BCE
BJÖRNSEN BERATENDE INGENIEURE

nofdp IDSS
User Manual

Version 1.2

English

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Table of Contents

List of Illustrations

List of Tables

1 INTRODUCTION

The nofdp IDSS is an information and decision support system developed cooperatively by Björnsen Consulting Engineers in Germany and Deltares in the Netherlands and commissioned within the framework of the "**n**ature **o**riented **f**lood **d**amage **p**revention" research and development project, which is sponsored by EU funds from the Interreg III B Program. Project partners are:

- Hessian State Ministry for the Environment, Rural Development and Consumer Protection, Wiesbaden, Germany (lead partner)
- Darmstadt University of Technology, Darmstadt, Germany (project coordination)
- Province of Noord Brabant, ´s-Hertogenbosch, the Netherlands
- German Federal Institute of Hydrology, Koblenz, Germany
- Aa en Maas Water Board, ´s-Hertogenbosch, the Netherlands
- Brabantse Delta Water Board, Breda, the Netherlands
- De Dommel Water Board, Boxtel, the Netherlands
- Mümling Water Board, Erbach, Germany

The goal of the research and development project is to support integrative river basin management that takes regard of spatial planning, water management and ecology for small river catchment areas, especially to improve protection against flood damage (see **Fig. 1-1**).

Fig. 1-1: Integrative river basin management with nofdp IDSS

The nofdp IDSS is not merely a decision support system. A strong emphasis in the system is placed on information exchange and communication. This tool is intended for use during the very earliest project phases, e.g. in the course of feasibility studies. The nofdp IDSS is only conditionally applicable for detailed planning (planning approval process).

With the nofdp IDSS, the necessary database and the modeling based upon it, both hydraulic and ecological, are bundled into a single system. It allows the multifaceted interrelationships and conflicts among spatial planning, water management, ecology and landscape planning to be identified and the derived results can be prepared in a coherent and concise form for dialogue with decision makers and citizens as well as all the parties involved.

Thus, the nofdp IDSS can help to evaluate the feasibility of a project at an early stage and enhance the acceptance of the planned measures. In the process, basis data in detailed form is significantly used and complex interrelated impacts are considered.

The concept for use of the nofdp IDSS is depicted schematically in **Fig. 1-2**.

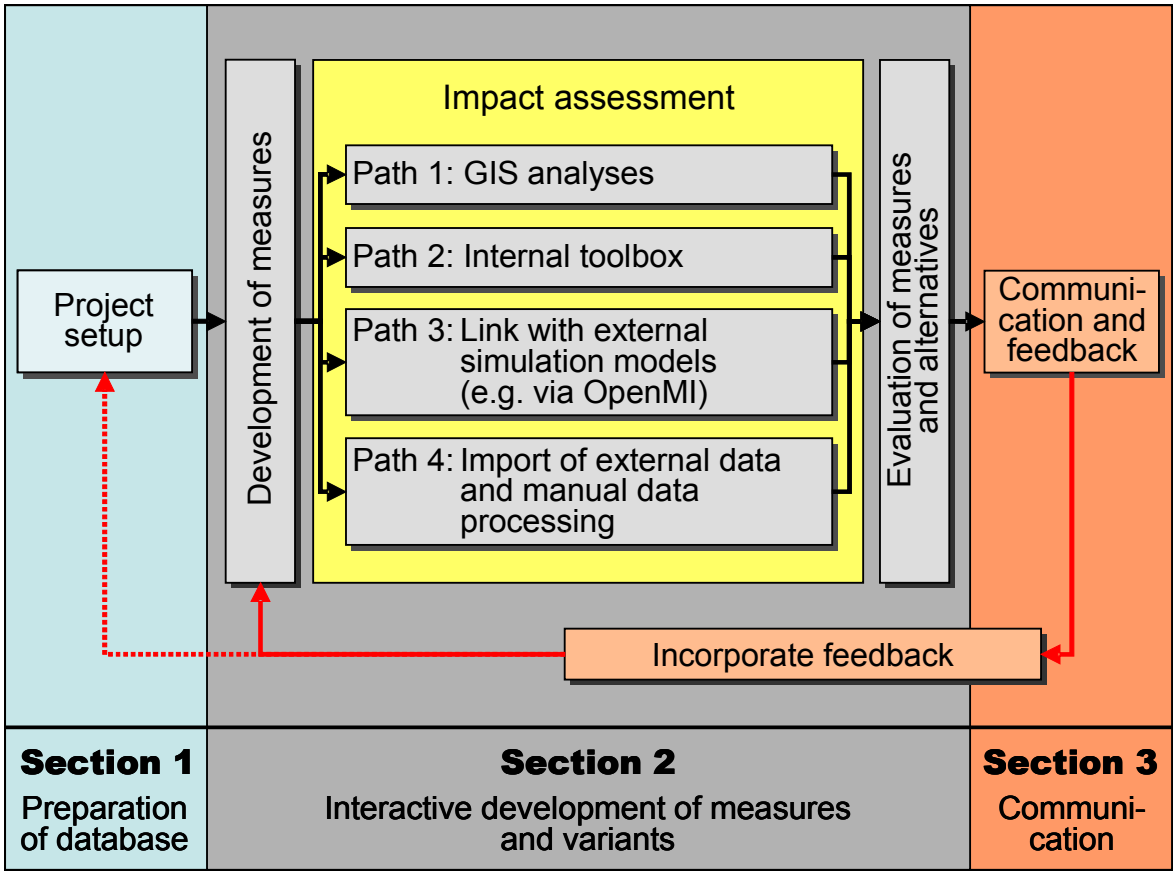


Fig. 1-2: nofdp IDSS workflow diagram

The typical workflow when using the nofdp IDSS is thus integrated in the scope of the phases *Project Setup* (Section 1) and *Communication* (Section 3). Between both of these phases lies *Interactive Planning* (Section 2), including the definition of measures and conflict analysis.

1.1 The nofdp IDSS Main Menu

The *Project Setup* section in particular is complex and requires in-depth experience in the use of geographical information systems and in regard to ecological and hydraulic modeling. The nofdp IDSS is thus not a Plug and Play tool, but requires familiarization with data preparation for the system and with the basic operating principles of modeled coherencies.
For an experienced user (*Expert*), the nofdp IDSS provides a user interface with all the modules and tools (see **Fig. 1-3**) –the *Project Setup* and *Analysis* modules in particular are aimed at use by *Experts*.

Fig. 1-3: The nofdp IDSS main menu in *Planner* (left) and *Expert* (right) modes

Once an *Expert* has set up the project fundamentally, a *Planner*, who in fact represents the target group of users, can employ the IDSS. A concise and coherent main menu is provided especially for the *Planner* (see **Fig. 1-3**, left side).

In *Planner* mode, the following modules are available:

- *Interactive Planning* (with the following tools: Conflict Detection, Measure Formulation, Variant Manager, Hydraulic Computation, Inundation Risk and Inundation Duration)
- *Evaluation* (with the following tools: Ranking, Rating, Cost-Effectiveness Analysis, Assessment Manager and Value Benefit Analysis)
- *Communication* (with the following tools: Screenshot Manager, Google Earth™ Interface, Report Manager and Export Manager)

Using from the menu bar above the nofdp IDSS main menu, the user interface switches back and forth between *Planner* and *Expert* modes. With , the user opens the Project Selection window (see **Chapter 4**). With , the context-sensitive Help function of the nofdp IDSS is invoked.

2 GENERAL REMARKS

The technical requirements for use of the nofdp IDSS are introduced below.

2.1 Hardware and Software Requirements

The following hardware and software requirements are recommended for deployment of the nofdp IDSS:

- PC, min. 2 GHz *(3 GHz, Dual Core)*, 2 GB RAM
- 1 GB free hard disk space *(and additional storage space for project data)*
- Microsoft Windows 2000 or Windows XP operating system
- Google Earth™, optional, for displaying exported KMZ files
- SOBEK 2.11 for execution of hydraulic computations (see **chapter 2.2.2**)

2.2 Installation

2.2.1 nofdp IDSS

Installation of the nofdp IDSS takes place with the help of a standard installation wizard. The user can specify the installation directories there in the familiar manner.

The nofdp IDSS is configured such that the projects and project data are filed within the installation directory in the *workspace* subdirectory.

Hint:
The files stored within the installation directory may not be changed or deleted. To import project data, use only the tools within the nofdp IDSS interface.

2.2.2 SOBEK

As simulation core for the hydraulic computation serves SOBEK by Deltares (www.deltares.nl). An installation at least of version 2.12 is required.

Using an existing installation
If there exists a SOBEK installation (version 2.12 or higher) it can be used by nofdp IDSS. A license for the module River is required.

Using the nofdp IDSS specific license
To use the nofdp IDSS specific license the free trial version has to be installed. The license can be expanded from a 100 nodes license to a 500 nodes license by requesting (and installing) a special license for nofdp IDSS.

Download and install
The installation file for the free trial version can be obtained via internet at http://delft-software.wldelft.nl (Downloads → SOBEK Free Trial Copy). There are also installation guidelines available (please note especially that in addition to the software also a licence manager has to be installed).

Hint:
To install SOBEK the user must be logged in to the Windows system as administrator.

Executing a hydraulic compution in nofdp IDSS is already possible using this test license. The license is however restricted to 100 nodes. A special nofdp IDSS license for 500 nodes can be obtained.

Requesting the nofdp IDSS specific SOBEK license
The nofdp IDSS specific SOBEK license is requested by transmitting the so called MAC address in an email to sobek.sales@deltares.nl with subject “nofdp”.
How to obtain the MAC address:

- Start → Run
- Run command: cmd.exe
- Execute in command window (pay attention to whitespaces!):
  - Ipconfig /all > %temp%\ipconfig.log
  - Notepad %temp%\ipconfig.log
- Copy text to email

The license will be issued for a year and will be submitted by email. In a final step the license has to be registered with the license manager.

2.2.3 Configuration of Sobek in the nofdp IDSS

To run a hydraulic calculation the installation path of Sobek has to be configured.

This configuration can be done under the menu *Windows – Preferences- nofdp IDSS.*

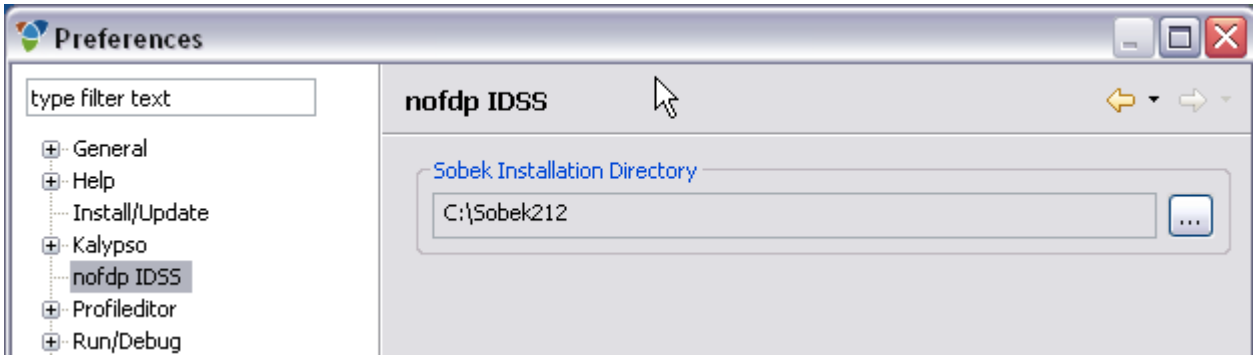


Fig. 2-1: nofdp IDSS reference to Sobek

2.3 Additional Integrated Software

Three external software components are integrated into nofdp IDSS. They are Open Source and freeware components that are explained in the following subchapter.

2.3.1 OpenOffice.org

The nofdp IDSS is supplied with a preconfigured version of OpenOffice.org (Portable OpenOffice 2.4.1). Upon starting Report Manager for the first time, Portable OpenOffice will be installed in the directory *workspace*\.*OpenOfficePortable*.

When creating the first report, the OpenOffice.org wizard is started once for registration and acceptance of the terms of license (see **Fig. 2.3.1-1**).

Once all five steps of the wizard have been completed and are concluded by selecting Finish, the report can be produced and then edited with OpenOffice.org.

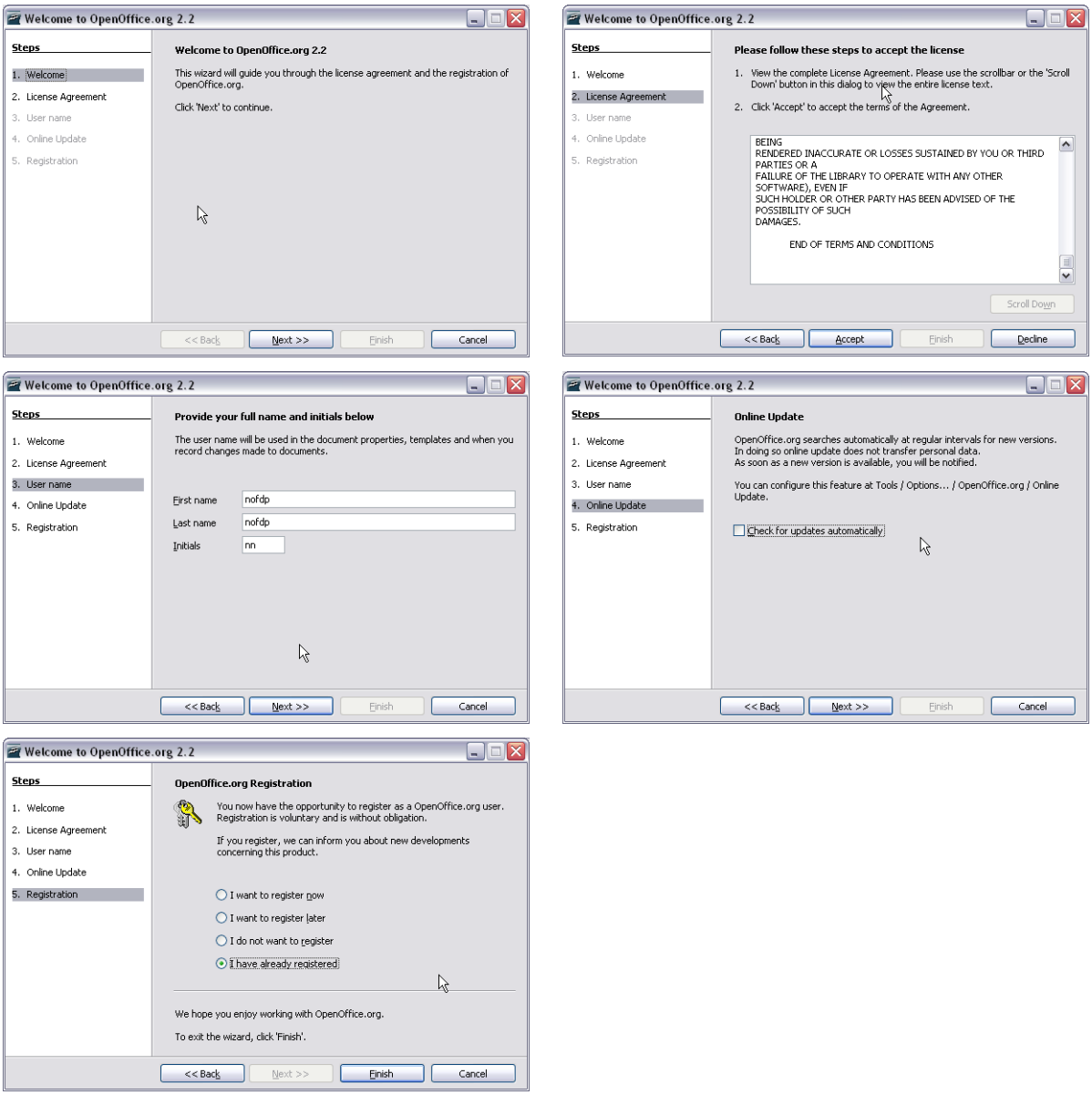


Fig. 2.3.1-1: OpenOffice.org Wizard — license terms and registration

2.3.2 SOBEK

SOBEK-River software must be installed for calculating the hydraulic network with SOBEK (for installation see **Chapter 2.2.2**).

The SOBEK software and interfaces and adapters of PI format and OpenMI are protected software products.

Users of nofdp IDSS can obtain a free expanded license from the SOBEK Helpdesk (sobek.support@wldelft.nl) permitting models with up to 500 nodes.

SOBEK software as well as the interfaces and adapter for PI format are registered software products.

2.3.3 Google Earth™

The nofdp IDSS includes an interface for creating KML 2.1 (Keyhole Markup Language). The data will be stored into KMZ files.

Google Earth™ software is recommended for displaying data in this format. Further information about Google Earth™ can be found at http://earth.google.com.

Google Earth™ is a registered trademark of Google Inc.

2.3.4 ISAR Web

The nofdp IDSS contains a modified copy of the ISAR Website (ISAR Informationssystem zur Auswahl effizienter Renaturierungsmaßnahmen für Fließgewässer).

ISAR-Client
Hessisches Ministerium für Umwelt, Landwirtschaft und Forsten
Postfach 3109
65021 Wiesbaden

ISAR- Contractor
Content, ideas, design and support:
Thomas Hillenbrand und Joachim Liebert
Fraunhofer-Institut für Systemtechnik und Innovationsforschung (ISI)
Breslauer Straße 48
D-76139 Karlsruhe

3 INTRODUCTION TO WORKING WITH nofdp IDSS

In this chapter, the basic techniques for working with the nofdp IDSS are explained.

3.1 Configuration

In order to use the nofdp IDSS, only a few global software settings are needed. Global settings are made under the menu *Windows - Preferences* (see **Fig. 3.1-1**).

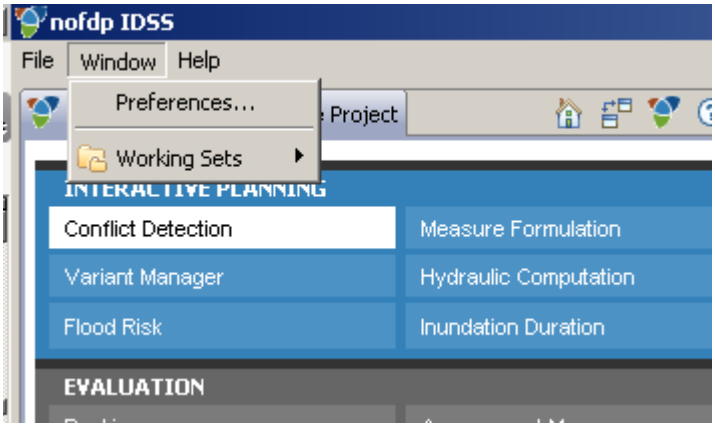


Fig. 3.1-1: Central configuration of the nofdp IDSS

In the *Preferences* window (see **Fig. 3.1-2**) the preference settings for the global coordinate system can be made under the Kalypso setting category (see also **Chapter 3.2**: Coordinate Systems and **Appendix A**).

