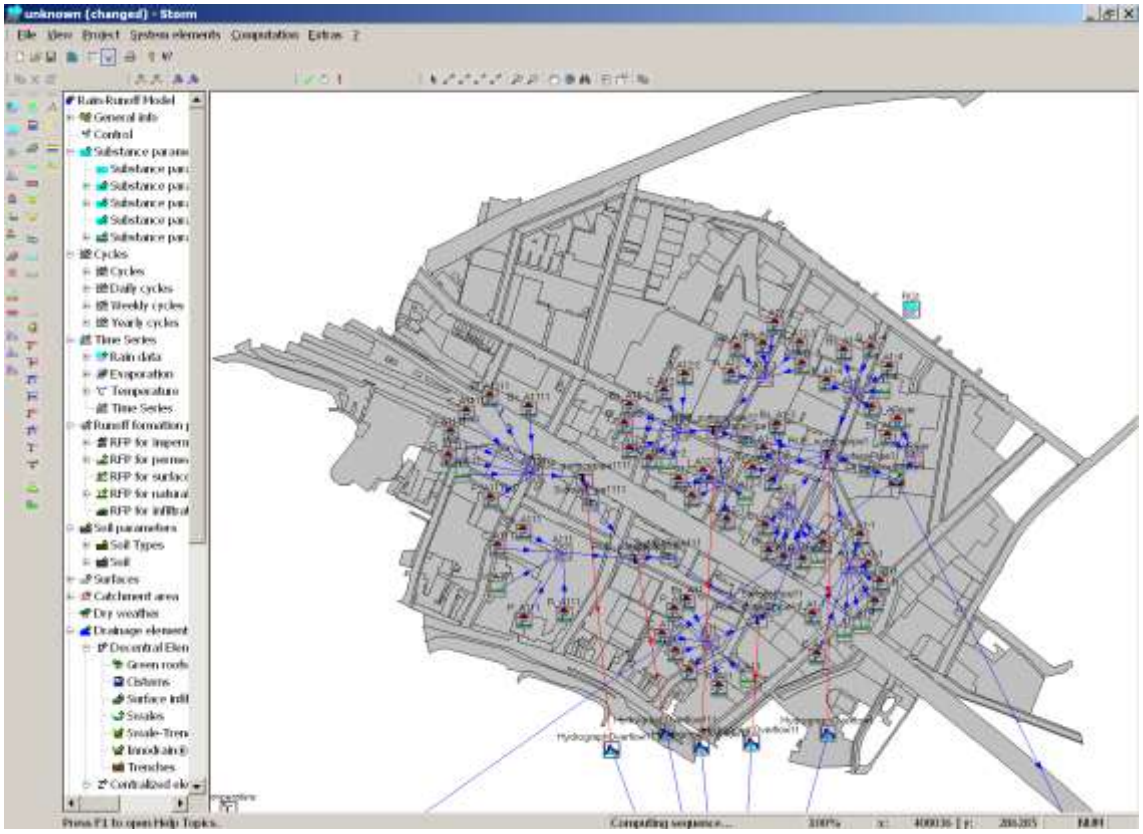

Figure 6: STORM Model

Table 1: Land use categories

Land use category	Codes Example
Building with flat roof	Bf
Building with slopped roof	Bs
Impermeable	I
Pavements	P
Road	R
Railway	Rw
Open space	O
Verges	V

3) In order to be linked to the BMP-DSS-Tool, the Storm model needs to be exported in .mdb format. (STORM: File -> Export -> MS-Access) This .mdb-file can then be linked to the BMP-DSS-Tool in the “Project properties” tab.

4) As described in D 2.3.2.a

5) Automatically done by BMP-DSS-Tool

6) In the STORM Software: File -> Import -> MS-Access

Figure 7 shows a detail of the STORM model before (top) and after (bottom) the placement of the BMPs.