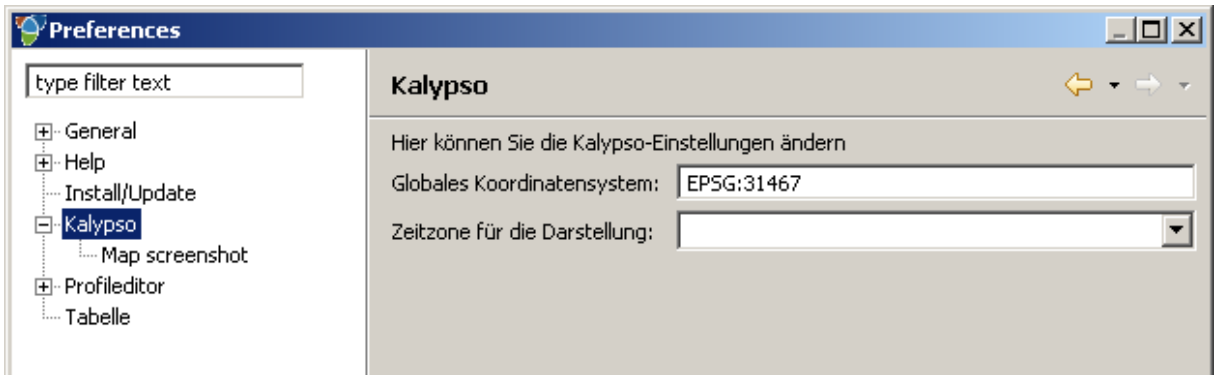


Fig. 3.1-2: nofdp IDSS coordinate system preferences

Type and size of the screenshots that will be exported are set under Kalypso / Map screenshot (see **Fig. 3.1-3**).

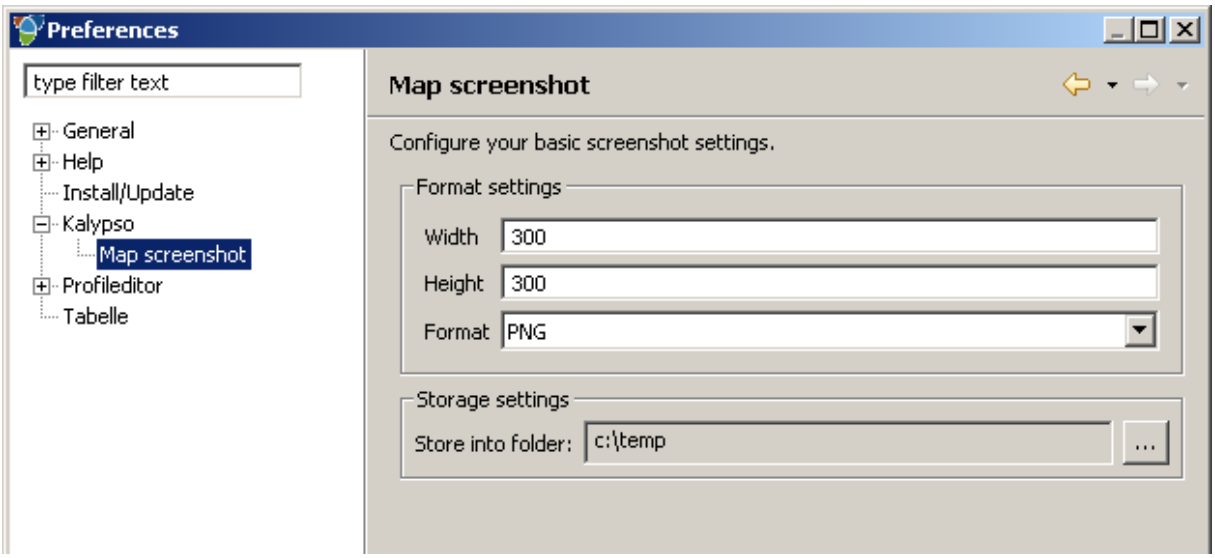


Fig. 3.1-3: nofdp IDSS screenshot preferences

3.2 Coordinate Systems

The coordinate systems supported by nofdp IDSS are described in **Appendix A**.

3.2.1 Definition of Coordinate Systems in nofdp IDSS

Coordinate systems are defined in various places in the nofdp IDSS:

- When importing geodata and Cross Section data, the coordinate system (source coordinate system) is defined. Once set, the coordinate system cannot be subsequently changed.
- All maps shown by the nofdp IDSS are displayed in the globally defined coordinate system.

3.2.2 Projection with Differing Coordinate Systems

In the nofdp IDSS, geodata with differing coordinate systems can be processed together. The only requirements are that the source coordinate system for the geodata is known and the target coordinate system for the map is defined. If the source and target coordinate systems differ, the data is projected *on the fly* into the target coordinate system. A correct representation of the geometries thus appears in the map.

3.3 Data Management

In the nofdp IDSS, data of various types and categories can be processed.

The nofdp IDSS therefore distinguishes amongst the following data **types**:

- Geodata
  - SHAPE data (SHP format)
  - Raster data (ASC format, see **Appendix B, Digital Topographical Model**)
  - Image data, geo-referenced (e.g. orthophotos, topographical base maps)
    - GeoTIFF
    - TIFF with World file (TFW)
    - JPEG with World file (JGW, JPW)
- Cross Section data as special geodata
  - ASCII format (XYZ format, see **Appendix B, Cross Section Data**)
- Time series data (see **Appendix B, Time Series**)
  - ASCII format (selectable delimiter and date format)
  - ZML format (internal XML based time series format,)
- Hydrographs (see **Appendix B Time-Series**)
  - ASCII format (selectable delimiter)
  - ZML format (internal XML based time series format)

Along with the differentiation of data types, data are defined in **Categories**. Using categories, a functional, thematic attribution and a detailed definition of the data structure can be conducted and tested. Data that is to be associated with a nofdp category must comply with various rules for the data structure; otherwise these data will be assigned to the user-defined category (*user category)* in the data structure (see **Fig. 3.3-1**).

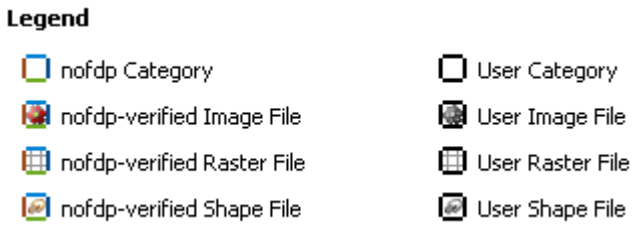


Fig. 3.3-1: Distinction of the data between *nofdp category* and *user category groups* and symbols for the data types

A data category is described in the internal data structure and contains information about data type, geometry type, quantity and content of the attributes. The fixed definition enables stabile (geodata-) processing and automated display in the maps.

Data Category Example: Soil Moisture
In order to process geodata for “soil moisture,” a polygon data set with at least one text attribute must be assigned. The content of the attribute fields may only contain values from the set {-9999,a,d,m,w}.

The nofdp IDSS categories are described in detail in **Appendix B**.

All data for a project are stored in the project directory, i.e. The nofdp IDSS import routines create a copy of the data. The data origin is stored in the metadata. A connection to the input data does not remain.

The administration and processing of data takes place with the following modules depending on the data type:

- Geodata Import (data type: Geodata)
- Cross Section Manager (data type: Cross Section data)
- Time Series Manager (data type: Time Series data)

3.4 Working with Geodata

Some of the modules integrated into the nofdp IDSS require geodata as entry data and also generate new geodata. The entry data should be reviewed, and adjusted or corrected if necessary, in a GIS before importing into the nofdp IDSS (see **Chapter 5.1**). The geometries must be sufficient with regard to the characteristics of the data structure requirements (see **Chapter 3.3** and **Appendix B**).

A viewer for GIS data is integrated into the nofdp IDSS for the display of geodata. The GIS Viewer contains a toolbar for navigation and output of data (see **Fig. 3.4-1**).

Fig. 3.4-1: GIS Viewer toolbar

The map scale can be predefined in the footer of the nofdp IDSS program window (see **Fig. 3.4-2**). After concluding the entry with the Return key, the map view is displayed in the desired scale.

Fig. 3.4-2: Scale of view setting

The individual tools have the functions described in **Table 3.4-1**. Some tools are grouped thematically and can be reached by pressing the small black triangle next to one of the symbols.

Table 3.4-1: GIS Viewer standard tools

Symbol	Function
	Shift view (Pan)
	Enlarge map view 20%
	Reduce map view 20%
	Select new map view with frame
	Set map view to the extents of all topics
	Shift map view to the west
	Shift map view to the south
	Shift map view to the north
	Shift map view to the east
	Create map screenshot (see **Chapter 9.1**)
	Export map topics as Google Earth™ KMZ files (see **Chapter 9.2**)

Along the right side of the map, a separate window for map content is displayed (see **Fig. 3.4-3**).

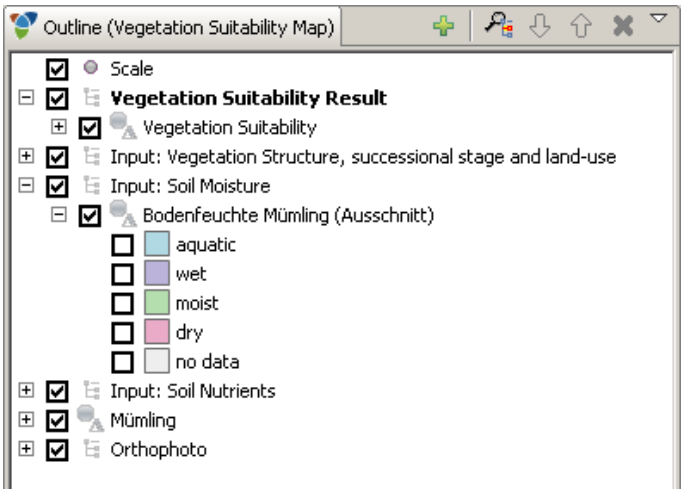


Fig. 3.4-3: Map content

Using the map window, the map topics can be managed. Map topics can be turned on and off using ☑. The topic list can be expanded with ⊞ to display the topic's legend and closed again with ⊟. New topics can be added to the map using ✚. After clicking on ✚ , a wizard opens to load new topics (see **Fig. 3.4-4**).

With help of the wizard, geodata, measures for variants, all measures or the project limits can be added. The wizard pages that follow change accordingly. For example, if geodata are to be loaded, on the second wizard dialog box the geodata set must be selected from the project geodata list and a name entered (see **Fig. 3.4-4)**.

The sequence of the map topics can be controlled with the arrows and . The selected topic is zoomed to its maximum extent by using . The selected topic is deleted from the map using .

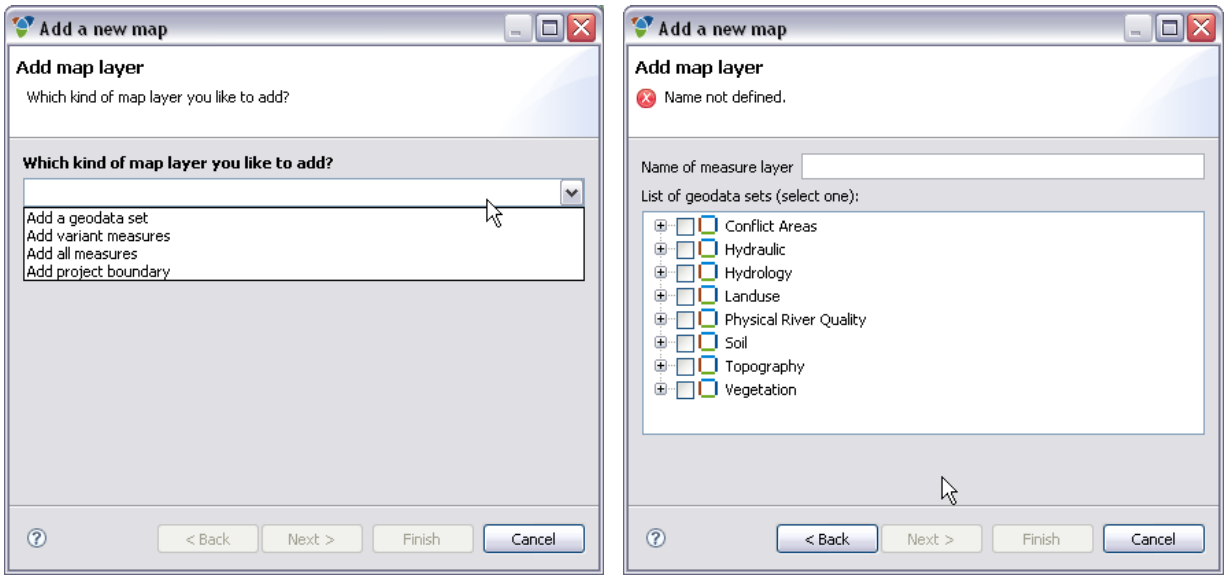


Fig. 3.4-4: Wizard for loading new map topics

3.5 Working with Cross Sections

Cross Section data can be visualized or modified in the nofdp IDSS using the Cross Section Manager, Flow Network Setup or Measure Formulation. In these modules, the map window of the Cross Section Viewer appears below the map window (see **Fig. 3.5-1**). The additional tool appears in the map window to select the active Cross Section in the displayed map. To display Cross Sections in the Cross Section Viewer, a Cross Section must be selected.

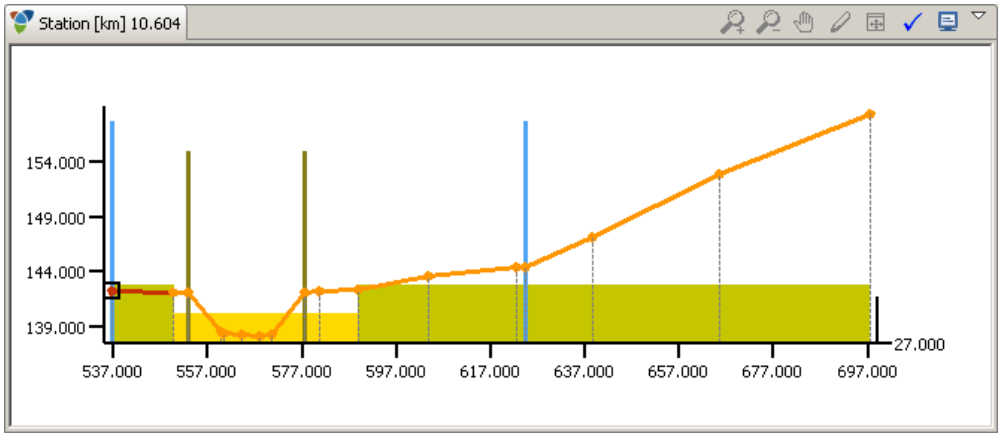


Fig. 3.5-1: Cross Section View window

In the cross section window, various tools are available. The view is reduced using and enlarged using . The view can be shifted (panned) using and returns the view to the show the entire profile. A screenshot can be created with , and then viewed in Screenshot Manager (see **Chapter 9.1**).
In the Cross Section Manager, the tool for the editing mode also appears, so that the nodes of the Cross Section can be modified interactively.

The valid data formats are listed in **Chapter 3.3** and **Appendix B, Cross Section Data**.

3.6 Working with Time Series and Hydrographs

Time series and Hydrographs are managed in the nofdp IDSS in the Time Series Manager and integrated into the Flow Network Setup or used to generate Inundation Durations. The valid data formats are listed in **Chapter 3.3** and **Appendix B, Time Series Data**.

4 PROJECT MANAGEMENT

4.1 Starting the Program

Every time the nofdp IDSS is launched the Welcome Page will be shown:

Abb. 4.1-1: Welcome Page

The Welcome Page is the key entring point of the nofdp IDSS and includes the following points:

- Start project work
- Installation of example projects
- Links to Guidelines
- Links to relevant Webpages
- Information about Terms of Use and Partners

To proceed with the project work the link *Start Project Work* must be excecuted. Projects are the top hierarchical level in which work is combined in the nofdp IDSS. Working with projects is the subject of the following sub-chapters.

Hint:
Changes in projects are saved automatically. There is no manual button to do this. Changes will be automatically saved each time a module is changed or the application is closed.

Hint:
For backup of the data, it is recommended that projects are regularly versioned (see **Chapter 4.4** Duplicate Project or **Chapter 4.6** Export and Import a Project). This should take place at least once per day – for complex projects, twice daily is preferable.

4.2 Creating a New Project

In the Project Selection window, is used to create a new project. A wizard appears, in which the project template and the project name must be defined by the user. Then a new project appears in the project list. **Fig. 4.2-1** shows the window for project selection and definition of a new project.

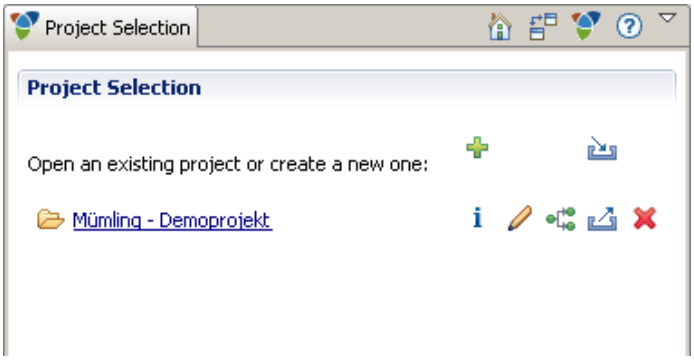


Fig. 4.2-1: Creating a project

4.3 Opening an Existing Project

In the Project Selection window, an existing project can also be selected. **Fig. 4.3-1** shows this window. By clicking on the symbol for the desired project in the project list, the user is switched to project operating mode.

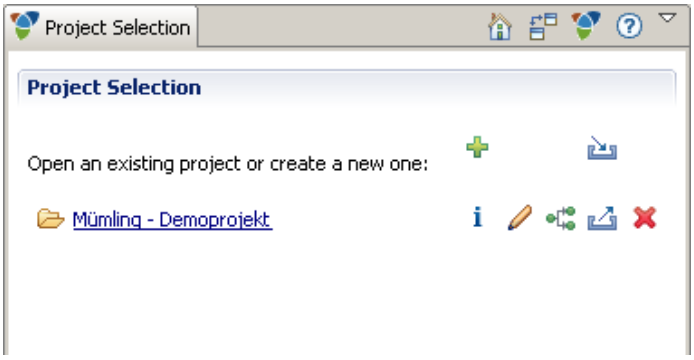


Fig. 4.3-1: Selecting a project

4.4 Duplicate Project

By clicking the button, the selected project is duplicated. The duplicated project then appears in the project list. All data belonging to the project is duplicated.

4.5 Delete Project

By clicking the button, the selected project is deleted. All data belonging to the project is deleted. The project is removed from the project list.

4.6 Export and Import a Project

By clicking the button, data belonging to the desired project is exported. A wizard appears, in which the desired path and file name can be selected. The data are compressed into an archive file (ZIP file). The ZIP file is transferred into the selected directory.

Projects can be imported with . For this purpose, the appropriate project archive file (ZIP file) is selected with the help of a wizard. Subsequently, the selected project is decompressed and integrated into the nofdp's internal project management. The project name thus appears in the project list and the project can then be opened.

4.7 Viewing Project Metadata

The metadata belonging to the desired project can be viewed by clicking the i button. Fig. 4.7-1 shows an example. In the lower left part of the window, the project area (project location) is shown as a rectangle displayed on the map. On the right side of the window (project info), text and illustrations are displayed.