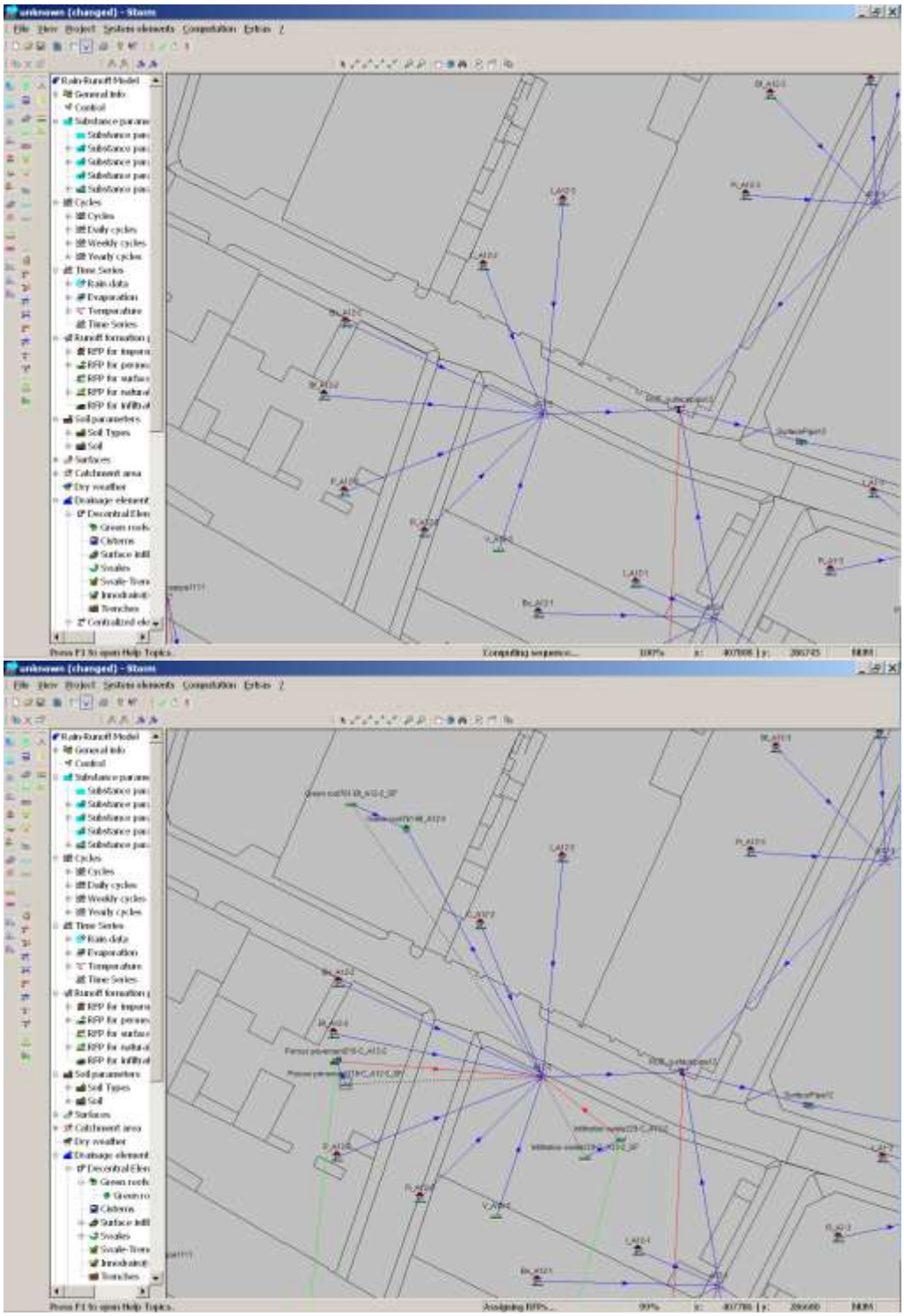

Figure 7: STORM model before (top) and after (bottom) the placement of the BMPs

7) STORM can export the results of the simulation in a text format. In the BMP-DSS-Tool, you can visualise some of these results, i.e. precipitation, pipe inflow and pipe overflow. Just define a filename in the output tab of any desired STORM object and the simulation results will be recorded. To run the simulation simply press F5 in the STROM software or click the button with the exclamation mark (!).

8) In the BMP DSS tool the results can be directly imported in the StormResults interface (Figure 8). Precipitation is represented by columns, pipe inflow by line, pipe overflow by square point.