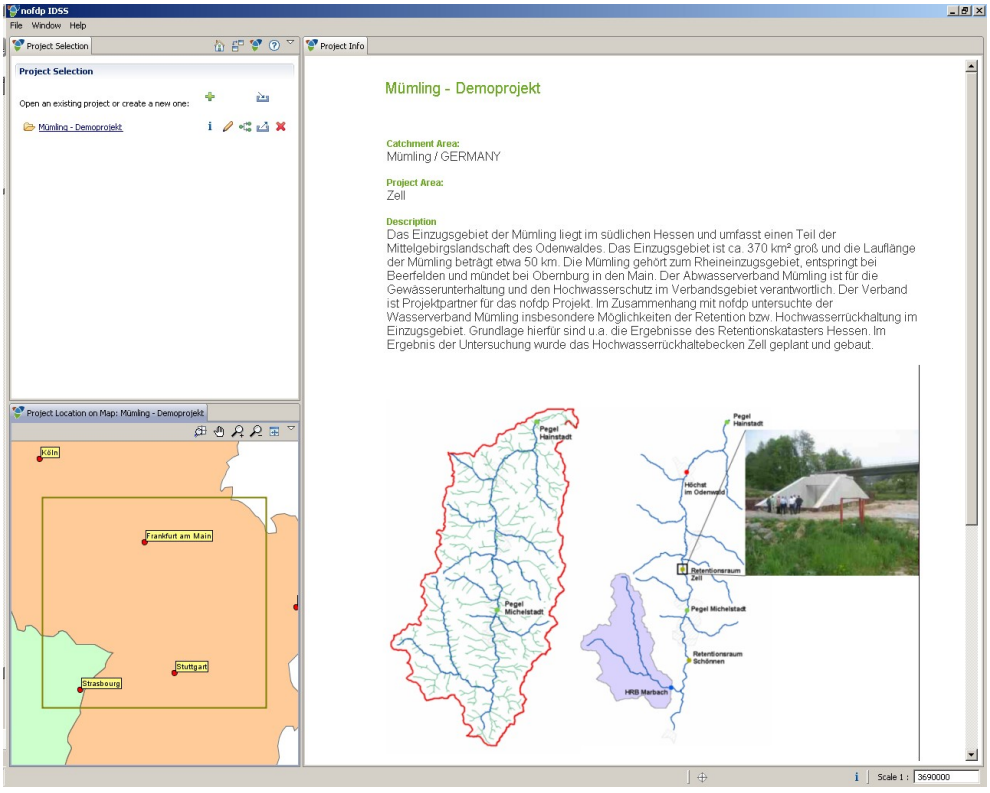


Fig. 4.7-1: Viewing project metadata

4.8 Edit Project Metadata

By clicking the button the user reaches the edit mode for metadata. Fig. 4.8-1 shows an example.

In the lower left part of the window, the project area (project location) is shown as a rectangle displayed on the map. In order to define the project area in the map the tool must be activated..

In the middle of the window, additional metadata for the project are defined. This includes project information (including a brief description and an illustration), contact information and time data.

In the right part of the window, further documents can be added to the project with . A wizard appears, in which the document can be selected and described with metadata. The document is thereby incorporated into the project and included in the document list in the right part of the window. An illustration (as previously-mentioned) can also be imported using this mechanism to become part of the project information.

The metadata for a selected document are displayed under “details” in the lower right part of the window. Selected documents can be deleted with or duplicated with . Using , these documents can be opened with the associated program.

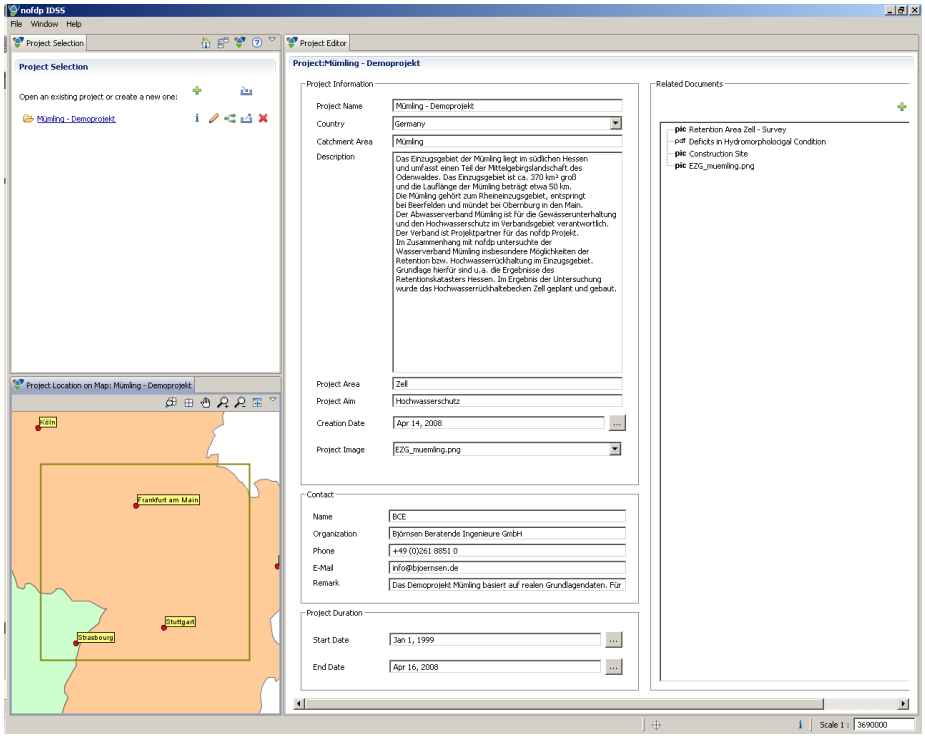


Fig. 4.8-1: Editing project metadata

4.9 Exit Program

The program can be closed during all steps of project work and in all modules. Changes to the active project will be saved automatically.

To execute Exit Program press:

- Window Close Button () or
- Window Menu -> File -> Exit

5 PROJECT SETUP

Before one is able to utilize the nofdp IDSS, certain presettings and configurations – especially with regard to using the database – must be made. These are the subject of the following chapter.

5.1 Geodata Import

The Geodata Import tool supports two modes:

- Standard Geodata Import, with user guidance. In this mode, the user is presented with the geodata topics necessary for the available tools. Thus, preparation of the data can proceed on the basis of precise questions.
- Advanced Geodata Import with a view towards the structure of the geodata filing system.

Additionally, Geodata Import contains a Map Manager. With the Map Manager, background maps can be configured for the other tools (e.g. Flow Network creation, see **Chapter 5.4**). Only geodata that has already been imported or is generated during the editing can be accessed for use in configuration.

5.1.1 Standard Geodata Import

The standard geodata import procedure is activated by selecting the import mode *Standard Geodata Import*. Under *Geodata* in the right window, a list of the analysis tools then appears. By activating the respective tool from the list, another list of the required geodata topics opens up (see **Fig. 5.1.1-1**).

Topics are marked with ✓ if they have already been imported and are available as nofdp IDSS-conform data sets, or with ⊗ if they are not available.

With the ✚ button, topic-specific geodata can be imported.

In **Fig. 5.1.1-2**, the import of geodata is shown using an example for the category *Soil Moisture*.

In the first step, the name and the path for the file to be imported is requested. This step is supported by a wizard, in which the data format that is defined for the current category is set by default in the wizard window as the data type to be imported. In the example using soil moisture, this is the SHAPE format.
Then in the following wizard dialog boxes, attributes associated with the selected shapefile are displayed, metadata can be defined and the significant attributes for, e.g. soil moisture, must be selected.
On the last wizard dialog box, the possibility exists to assign the geodata to be imported to a map template. The map templates are organized according to the nofdp IDSS tools. Each nofdp IDSS tool with a map view has its own map template, which is displayed as a background map. The assignment to the map templates is possible in the Map Manager (see **Chapter 5.1.3**). Upon selecting *Finish*, the import is executed. Here the user can add and remove themes to maps regardless of the geodata import.

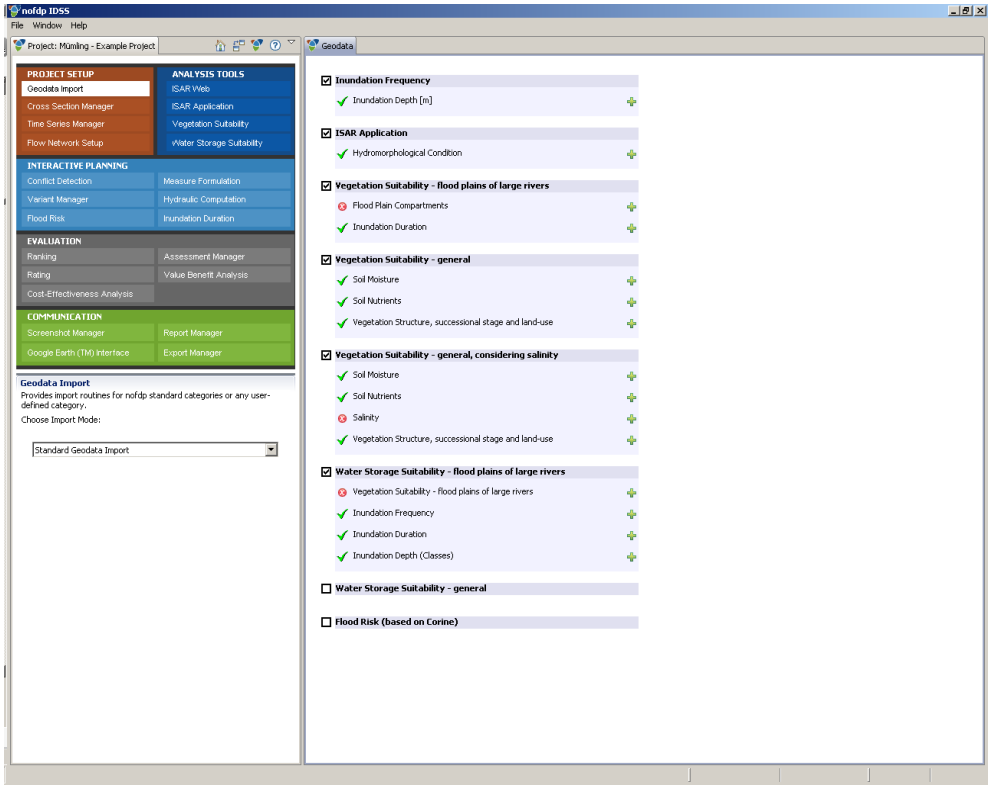


Fig. 5.1.1-1: Standard Geodata Import

Thereby, the data sets are validated according to the category-specific nofdp IDSS data format specifications (see **Chapter 3.4**). If these conventions are fulfilled, the import is completed and the category receives a ✓ in the screen view.

If the validation fails, the import is automatically cancelled. This can, on the one hand, be due to a data error that could be repaired with external means. On the other hand, it can be the case of a user format. User-defined data formats are generally imported with the help of *Advanced Geodata Import*.

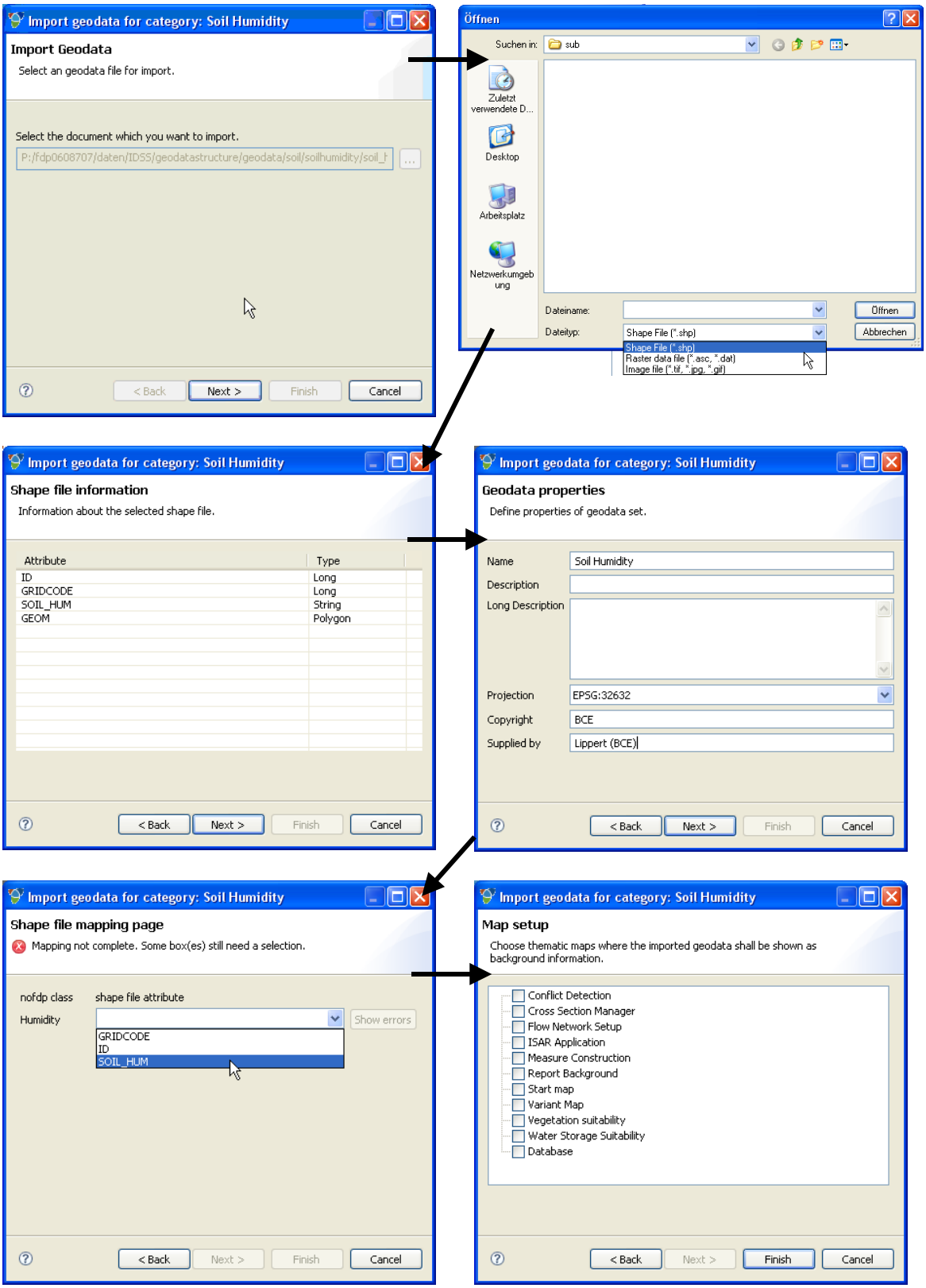


Fig. 5.1.1-2: Import wizard (sequence: from left to right and top to bottom)

5.1.2 Advanced Geodata Import

The Advanced Geodata Import function is activated by selecting the import mode *Advanced Geodata Import*. Under *Geodata* in the right window, a tree view appears with the nofdp IDSS standard data categories. Some of these standard categories contain subcategories, which are expanded for view when the respective standard category is activated (see Fig. 5.1.2-1). An example is the standard category *Hydraulic*, which contains the subcategories *Inundation Area*, *Inundation Depth*, *Inundation Duration* and *Inundation Frequency*.

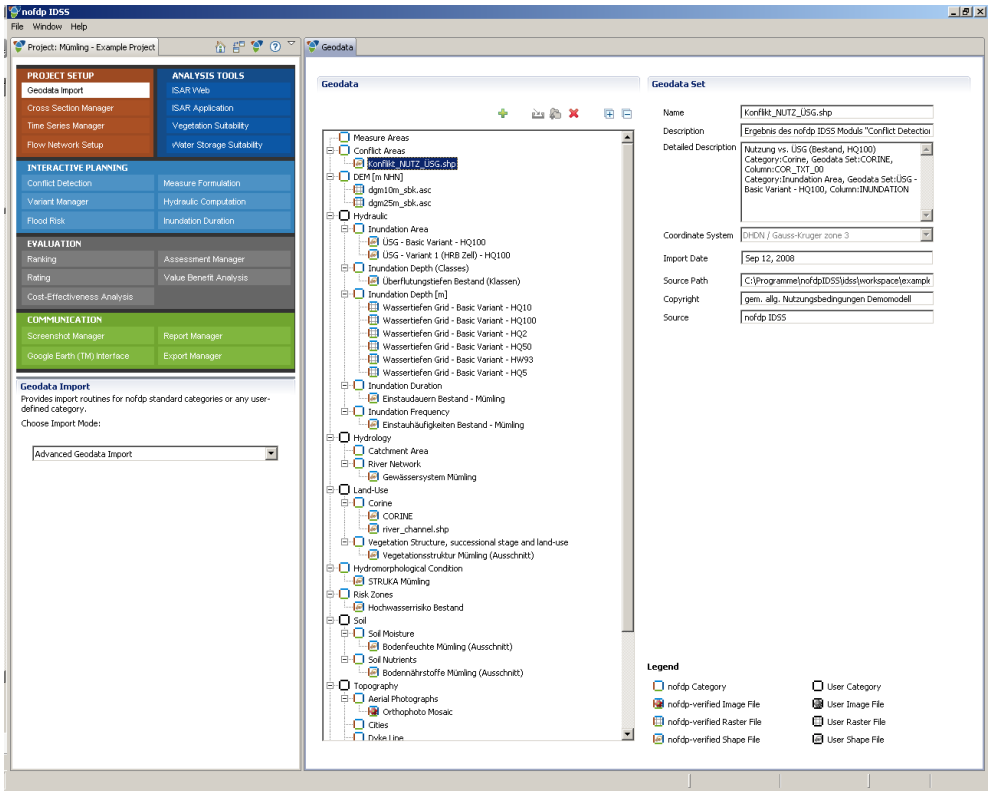


Fig. 5.1.2-1: Advanced Geodata Import

With the button in the menu bar above the displayed geodata list, the geodata list with all of its subcategories is displayed fully expanded. With , the tree view can be reduced again to display only the top-level standard categories. With or adjacent to the respective category, it is possible to display or hide the subcategories of the geodata list.

Basically the nofdp IDSS distinguishes between user-specified and nofdp IDSS standard geodata categories. If geodata sets are imported as nofdp IDSS standard categories special methods are available for those data sets.

User-specified categories are added with . Subcategories for an unlimited amount of hierarchical levels can be created with . First, the category or subcategory for which a subcategory is to be created must be marked with the cursor.

User-specified categories/subcategories and imported geodata sets are deleted with . The nofdp IDSS standard categories cannot be deleted as well as User-specified categories containing nofdp IDSS standard catagories.

For data import, the respective category/subcategory must be marked with the cursor. By using the button, the geodata import is initiated and an import wizard analogous to the one in *Standard Geodata Import* opens (see **Fig. 5.1.1-2**).

As with the Standard Geodata Import, the actual import is first implemented after clicking on *Finish* (in the last wizard dialog box, also allowing the assignment to map templates). In the case that geodata for nofdp IDSS standard categories is to be imported, validation of these geodata sets takes place in respect to the category-specific nofdp IDSS data format specifications (see **Chapter 3.4**). As long as the data format specifications are fulfilled, no message is given. The imported geodata set then appears as a nofdp-conform data set in the tree view, as part of the previously selected category or subcategory. All nofdp-conform data sets are displayed with icons in the nofdp colors as shown in **Fig. 5.1.2-2**.

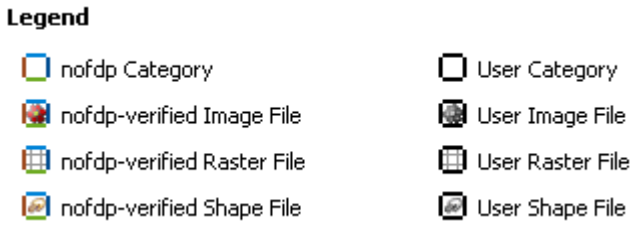


Fig. 5.1.2-2: Legend for geodata files

If the validation fails, the user receives a message (see **Fig. 5.1.2-3**) and can reject the import with *Cancel* or load the geodata as a user data set with *OK*.

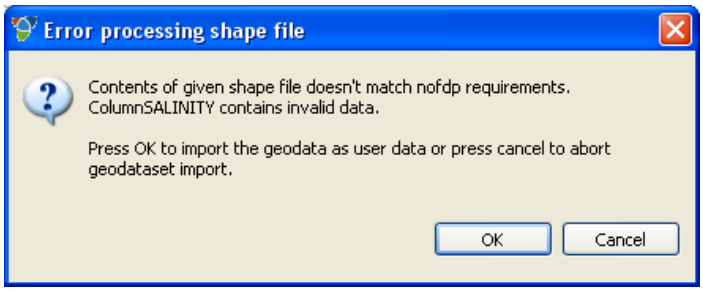


Fig. 5.1.2-3: Message window if validation shows noncompliance with the nofdp IDSS data specifications

Where applicable, the imported geodata set is shown as a user-specified data set in the previously selected category or subcategory of the tree view. User data sets are displayed with black/gray icons as shown in **Fig. 5.1.2-2**.

5.1.3 Map Manager

The Map Manager function is activated by selecting *Map Manager*. Beneath the selection mask, a list of the available map templates appears. The list contains the nofdp IDSS standard map templates (see **Fig. 5.1.3-1**) at a minimum.

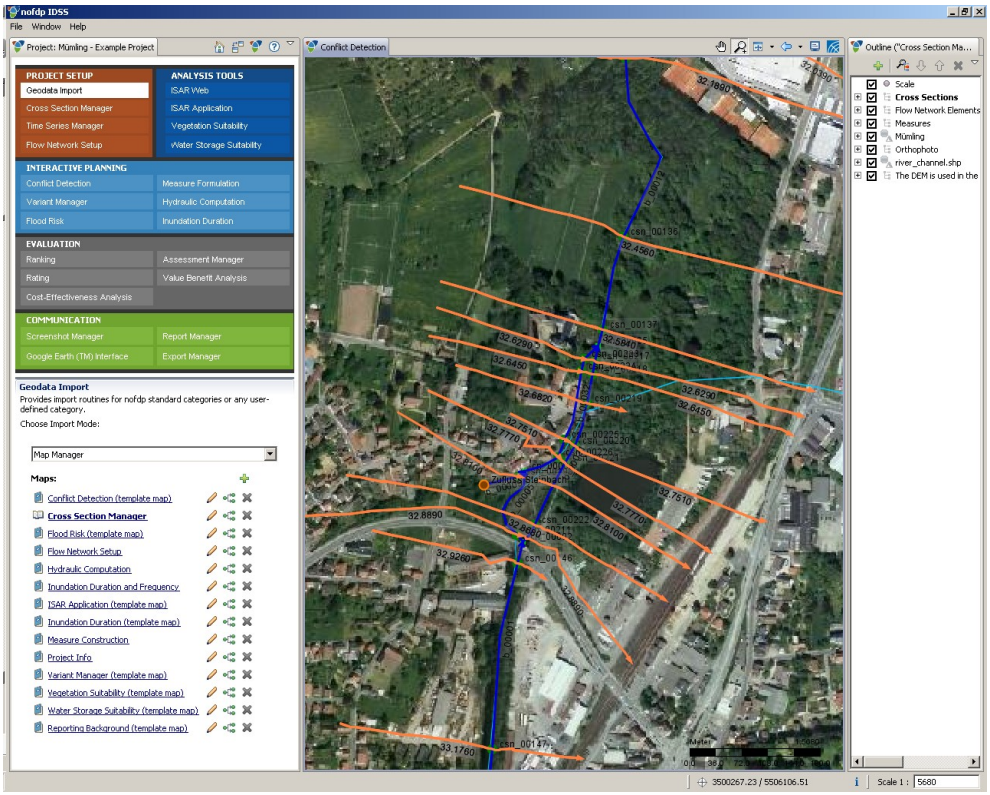


Fig. 5.1.3-1: Map Manager

With the Map Manager, the user configures map templates for nofdp IDSS tools that include a map or GIS component. Map templates can contain geodata, which can be made available for the nofdp IDSS project using the Geodata Import tool.

A map template can be worked upon by clicking on the name in the list. The current map template is marked with in the list and simultaneously appears in the map view at the right, next to the main menu. Dependent on the volume of the geodata associated with the map template, it could take a while to fully load the map. Non-active map templates and ones that are not currently displayed are marked with in the list.

After the name of the map template in the list are three icons. The name and brief description of the map template can be edited with . The map template can be duplicated with and deleted with . The nofdp IDSS standard map templates cannot be deleted, so the corresponding delete icon is always shown grayed-out .

New map templates are generated with *Create New Map Template*, and added to the list.

To the right of the map view is the Overview window, where the hierarchy for the topics attached to the current map template are displayed. The Overview window serves for controlling the map view. The individual topics can be turned on (green check mark) and off in the map by clicking on the checkbox in front of the name. The hierarchy can be changed, by activating a topic with a mouse click and moving it up or down with ⇧ or ⇩ to change its priority when displaying the map.

New topics for the current map template can also be added by using the Overview window. After clicking ✚ in the menu bar, a wizard appears to support the user with this action (see **Fig. 5.1.3-2**).

When adding new topics to a map template, the user has four options to choose from:

- A geodata set from the nofdp IDSS project
- The measures of a variant within the nofdp IDSS project (see **Chapter 7.3**)
- All measures of the nofdp IDSS project (see **Chapter 7.2**)
- The geographical boundaries of the project region

If a geodata set from the nofdp IDSS project is to be added, the project geodata list (see **Chapter 5.1.2**) appears upon choosing *Next*. The desired topic must then be activated in the geodata list by clicking on the checkbox in front of the corresponding name, whereupon a check mark appears in the checkbox. Then you have to name the new map layer. The procedure is then concluded by choosing *Finish*. All selected data sets will be imported according to their geodata tree structure.

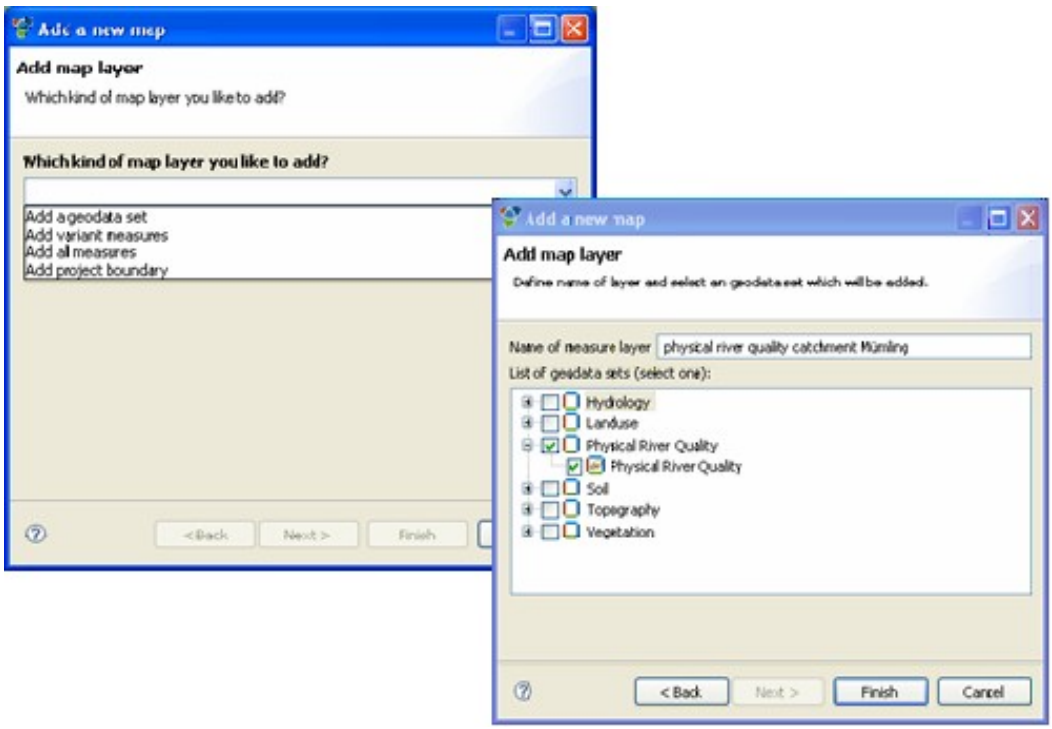


Fig. 5.1.3-2: Dialog box for adding topics to map templates

Loaded map themes can be deleted by ✖. To delete a map theme it has to be selected previously by mouse. Nofdp IDSS specific map themes cannot be deleted. zooms to a selected map theme.

5.2 Cross Section Manager

The Cross Section Manager primarily serves the management and processing of cross sections, which are necessary, for example, for the hydraulic calculation (see Fig. 5.2-1).

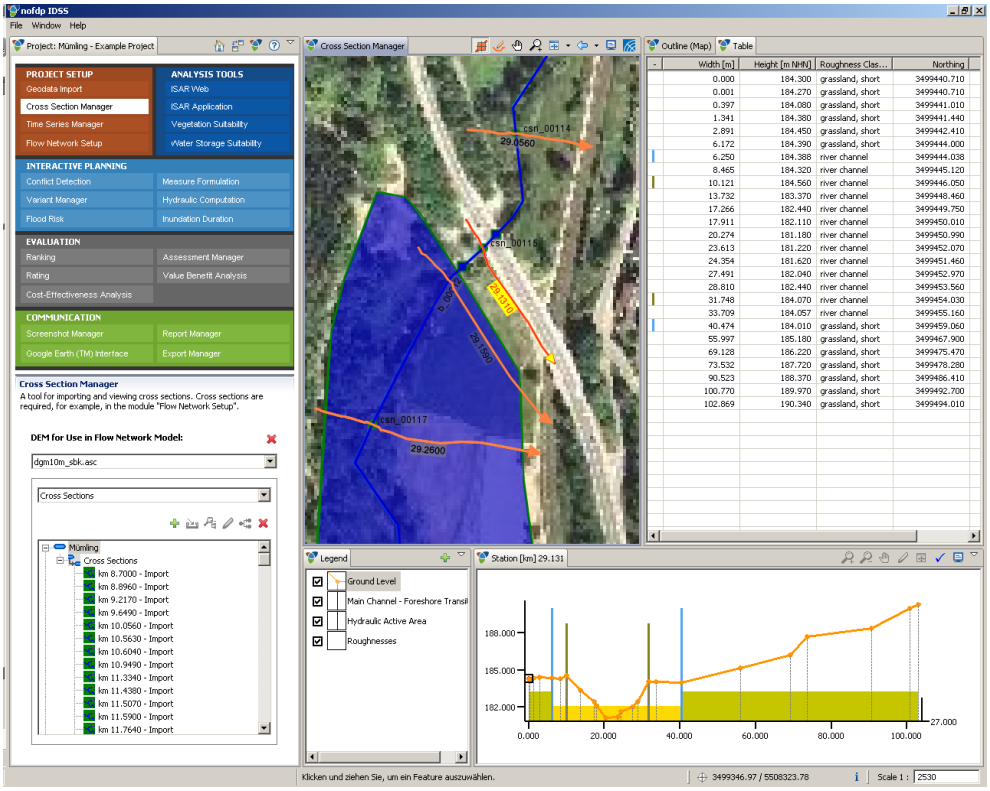


Fig. 5.2-1: Cross Section Manager and viewing components

The graphical user interface of the Cross Section Manager consists of multiple elements:

- *Editing mode* and digital elevation model (DEM) selection (see Fig. 5.2-1, below left)
- *Map View* (see Fig. 5.2-1, top center)
- *Outline View* for controlling the map view (see tab, above right in Fig. 5.2-1, not activated in the illustration)
- *Tabular View* with the characteristics of the selected cross section (see Fig. 5.2-1, top right)
- *Cross Section View* (see Fig. 5.2-1, below right)
- *Legend* for the Cross Section View (see Fig. 5.2-1, bottom center)

The individual elements are linked to one another for efficient and comfortable use, so that, for example, a Cross Section in the map view can be selected, it is displayed in the Cross Section View and the alphanumeric cross section data can simultaneously be viewed and edited in the table.

The following editing modes are available:

- *Cross Section Manager and Data Import*
- *Roughness Class Manager and Roughness Assignment*
- *Roughness Assignment using Land-Use Class*

5.2.1 Cross Section Manager and Data Import

Upon starting Cross Section Manager for the first time, no cross section data is initially available for use. These must first be imported into the nofdp IDSS project (see **Fig. 5.2.1-1**). For a description of the cross section formats supported for import, see **Chapter 3.5**.

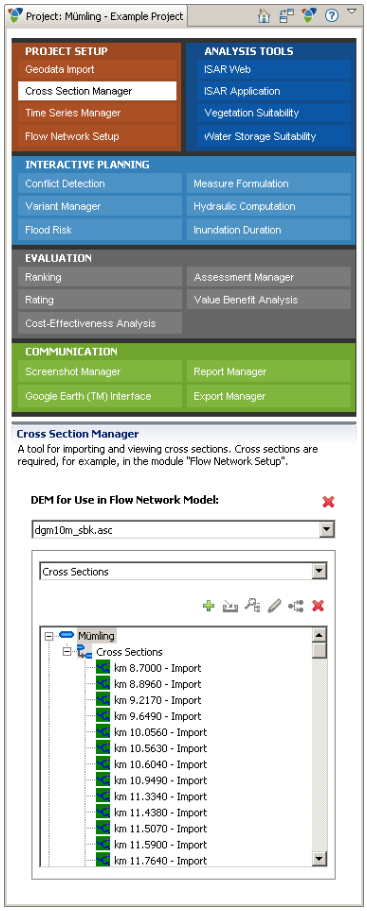


Fig. 5.2.1-1: Import and organization of cross sections

Prior to importing cross sections, it is recommended to create a simple data structure. In the window under the main menu, a tree view of the cross section database is displayed. The first level of the tree view is predefined as *Catchment Areas*. By clicking on ✚ in the menu bar above the tree view, a new river is added. With the help of a wizard, the river's name and an optional description can then be entered.

To import cross sections, the respective river must be selected in the tree view. By clicking on in the menu bar above the tree view, cross sections can then be imported. In the import wizard, the cross-section format to be imported and the data source are specified. With ✖, selected rivers or cross sections can be deleted.

The Cross Sections contained in the Cross Section Manager are displayed together with background maps in the map view (see **Fig. 5.2.1-2**). As a precondition, the appropriate map template must have been configured with topics using the Map Manager (see **Chapter 5.1.3**).

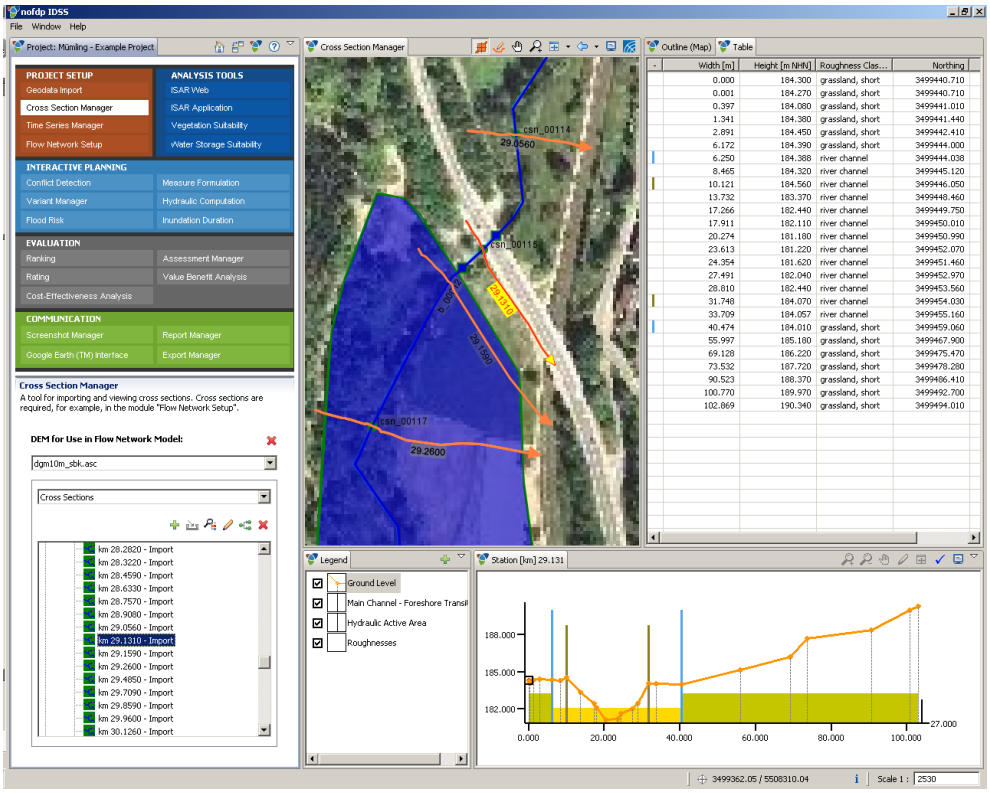


Fig. 5.2.1-2: Cross Section selection in the Map or Cross Section List

Selection of a cross section takes place by clicking in the Cross Section List (tree view under the main menu) or by clicking on the icon in the menu bar of the map view and then clicking on the desired cross section in the map. Thereby, the selected cross section is highlighted (red) in the map view, and both the table with the attributes of the selected cross section and the Cross Section View are displayed.

Cross sections can also be derived interactively from a digital elevation model. First, a digital elevation model (raster data) previously imported into the geodata database is selected in the selection list beneath the editing mode selection. By clicking on in the Map View's menu bar, the cross section's course can then be interactively defined in the map. A double-click completes the digitalization. Subsequently, a wizard appears, in which the cross section must be assigned to a river from the River List and the new cross section must be positioned. The new cross section is then incorporated, with its attributes, into the Cross Sections List and the Map view. The direction of digitalization in relation to the river can be freely selected. Usually Cross-Sectional Profiles are digitized starting on the left river bank.

Hints:

The definition of cross sections from digital elevation models should only take place on the basis of high-resolution models, such as those created with aerial laser scanning, for example.
Digital elevation models generally do not represent the river's morphology adequately. In particular, the laser scanning method cannot capture the riverbed. This fact should be considered when deriving cross sections from digital elevation models.

In the Cross Section View, the developed length of the cross section's course from the map view is represented in elevation. The developed length is identified there as *Width*. To identify the greatest width value unambiguously, this point is depicted in the map view, with an arrowhead pointed outwards (right bank). Navigation within the map and the procedure for loading new topics, as well as the activation of individual layers in the map takes place according to the procedures and conventions as described in **Chapter 3.4**.

The Cross Section View is provided with tooltips for orientation. The tooltip is automatically activated when the user moves with the cursor across the terrain points of the cross section (yellow dots) in the Cross Section View (see **Fig. 5.2.1-3**). The latitude and elevation of the respective point are displayed.

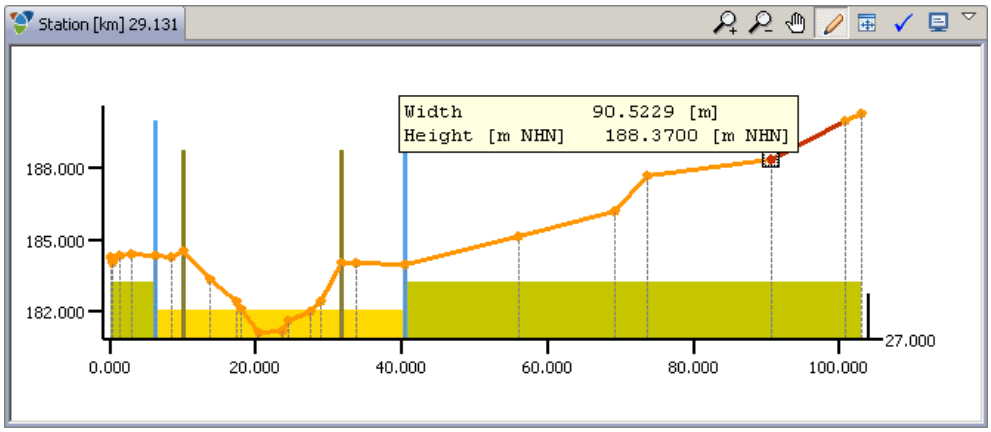


Fig. 5.2.1-3: Cross Section View showing tooltip

The information about terrain and geometry are represented in the cross section data databank by values for *Width*, *Elevation* (z value), *Northing* (y value) and *Easting* (x value) (see **Fig. 5.2.1-4**). The columns in the table are also arranged in this order (from left to right) with den cross section data. The cross section points in the table are sorted in rows, beginning with the first point on the left riverbank (topmost row) and ending with the last point on the right riverbank (last row).