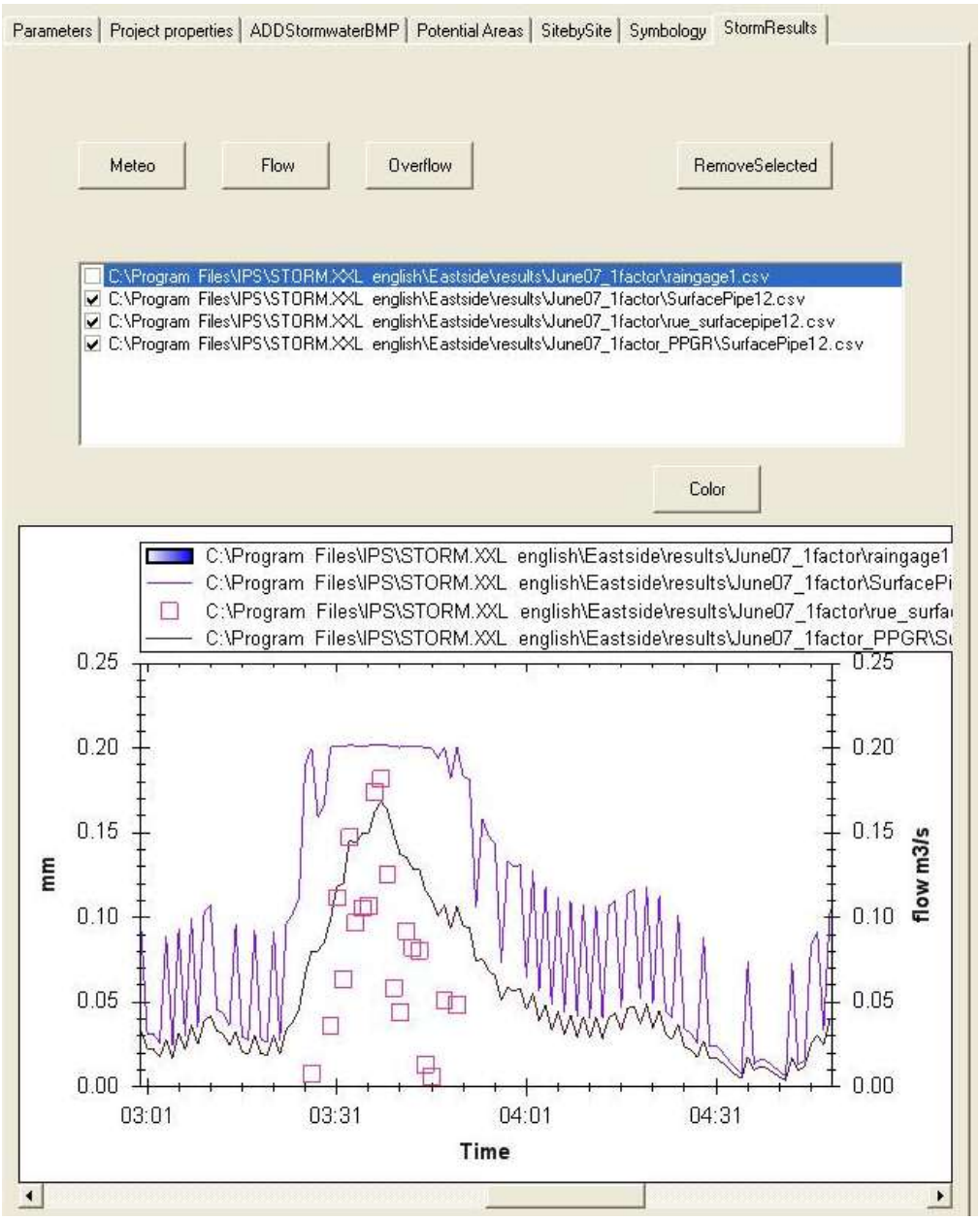

Figure 8: STORM results in the BMP-DSS-Tool

5 Resources

STORM can be downloaded form IPS's website: http://www.sieker.de/english/. All SWITCH members will get a full licence free.

6 Literature

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