The geometry of a cross section can be changed in the table. To do this, click on the desired cell in the table with the mouse (the selected row is grayed-out and the selected value is highlighted in blue) and then enter the change to the value. The changes are completed by pressing the Enter key or the Tab key.

For constructing or inserting a new cross section point, the following steps are necessary:

- Select the desired cross section from the Cross Section Profile List
- Click on the desired row in the table
- Click the right mouse button and select *Insert New Point*

The values for Latitude and Elevation are set by default at (0, 0) for the first point. These values can be edited thereafter, using the procedure explained above. The new point is always inserted in the table beneath the marked row.

A cross section point selected from the table is simultaneously marked in the Cross Section View (see **Fig. 5.2.1-4**), in that the point is framed with a black box and the point itself, as well as the terrain segment to its right are highlighted in red. Conversely, a point marked in the Cross Section View is highlighted in the table.

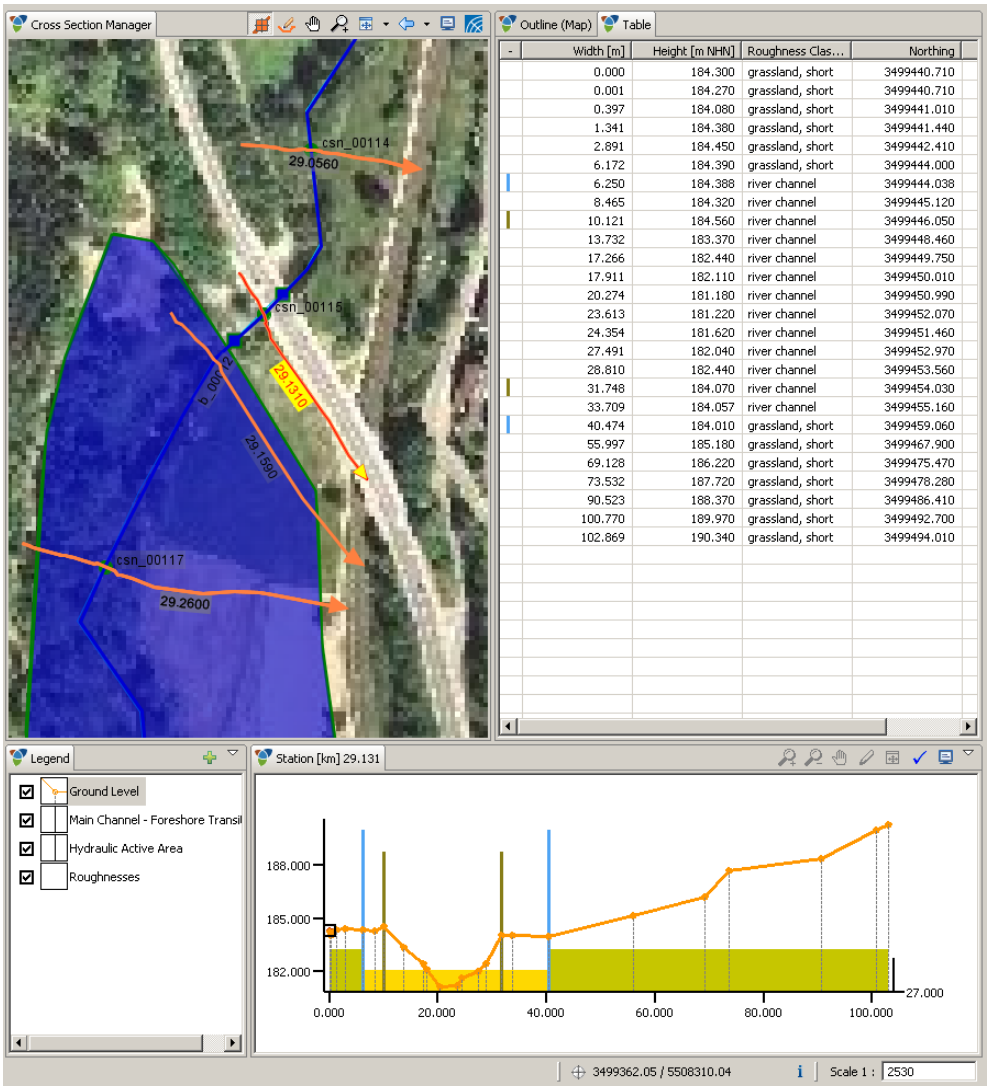


Fig. 5.2.1-4: Editing cross sections in the table

In addition to editing within the table, the cross-sectional geometry can also be interactively changed graphically in the Cross Section View. First, in the Legend view for the cross section, the item *Grade Elevation* must be selected (text with blue background), then, in the Layer view, the presetting under Edit (*horizontal* / *vertical*) can be activated with the mouse (see **Fig. 5.2.1-5**, left); additionally, each Cross Section can be annotated here with comments. Accordingly, the Edit cursor in the menu bar of the Cross Section View must be activated. With the mouse, move the cursor to the terrain point to be edited (a dashed selection frame is shown around the point) and then move the point as desired by clicking on the point and holding down the left mouse button.

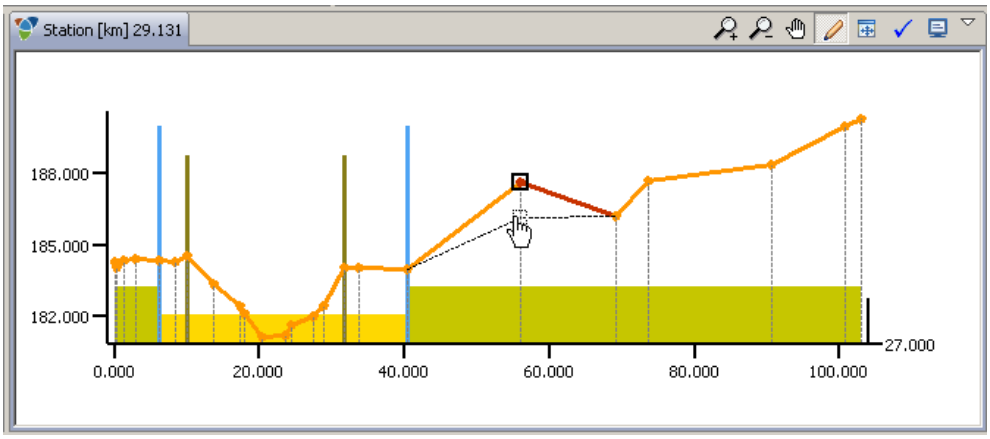


Fig. 5.2.1-5: Interactive editing of cross sections

Hints:

Do not enter any vertical lines / walls; all geometric values must be a minimum of 0.05 m apart from each other in the horizontal.
Do not enter any setbacks; it is possible to enter setbacks, which means no continuous increase in the width values exists in the column width. The location where the continuity is interrupted is shown with a red marking.

In addition to the terrain, flow zones must be defined in the cross sections. These are definitions regarding:

- *Main Channel – Foreshore Transition*
- *Hydraulic Active Area*

Details about the two areas are entered in the Cross Section View (see **Fig. 5.2.1-6**). The *Main Channel – Foreshore Transition* is indicated with a green bar and the *Hydraulic Active Area* is indicated with a light blue bar in the Cross Section View. Moreover, the points falling on this boundary are displayed in the table with an additional attribute of the same color. To move this boundary, click with the mouse on the respective bar (a dotted box appears around the bar) and, keeping the mouse button pressed, moved the cursor to the desired cross section node. Once the mouse button is released, the bar will appear in the new location. The entries in the table are simultaneously updated.

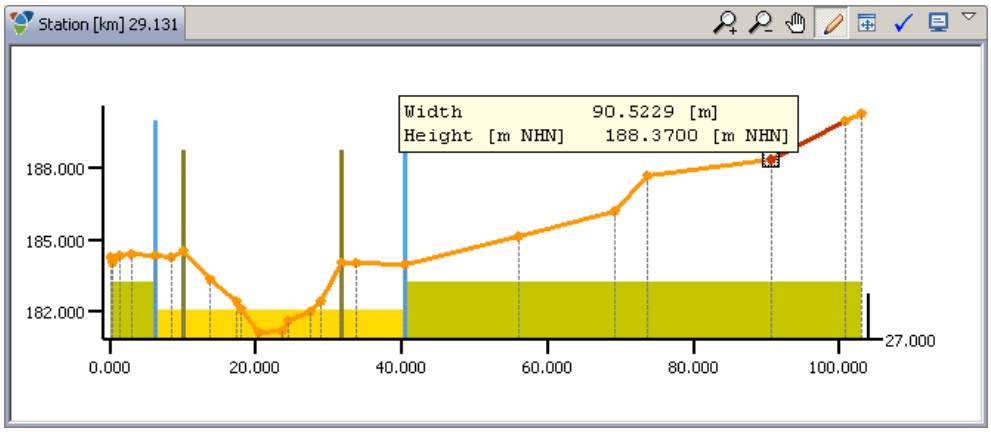


Fig. 5.2.1-6: Cross Section View with markings for *Hydraulic Active Area* (light blue) and *Main Channel – Foreshore Transition* (brown), plus Legend and Layer Views

Main Channel – Foreshore Transition (mandatory):
This information is mandatory. It is needed as additional information in order to account for special measures in the cross section (e.g. bank excavations).

It is recommended to define the left and right upper edges of the embankment as *Main Channel – Foreshore Transition*.

Hydraulic Active Area (optional):
Information about the *Hydraulic Active Area* is optional as long as a hydraulic calculation will be executed. The *Hydraulic Active Area* defines the discharge-active portion of the cross section. Areas lying beyond this zone are ignored when calculating the water surface level. If the terrain beyond this zone lies under the calculated water surface level, these areas are used as retention areas.

Especially with a very wide floodplain cross section, restriction of the *Hydraulic Active Area* is expedient, since the flow velocities in the peripheral areas of the cross section are nearly zero (null). Areas lying behind dikes should also be factored out of the *Hydraulic Active Area*.

The *Hydraulic Active Area* should also be expediently evaluated for areas in front of and behind constructed works (e.g. weirs), in order to correctly depict, in hydraulic terms, the constriction in front of the constructed work as well as the widening behind it.

Hint:
If the settings of the *Main Channel – Foreshore Transition* or *Hydraulic Active Area* should have been deleted they can be recovered with ✓ in the toolbar of the Cross Section View.

5.2.2 Roughness Class and Roughness Assignment

For the hydraulic calculation, the cross sections must be attributed with roughness coefficients according to Strickler (k_{St} in $m^{1/3}/s$). First, Roughness Classes are defined, differentiated according to Land-Use Classes.

A Roughness Class is defined with a designation and the respective k_{St} value. Additionally, metadata for the Roughness Class and a confidence interval—plausible upper- and lower limits for the k_{St} values—can be entered. Furthermore the color for the presentation of the Roughness Class in Cross-Sectional Profiles can be selected. Finally Roughness Classes can be mapped for use in certain measures (see **Chapter 7.2**). Each Measuer(-group) must have at least one Roughness Class assigned to it.

By clicking on ✚ in the menu bar left beneath the nofdp IDSS Main Menu new Roughness Classes can be defined. This is supported by a wizard (see **Fig. 5.2.2-1**). The newly defined Roughness Class is then integrated into the list of existing Roughness Classes that is below the menu bar. With ✎, the data for the selected Roughness Class can be modified. ✖ deletes the selected Roughness Class.

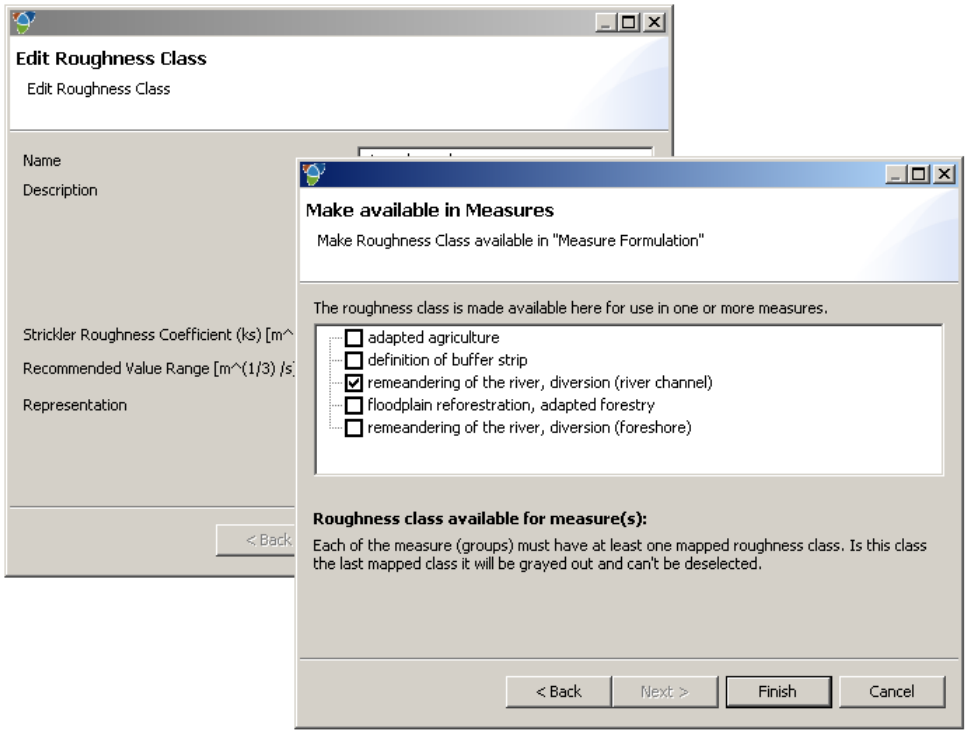


Fig. 5.2.2-1: Definition of Roughness Class

The Roughness Classes can subsequently be manually assigned to the individual cross section segments. This is achieved in the Tabular View in the column Roughness Class, using pull-down menus in the individual cells to select the characteristics for the Roughness Classes for this area (see **Fig. 5.2.2-2**).

Hint:

For Roughness Assignment, the convention holds that the area from the current point to the next point in the list is sufficient. The last point in the list requires no Roughness Assignment.

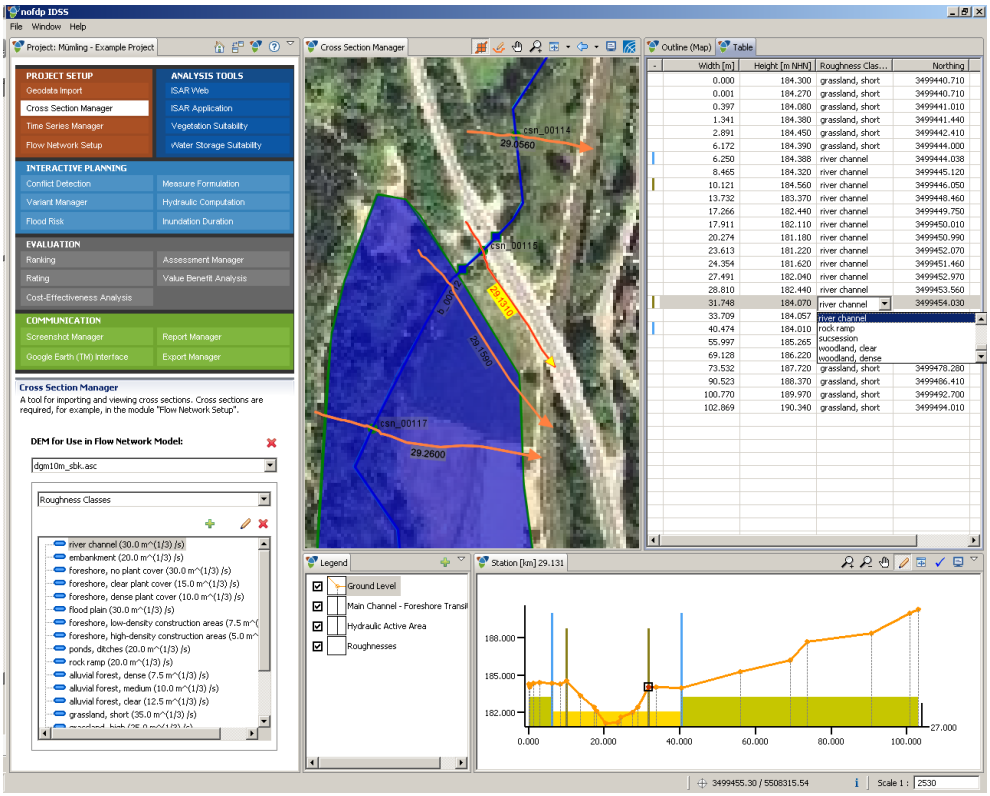


Fig. 5.2.2-2: Roughness class assignment to cross section segments

5.2.3 Roughness Assignment using Land-Use Classes

The assignment of Roughness Coefficients to the cross section's course is a laborious process. Thus, the nofdp IDSS includes the possibility to derive Roughness Assignments directly from a Land-Use Classification. Thereby, an intersection is made of the Land-Use Classification with the defined Cross Sections in the investigation area. It must be noted that the cross sections resulting from the intersection can be automatically supplemented with new nodes. The grade elevations of these new nodes are interpolated linearly between the adjoining, original cross section points.

This process is initiated by selecting Import Cross Section roughnesses. First, the desired use classification data set is selected from the internal geodata manager (see Fig. 5.2.3-1). Then the Land-Use classification attribute of the selected geodata set is identified. In the next step Cross-Sectional Profiles must be selected. Only Roughness Classes of selected Cross-Sectional Profiles will be modified. Assignment of the individual Land-Use Classes to the defined Roughness Classes then takes place (see Chapter 5.2.2). The result of this intersection is subsequently available for further use. The Land-Use Classification with the assigned Roughness Classes is then displayed in the map view (see Fig. 5.2.3-2). Thereafter, an individual Roughness Class Assignment can be modified if required (see Chapter 5.2.2).

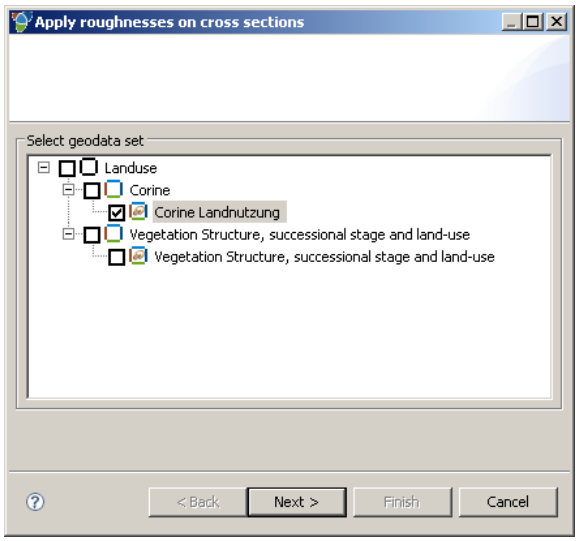


Fig. 5.2.3-1: Choice of Land-Use Classification

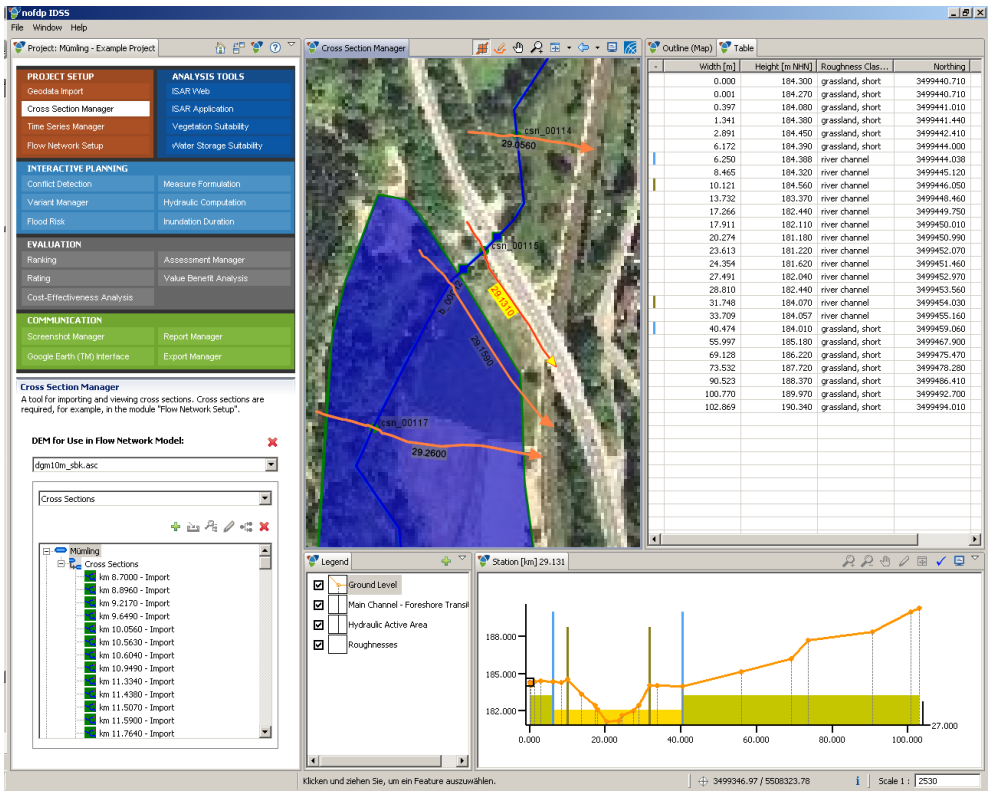


Fig. 5.2.3-2: Roughness Assignment using Land-Use Classes

5.3 Time Series Manager

The Time Series Manager primarily serves the management and processing of time series (hydrographs) and duration curves, which are necessary, for example, as boundary conditions for the transient hydraulic calculation. Duration curves are used to derive the spatial distribution of inundation durations.

The Time Series Manager graphical user interface consists of multiple elements (see Fig. 5.3-1):

- *Diagram View* – for the graphic representation of time series
- *Tabular View* – with time series value pairs (time, water level) and (time, flow rate)
- *Properties View* – with metadata for time series

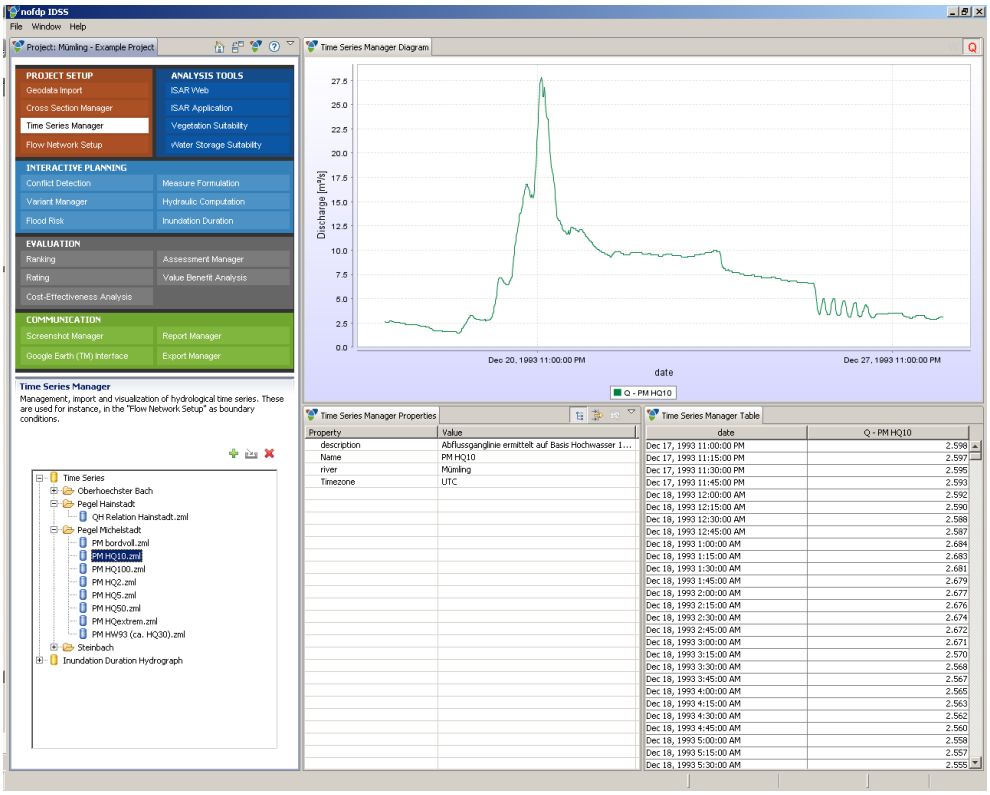


Fig. 5.3-1: Time Series Manager and View components

5.3.1 Import of Time Series and Duration Curves

Upon starting Time Series Manager for the first time, no time series or duration curves are available. These must be imported in the nofdp IDSS project. For a description of the time series formats supported for import, see Chapter 3.6. The handling of time series and duration curves is very similar and will be explained based on time series examples.

Before importing time series, it is recommended to create a simple data structure. In the window under the main menu, the tree view of the Time Series database is displayed. The top level of the tree view is predefined as a *time series root element*

(container). By clicking on ✚ in the menu bar above the tree view, a new directory or subdirectory is added (see **Fig. 5.3.1-1**). The name of the directory or subdirectory is entered in a dialog window. The following file structure is recommended for the time series database:

→ Time Series Container
  → River
    → Level 1
      → Time Series 1
      → Time Series 2
      → etc.
    → Level 2
→ Inundation Duration Curve Container
  → River
    → Level 1
      → Inundation Duration Curve 1
      → Inundation Duration Curve 2
      → etc.
    → Level 2

Sorting of the individual levels in the time series tree view takes place alphanumerically, which should be taken into consideration when naming the elements.

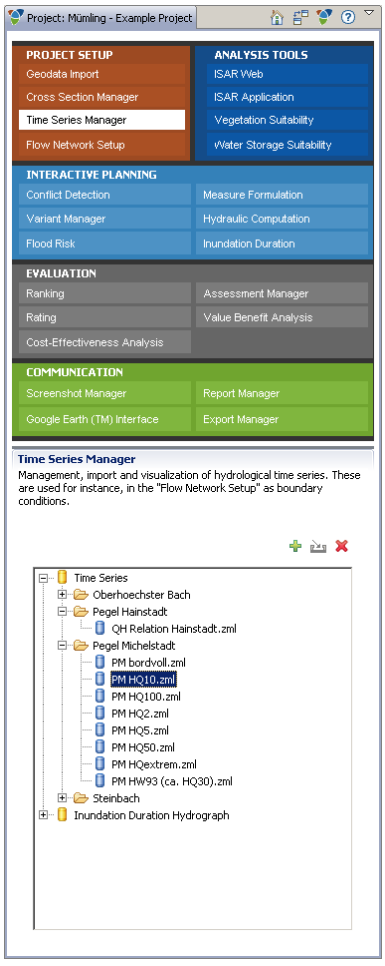


Fig. 5.3.1-1: Import and Organization of time series

To import time series, the respective river must first be selected in the tree view. The time series are then imported by clicking on in the menu bar above the tree view. With the help of an import dialog, the time series format to be imported (CSV or ZML), as well as the time series type (*Water Level* or *Discharge*), the data source(s) and, if applicable, a Water Level Discharge Table are defined. As an example, the dialog box for importing a time series in CSV format is shown in **Fig. 5.3.1.2**, where, among other things, specifications for CSV column separator, decimal delimiter, time format and time zone must be given.

With , the selected directories or time series in the time series database can be deleted.

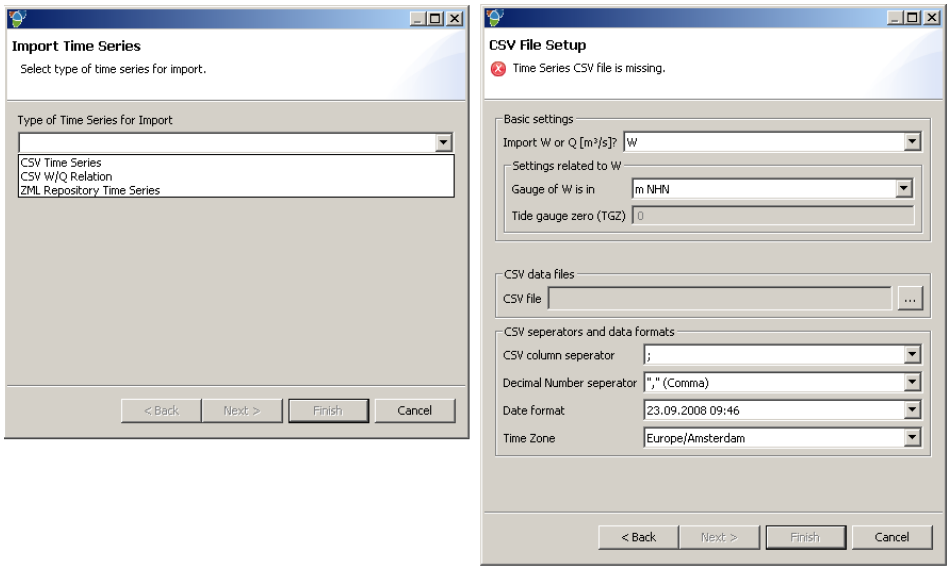


Fig. 5.3.1-2: Time Series Import in CSV format

5.3.2 Time Series Overview

Time Series and, where applicable, associated Water Level Discharge Tables cannot be edited in the nofdp IDSS application. This must be accomplished externally.

For visualization in the Diagram View, the time series must first be chosen by mouse click in the time series database tree view.

In the table, the time series values are sorted and displayed in increasing chronological order. Metadata for the time series are displayed in the lower center area of the window. Refer here also the lower parts of **Fig. 5.3.2-1** and **Fig. 5.3.2-3**.

Graphs can be enabled / disabled in the diagram view by clicking W or Q for water-level or discharge.

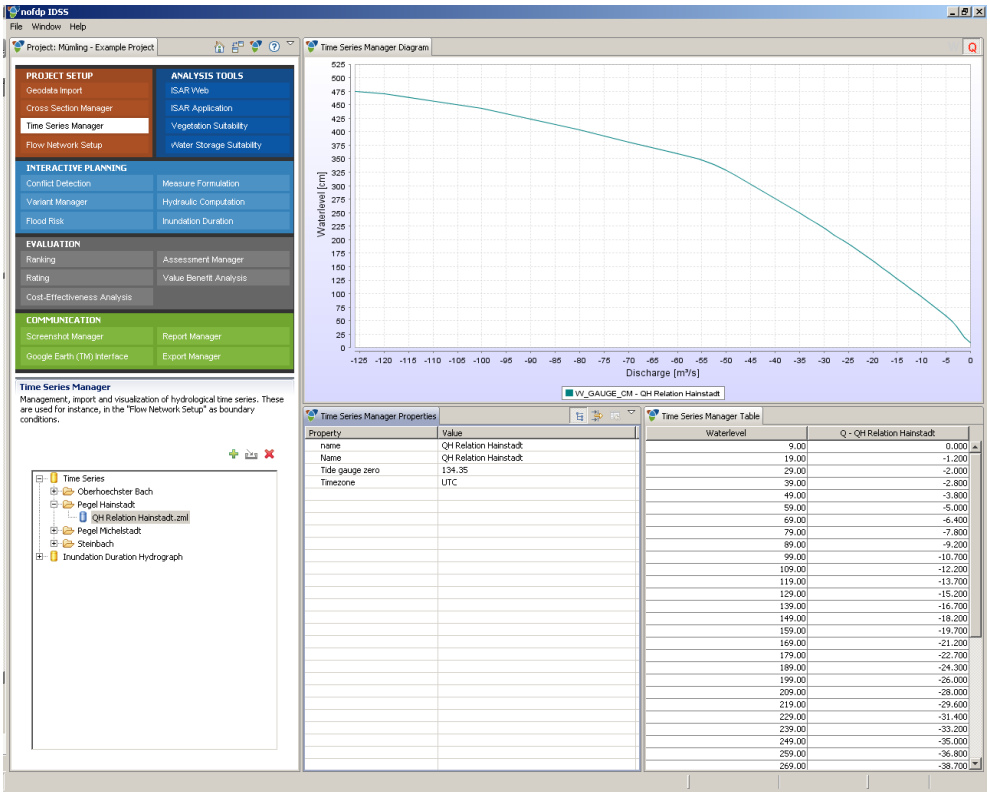


Fig. 5.3.2-1: Time Series Overview of a Water Level Discharge Table

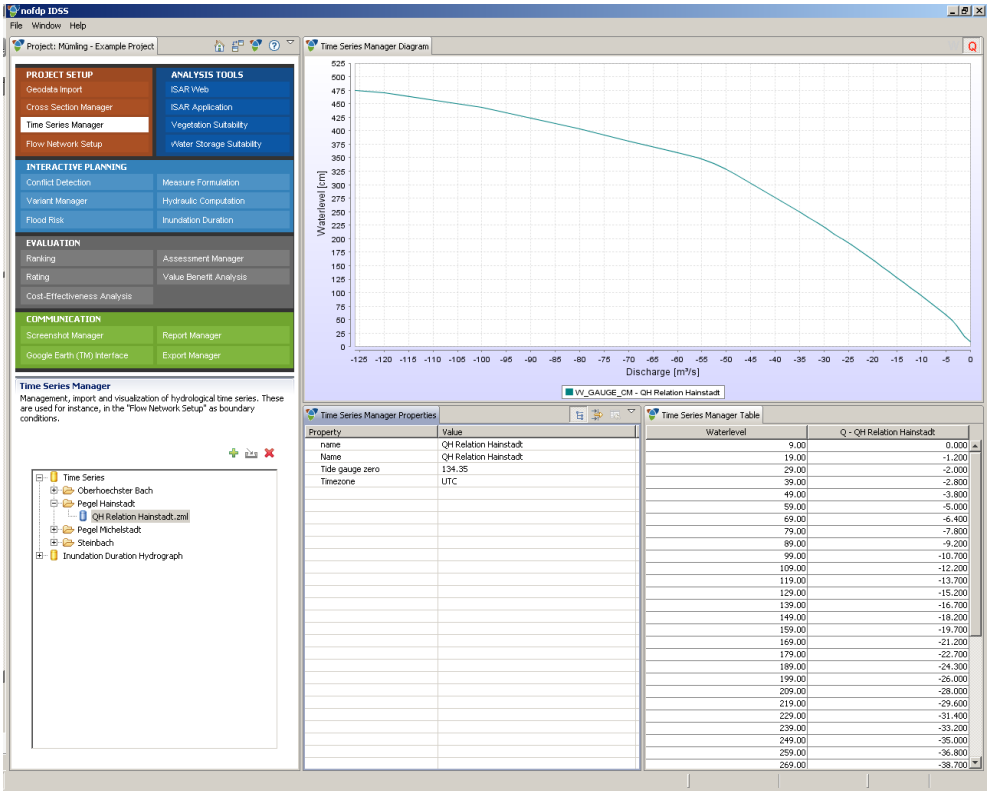


Fig. 5.3.2-2: Time Series Overview for a Water Level Hydrograph without Water Level Discharge Table

5.4 Flow Network Setup

The Flow Network represents the fundamental basis for the hydraulic calculation. First, the so-called as-is state (current status) of the catchment area is represented. On this basis, the hydraulic repercussions of planned measures can then later be analyzed (see **Chapter 7**).

For first-time compilation of the Flow Network, the following procedure should be followed:

1. Definition of the Drainage Network (see **Chapter 5.4.2**)
2. Cross Section Assignment (see **Chapter 5.4.3**)
3. Definition of Structural Nodes (Weirs, Retarding Basins, and Polder) (see **Chapter 5.4.4**)
4. Definition of Time Series Nodes for the input of time series for simulation scenarios (see **Chapter 5.4.5**)
5. Definition of the Calculation Case with the desired time series assignments (see **Chapter 5.4.6**).

The Flow Network can be supplemented at a later time. When so doing, it is likewise logical to maintain the previously delineated sequences. Compilation of the Flow Network takes place in a nofdp IDSS window that consists of multiple areas:

- *Calculation Case Definitions* and *Selection of the Flow Network Model* (see **Fig. 5.4-1** below left)
- *Map view* with the Flow Network (see **Fig. 5.4-1** above center)
- *Directory of the Flow Network Components* (see **Fig. 5.4-1** above right) and import and validation of Flow Networks
- *Outline view* for controlling the map view (see tab in **Fig. 5.4-1** below right)
- *Cross Section View* (see **Fig. 5.4-1** below center)

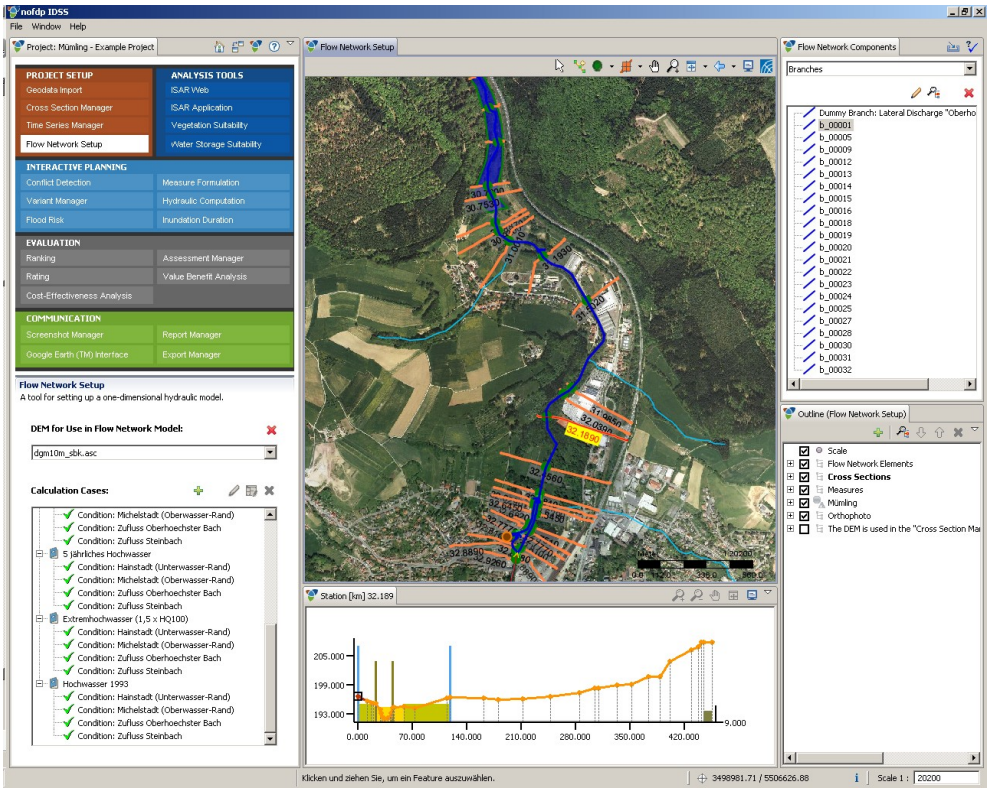


Fig. 5.4-1: Flow Network Setup

Navigation in the map view and loading of new topics as well as the activation of individual layers in the map takes place according to the procedures and conventions as described in **Chapter 3.4**. Furthermore, tools for creation and editing of Flow Networks are arrayed in the menu bar of the map view. These are explained in **Chapter 5.4.1**.

So that a digital elevation model can be accessed as part of the measure formulation and the analyses that are based thereupon (see **Chapter 7**), a digital elevation model (raster data), which is stored in the geodata databank of the nofdp IDSS, must be selected in this window, on the left below the nofdp IDSS main menu.

5.4.1 Components of the Flow Network

The Flow Network comprises four different system component categories:

- Flow Network Branches (symbol)
- Connection Nodes (, and symbols)
- Cross Section Nodes (symbol)
- Structure Nodes (, and symbols)

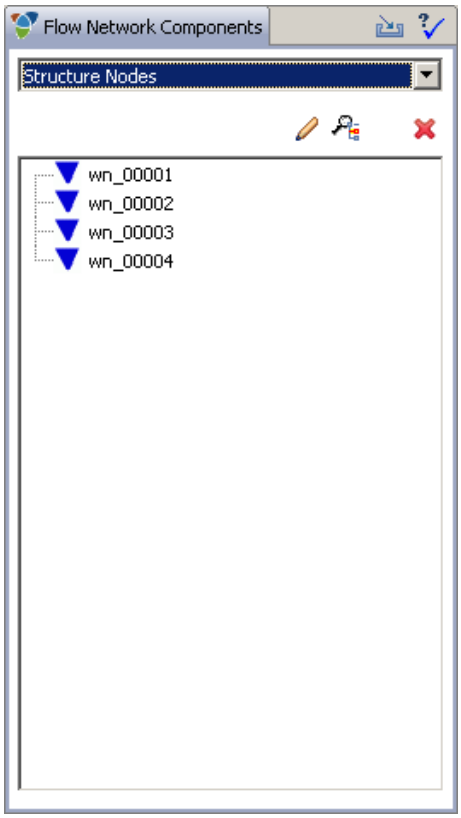


Fig. 5.4.1-1: System elements

The system element categories can be selected from a pull-down list in the System Elements area. The defined elements are then added to this category in an itemized list (see **Fig. 5.4.1-1**). After selecting one of the elements in the list with , or by double-clicking on an element in the list, both the metadata and the technical data for this element can be edited with the help of a wizard. The selected elements are displayed and highlighted in the map view are displayed and highlighted. zooms to a selected Flow Network element in the map. With , the selected element is deleted.

imports an exsting SOBEK PI Flow Network (see **Chapter 5.4.7**). checks the Flow Network for errors (see **Chapter 5.4.8**).

Table 5.4.1-1 shows the additional tools provided in the menu bar of the Map view for creating and editing Flow Network components. Editing in the map follows the procedures and conventions as described in **Chapter 3.4**.

Table 5.4.1-1: Additional tools for creating and editing Flow Network components in the map view

Symbol	Function
	Neutral mode, no editing
	Create Flow Network Branches
	Cross Section Assignment
	Create Polder

Symbol	Function
	Create Weir
	Create Retarding Basin
	Select a Flow Network Component in the map
	Select a Cross Section in the map

 **Hint:**
The geometries of system elements cannot be subsequently modified.

5.4.2 Creation of the Drainage Network

The Drainage Network– as previously explained – is the essential foundation for further definition of the Flow Network. Compilation of the Drainage Network for the Flow Network takes place in front of the backdrop of digital map information (e.g. watercourses, orthophotos) that have been made available via geodata import (see **Chapter 5.1**).

Digitalization of the river course represents a generalization of the natural conditions. Attention should be given to ensure that the essential topological and topographical conditions are recorded in the digitalization. The river course is always defined at the river's middle. A good basis for data acquisition is achieved by using a scale between 1:10,000 and 1:20,000.

The main branches, analogous to a tree, must first be digitalized in order to subsequently record the secondary branches (tributaries) and then connect them to the main branches. Digitalization must always take place in the direction of flow.

The digitalization mode is started for each river branch by activating  in the menu bar of the Map View. The cursor appears as a crosshair in the Map View. Then, the individual nodes of the river branch are digitalized using the mouse. The procedure is concluded with a double-click on the last point. The direction of digitalization is symbolized by an arrowhead at the current last point. River branch nodes are symbolized by a green square ■ (see **Chapter 5.4.5**). During digitalization, the last point that has been entered can be deleted by clicking the right mouse button. Thus, the entire polyline that is currently being entered can be successively deleted. Geometries can also be deleted by clicking the middle mouse button or pressing the Escape button.

The connection to other branches is aided by a snap function (see **Fig. 5.4.2-1**). In this case, a large, red square appears when passing over the other branches with the cursor. If a node from the other river branch lies within this area, the cursor snaps automatically to that point. If a line segment from another river branch lies within this area, the current cursor position is thereby snapped onto the line segment, ensuring proper connection of the branches: upon completing digitalization of the river branch, a new node in the respective river branch is then dynamically inserted – a River Connection Node ■ (see **Chapter 5.4.5**). The geometries of the recorded river branches cannot be retroactively modified.

Hint:
Rivers should be defined with a small number of branches. Thus inundation areas can be computed continuously (see **Chapter 7.4**).

Fig. 5.4.2-1: Connection of a secondary branch to the main branch using snap mode during digitalization

The river branches are registered as elements of the Flow Network (see **Chapter 5.4.1**). There, the selected river branch can be deleted with ✖ or the associated metadata can be viewed and edited with ✎ (see **Fig. 5.4.2-2**). Each river branch can be registered there with a name and a brief description; additionally, the river branch length is displayed in meters.

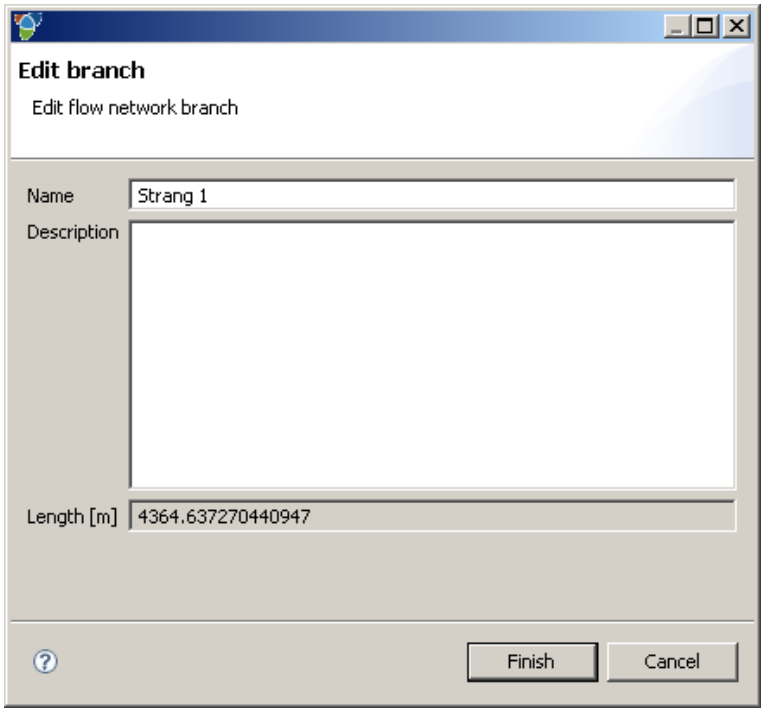


Fig. 5.4.2-2: River Branch Metadata

Hints:
The geometries of existing river branches can no longer be modified in the nofdp IDSS application after completing the digitalization. If the geometries of any river branches must be changed, this can only be accomplished by deleting the respective existing river branch from the Flow Network and then recreating the segment in its entirety with the new geometry.
A river can consist of multiple river branches that are successively connected to one another.

5.4.3 Cross Section Assignment

After the Drainage Network has been created, characteristic cross sections must be assigned to the river. Also in this case, generalization in the modeling takes place through a selected cross section parameter. Conversely, dense consolidation of assigned cross sections do not necessarily improve the model quality; a large quantity of cross sections increases the computation complexity for the hydraulic model and therefore has an effect on the computational time needed for the model. New cross sections should always be assigned to those locations where the cross section geometry of the river changes substantially in comparison to the previous cross section, or where significant change in longitudinal slope exists. Furthermore, cross sections should be placed more closely together at locations where complex hydraulic activity can be expected (e.g. in front of and behind weirs, block ramps and bridge structures). New cross sections are also needed behind river estuaries. In all other cases, it is sufficient to insert a new cross section on average every 100 to 300 meters.

Attention must be given to ensure that the assigned cross sections do not overlap one another in their depicted plan location, since hydraulically inconclusive boundary conditions can result. The cross sections should be established perpendicular to the water flow wherever possible, and the course should be – apart from exceptions of river meanders – strictly linear. The cross sections may only intersect one river in each case; this must be given particular attention in junction areas.

After clicking on in the menu bar of the Map View, a cross section in the Map View can be chosen. This cross section is simultaneously depicted in the Cross Section View. Working with Cross Sections is explained in detail in **Chapter 3.5**.

The cross section node layer and the river course from the Flow Network as well as the cross section layer can be selected in the Outline View. Then, in the Map View menu bar, the switch *Set Cross Section Node* is selected. The cursor appears as a crosshair in the Map View. When moving the cursor across an intersection point of a cross section with the river branch, a large red square with a snap function is displayed. By clicking the left mouse button, this cross section is then selected. Then the cross section is displayed and highlighted in red; the intersection point with the river is depicted as a yellow dot with a red circle surrounding it (see **Fig. 5.4.3-1** below). After selecting an additional cross section, the previously selected cross section is marked with a green point at the intersection with the river (see **Fig. 5.4.3-1** below).

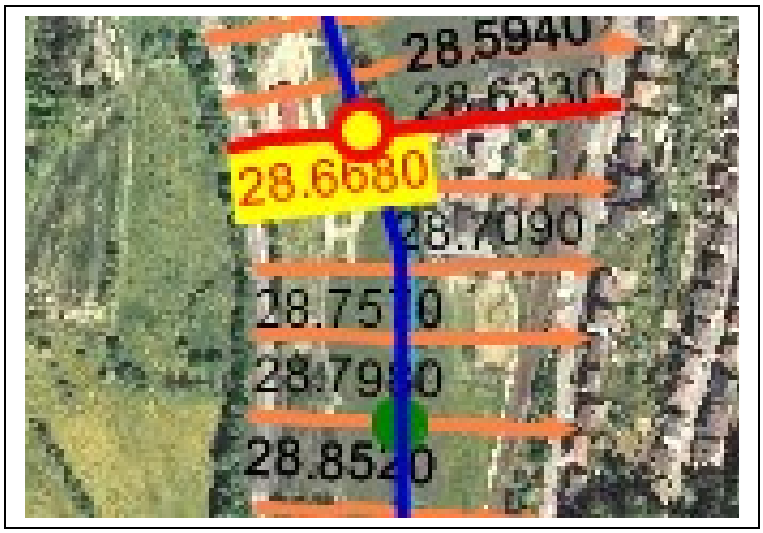


Fig. 5.4.3-1: Cross section assignment

The cross section nodes are stored as components of the Flow Network (see **Chapter 5.4.1**). There, the selected cross section nodes (Cross Section Assignment in the Flow Network) can be deleted with ✖ or the corresponding metadata can be viewed and edited with ✎ (see **Fig. 5.4.3-2**). Each cross section node can thereby be assigned a name and a brief description; additionally, the corresponding Cross Section is displayed together with its positioning. Here, the active cross section nodes can also be assigned to another cross section. For this purpose, a Cross Section List of the current river branch is available here as a pull-down list.

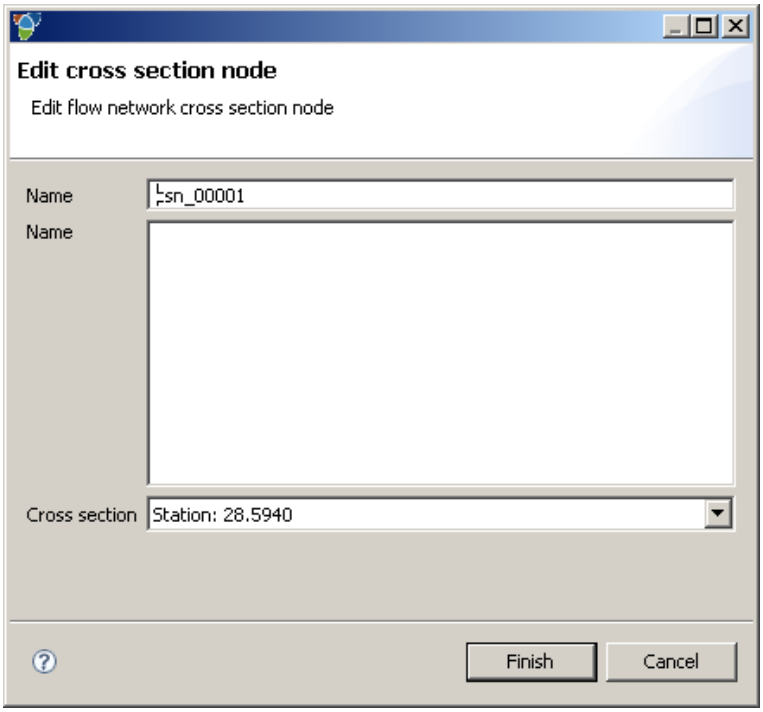


Fig. 5.4.3-2: Metadata for cross section nodes

5.4.4 Definition of Structural Elements

After the Drainage Network and associated cross sections have been defined, the Flow Network can then be supplemented with further, constructive structural elements. These include *Polder* (), *Weirs* () and *Retarding Basins in the Main Channel* (). These structural elements are only recorded topologically on the Drainage Network, albeit accurately positioned; the spatial extent of the structural elements is not recorded geometrically. Attention should be given to ensure that the structural element nodes do not coincide with any cross section nodes on the river.

The Cross Section Node layer, the Polder Node layer, the Weir Node layer, the Retarding Basin layer and the River Course from the Flow Network must all be selected in the Outline View. In the Map View's menu bar, one of the following switches listed here is then to be selected:

- *Set Polder Node*
- *Set Weir Node*
- *Set Retarding Basin Node*

The cursor then appears as a crosshair in the map view. When moving with the cursor across the river branches, a large red square (with snap function) appears. By clicking the left mouse button, the desired structural element is inserted at this point. Afterwards, the structural element is displayed and highlighted with a red outline (see **Fig. 5.4.4-1**, top). Additionally, metadata and technical attributes specific to the element are registered with the support of a wizard. If, at this point the entry is disrupted or discontinued, the entire definition of the object is canceled and as a result, the node marking in the map view is also deleted. **Table 5.4.4-1** shows an overview of the element-specific metadata and technical attributes to be defined.

Fig. 5.4.4-1: Structural element definition exemplified with a polder

Table 5.4.4-1: Attributes of Structure Nodes

Structural Element	Metadata	Technical Attributes		
		Designation	Type*)	Unit
Retarding Basin	Name Description Image	Overflow Crest Width	F	m
		Overflow Crest Height	F	m NHN
		Mean Bed Elevation	F	m NHN
		Storage Area	F	m²
		Bottom of Outlet	F	m NHN
		Outlet Width	F	m
		Outlet Height	F	m
Polder	Name Description Image	Overflow Crest Width	F	m
		Overflow Crest Height	F	m NHN
		Effective Discharge Coefficient Ce	F	-
		Contraction Coefficient Cc	F	-
		Flow Direction (negative, positive, negative and positive)	W	-
		Mean Bed Elevation	F	m NHN
		Storage Area	F	m²
		Drawdown Rate, to empty the polder	F	m³/s
		Flow Depth in the River, below which the polder will be emptied	F	m NHN
		Flow Depth in the River, above which the polder will not be emptied	F	m NHN
Weir	Name Description Image	Overflow Crest Width	F	m
		Overflow Crest Height	F	m NHN
		Effective Discharge Coefficient Ce	F	-
		Contraction Coefficient Cc	F	-
		Flow Direction (negative, positive, negative and positive)	W	-

*) Abbreviations for the attribute characteristics:
C: text (character), F: decimal number (float), I: whole number (integer), W: selection list

5.4.5 Definition of Time Series Nodes

After completion of the steps

- *Creation of the Drainage Network* (see **Chapter 5.4.2**),
- *Cross Section Assignment* (see **Chapter 5.4.3**) and
- *Definition of Structural Elements* (see **Chapter 5.4.4**),

in the last step, connection points within the Flow Network for definition of hydraulic forces are specified for the model. These are so-called connection points that are derived from the start and end points of the defined river branches, and are displayed in *Flow Network Components* under *Connection Nodes* (see **Fig. 5.4.5.-1**).

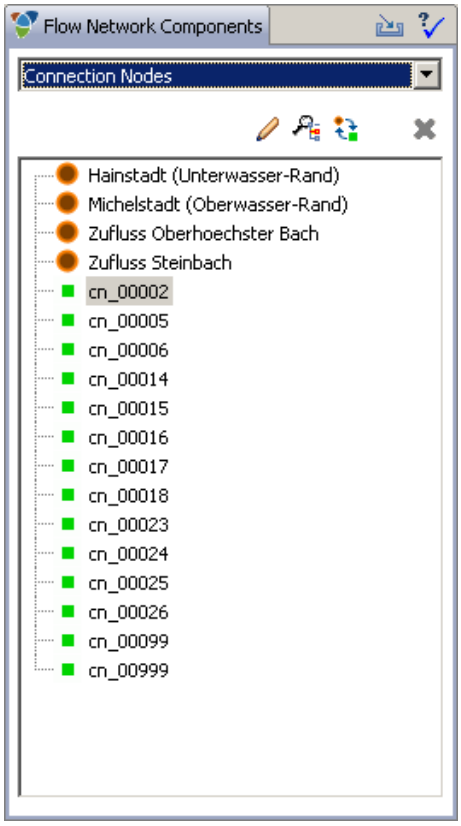


Fig. 5.4.5-1: Connection Nodes

After creating the individual river branches, only the river branch's end nodes (symbolized by a green square ■) and connection nodes (symbolized by a blue square ■) are defined here. With in the *Flow Network Components* menu bar, a Connection Node can be transformed into a Time Series Connection Node (symbolized by a brown dot ●). This procedure can be revoked through repeated selection of . When changing Connection Nodes to Time Series Nodes, the type must be distinguished using a wizard, as either a *Discharge Hydrograph*, a *Water Level Hydrograph* or a *Water Level Discharge Function*.

The Time Series Nodes defined here are automatically allocated to every calculation case. Thus, the respective time series for these nodes are selected and assigned in the nofdp IDSS Time Series Manager (see **Chapter 5.4.6**).

Neither Connection Nodes nor Time Series Connection Nodes can be individually deleted, since they are components of the river branches. If, however, a river branch is deleted, the associated Connection Nodes and/or Time Series Connection Nodes will also be deleted.

Hint:
This section is not concerned with the actual time series assignation, but rather the fixing of nodes in the Flow Network, which are assigned later for simulation time series (calculation case definition).

Hint:
A valid flow network is characterized by definition of a *Water Level Hydrograph* or a *Water Level Discharge Function* for at least one *Time Series Connection Node*, i.e. for at least one boundary node the water level must by specified.

5.4.6 Definition of Calculation Case

Hydraulic impacts for the previously defined hydraulic system structure (Flow Network) are defined with calculation cases. Time series assignments can only be implemented for the defined time series connection nodes (see **Chapter 5.4.5**).

The existing calculation cases are itemized in the list below the nofdp IDSS Main Menus (see **Fig. 5.4.6-1**). By clicking on ✚ in the menu bar above the calculation case list, a new calculation case can be defined. This is supported by a wizard (see **Fig. 5.4.6-2**). A calculation case is defined with a designation, supplementary annotations, starting and ending points in time for the simulation, the lead time before the planned start of the simulation (in hours), the simulation time increment (in minutes) and the simulation result time increment as an integer multiple of the simulation time increment. For each calculation case, the defined time series connection nodes are automatically added as sheets (see **Chapter 5.4.5**).

The simulation lead time serves the internal determination of hydraulic boundary conditions for the transient hydraulic simulation. As a rule of thumb for orientation:

- simulation lead time [h] = maximal total length of river [km] / 3.6

The simulation lead time is dynamically supplemented for the assigned Time Series from the nofdp IDSS internal Time Series Manager, provided that this is possible. If no Time Series data for this period of time are available, a constant inflow is automatically supposed, complying with the inflow at the starting time of the simulation.

The time increment must adequately simulate the selected inflow hydrograph. The following rule of thumb can give general guidance:

- simulation time increment [min] = duration of the flood wave [h] / 0.6

Hints:
The selected simulation time increment should not be greater than 60 minutes.
The selected simulation time increment should not be less than 5 minutes.

With ✎, the data of the selected calculation cases can be edited. A selected calculation case can be deleted with ✖.

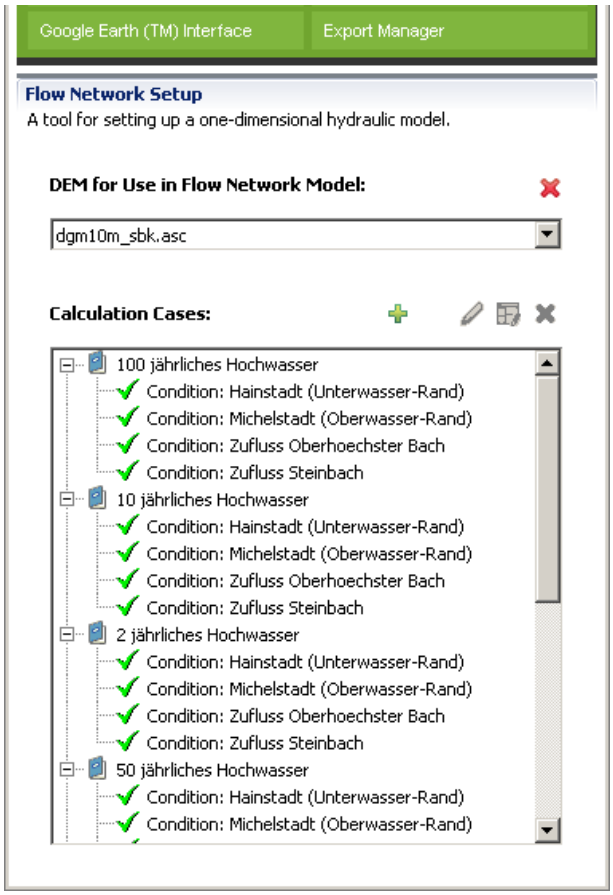


Fig. 5.4.6-1: Existing calculation case definitions

Time Series assignments are made directly on Time Series Connection Nodes. A Time Series Connection Node is selected from the list and then the Edit cursor in the menu bar is selected. A digital wizard appears, in which in the first dialog box, the calculation case, the active Time Series Connection Node, and the type of Time Series (Discharge Hydrograph or Water Level Hydrograph) is displayed. In the first dialog box, it is also possible to define start and end points for these Time Series. The time frame selected here must completely contain the time frame given in the definition of the calculation case. In the header of the next wizard dialog box, a selection can be made about whether a Time Series from the nofdp IDSS Time Series Manager will be selected, or whether a constant value for the inflow will be used together with a predetermined time increment.

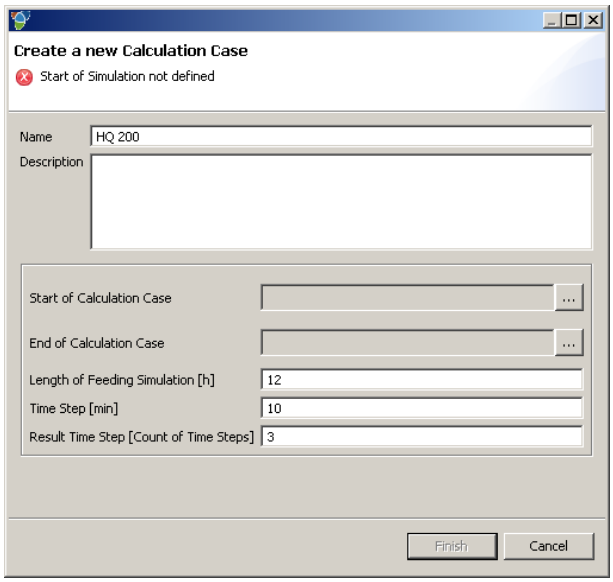


Fig. 5.4.6-2: Definition of calculation case

Fig. 5.4.6-3 shows the result of a time series selection from nofdp IDSS's internal Time Series Manager. Thereby, a time series can be selected from the time series list on the left side, which is then displayed in a diagram showing the predefined time period. Additionally, the individual time-value set for this time series is shown in the table.

After completion, the symbol preceding the Time Series Connection Node in the respective calculation case changes from ✓ to ✓, indicating that a completed time series definition exists at this position. The time series defined in the time series assignment process are copied into a separate calculation case Time Series Manager. There, for selected Time Series Connection Nodes, the time series values can be edited by choosing in the menu bar above the calculation case list.

The hydraulic calculation can be activated under the item *Hydraulic Calculation* in the *Interactive Planning* module (see Chapter 7.4).

Hint:
Time series that are altered during the definition of calculation cases are not synchronized with the time series contained in the nofdp IDSS Time Series Manager. These modifications are only active for the current calculation case.

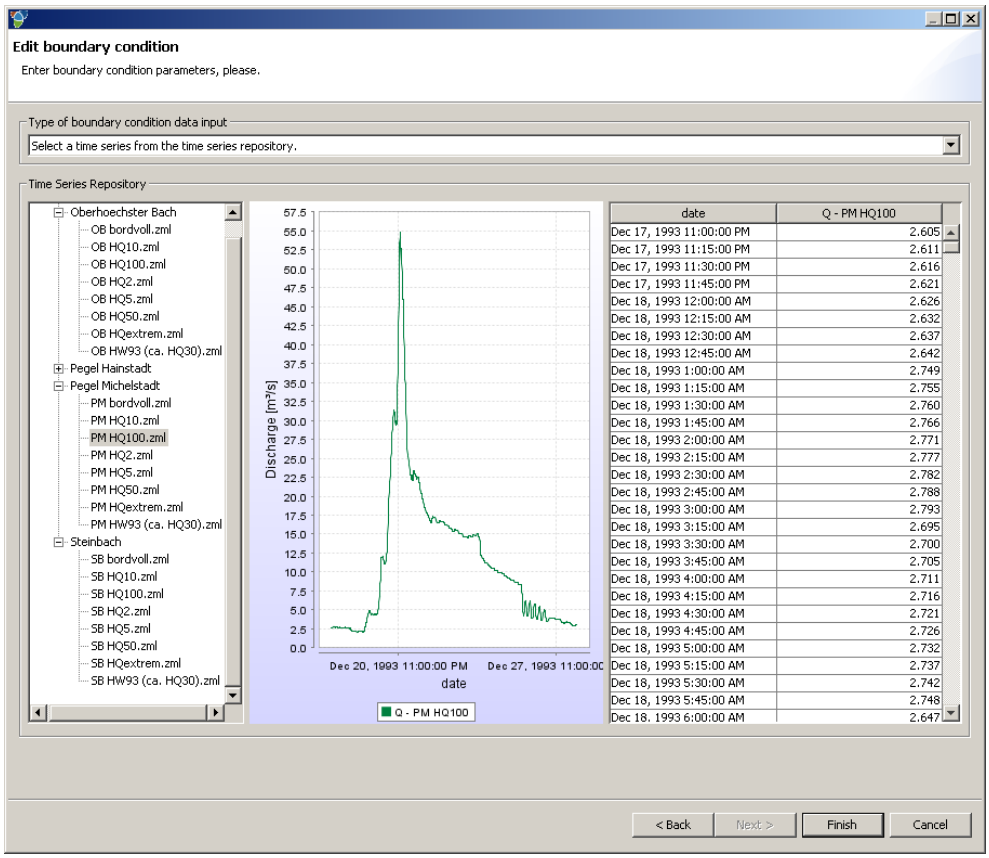


Fig. 5.4.6-3: Definition of calculation case

5.4.7 Import of a Flow Network

An existing SOBEK PI model can be imported with the use of . Import is based on the SOBEK PI scheme. It comprises a subset of the SOBEK PI elements. The elements supported by nofdp IDSS are:

- Flow Network Branches (symbol)
- Connection Nodes (, and symbols)
- Cross Section Nodes (symbol)
- Structure Nodes (, and symbols)

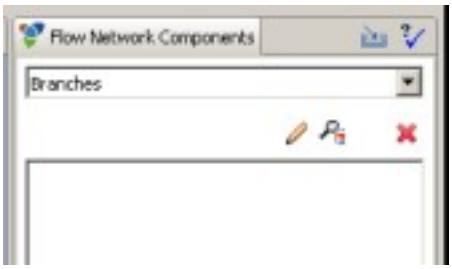


Fig. 5.4.7-1: Definition of calculation case

In order to successfully conduct an import, the PI main folder must be specified in the import wizard. Furthermore, the source coordinate system for the SOBEK geometries

must be specified. A standard roughness is assigned to the cross sections, which can be configured with the help of a selection menu in the wizard.

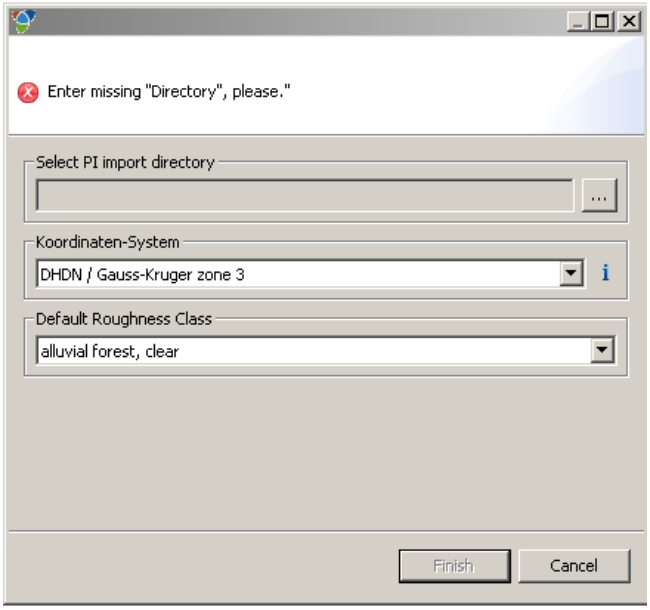


Fig. 5.4.7-2: SOBEK PI import wizard

A SOBEK PI Folder consists of the following files:

- Boundaries.xml
- Branches.xml
- CrossSections.xml
- Nodes.xml
- Structures.xml

The content of each individual file is explained in the SOBEK PI-Scheme.

Hint:
An existing nofdp IDSS Flow Network cannot be expanded by using the Import command. If a Flow Network is to be imported, an existing Flow Network must be deleted.

5.4.8 Flow Network Validation

The Flow Network can be verified by using (see Fig. 5.4.7-1).

The status of the Flow Network is displayed in a wizard. Detailed status reports are available by clicking the “Details” button – or with another double click on a status report within the table.

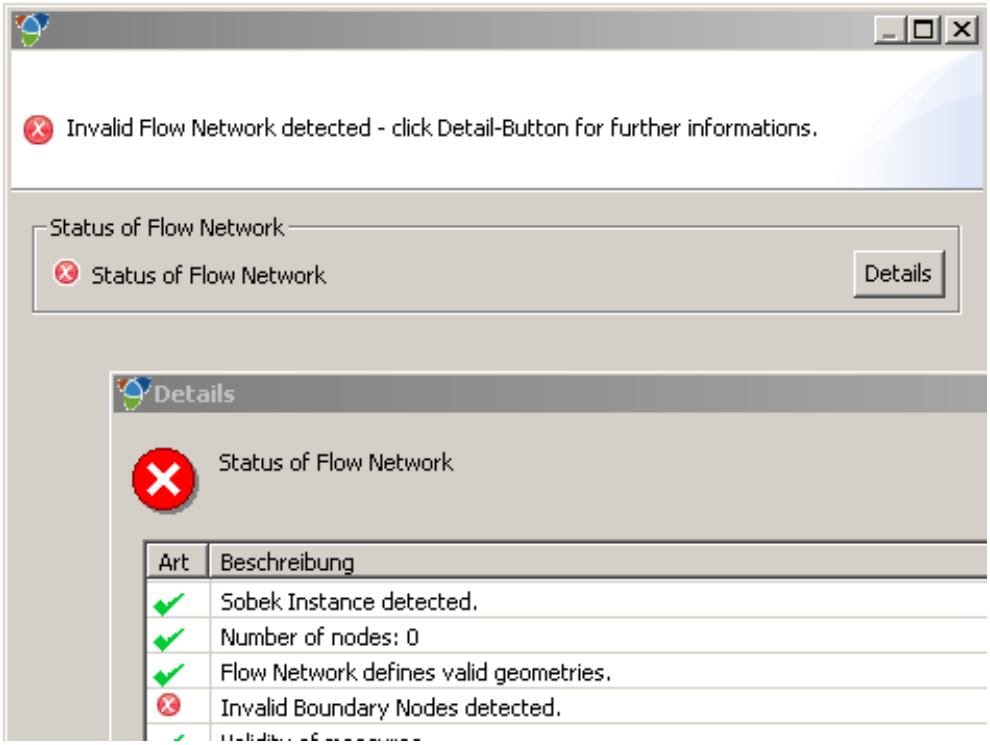


Fig. 5.4.8-1: Flow Network validation

6 ANALYSIS TOOLS

Various analysis tools are integrated into the nofdp IDSS. The use of these tools is described below.

6.1 ISAR Web

ISAR (*ISAR: **I**nformations**s**ystem zur **A**uswahl effizienter **R**enaturierungsmaßnahmen für Fließgewässer*) is an information system for the selection of efficient renaturation measures for watercourses (see **Chapter 2.3.4**). The menu bar has four functional areas: Home, Interactive Analysis, Knowledge Base and About. **Fig. 6.1-1** shows the ISAR Web homepage.

Fig. 6.1-1: ISAR Web homepage

6.1.1 Home

Returns the user to the ISAR Web homepage.

6.1.2 Interactive Analysis

Five steps are completed for water body classification. By clicking one of the two displayed illustration groups, the user defines the parameter characteristic for the respective watercourse. It is also possible to return to a previous classification step to make changes. Upon completion, the identified deficiencies and possible renaturation measures as well as the cost-effectiveness of the renaturation options are displayed for the user. **Fig. 6.1.2-1** shows an example.

Detailed help Hilfe and further information regarding this functional complex are found at the bottom of the Interactive Analysis page in the ISAR Web.

Fig. 6.1.2-1: ISAR Web homepage

6.1.3 Knowledge Base

Provides information about deficits and renaturation measures.

6.1.4 About

Provides information about the project client and the developers of the ISAR Web application.

6.2 ISAR Application

The ISAR application (*ISAR: **I**nformations**s**ystem zur **A**uswahl effizienter **R**enaturierungsmaßnahmen für Fließgewässer*) enables understanding of the physical river quality. By evaluation of the main five physical river quality parameters a catalog of measures is proposed in accordance with the methods described in Chapter 6.1.

For this purpose, corresponding shapefiles are first imported with ✚ (bottom left window). These are then available for selection in a drop-down list. Data import is supported by a wizard. First a shapefile is chosen. After displaying the associated attributes of the linked dBASE file and the input of metadata, attribute assignments for the following deficits must be made: water course, riverbed erosion, standard profile and riverbed shoring, transmissibility and riverbank. Lastly, the thematic areas in which the newly imported geodata will be used must be defined.

When importing the shapefiles, measures differentiated according to five categories are determined and recorded in the associated dBASE file (refer to **/1/**, listed in Appendix F, for the methodology of this classification) automatically, based on the identified deficit characteristics. These attributes are then also available for later analysis.

Fig. 6.2-1 shows an example of the ISAR application. Navigation in the map and loading of new topics as well as the activation of individual layers in the map takes place according to the procedures and conventions as described in **Chapter 3.4**.

After activating the i button in the GIS Viewer toolbar, the proposed measures for each section are displayed in a context window according to the five categories when moving the mouse over the watercourse. Upon activating and by clicking on a river section, the results of ISAR Web's physical analysis of the river are displayed (see Chapter 6.1.2).

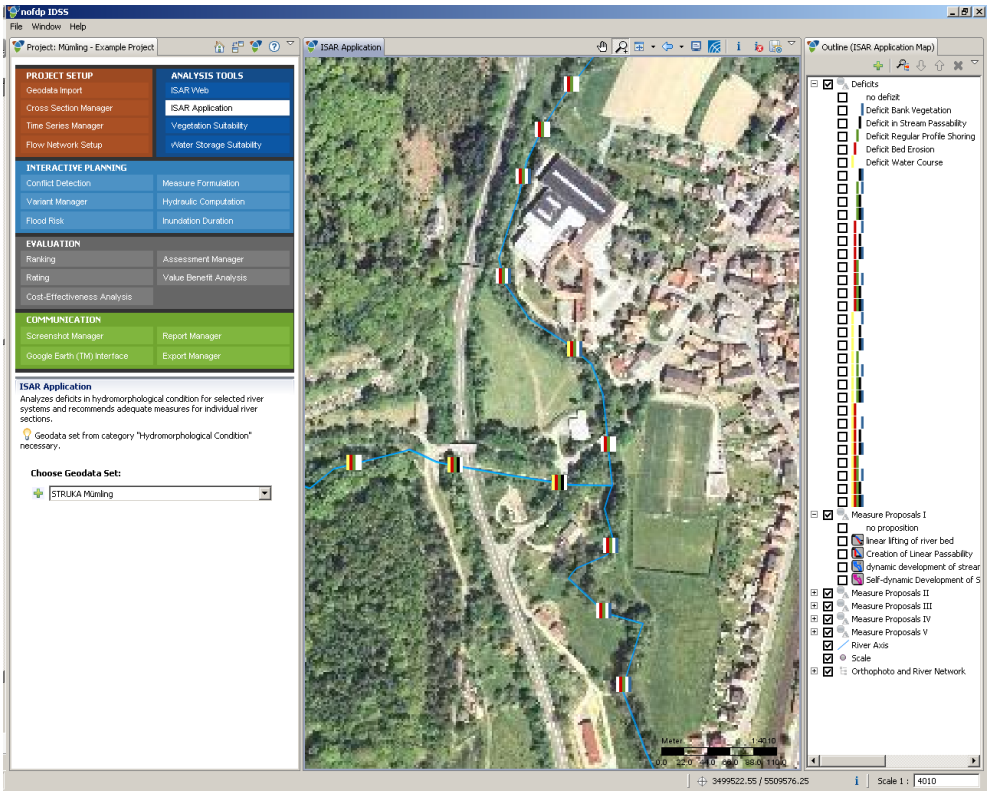


Fig. 6.2-1: ISAR Application

6.3 Vegetation Suitability

The determination of vegetation suitability is differentiated according to three methods addressing

(1) streams and their floodplains in general,
(2) streams and their floodplains in general influenced by saltwater and
(3) of large free flowing rivers.

Geodata regarding soil nutrients, soil moisture and vegetation structure are needed for the methods 1 and 2. Method 3 requires geodata concerning inundation duration and typical floodplain compartments.

First, the method (1, 2 or 3) is chosen from a drop-down list. Then, shapefiles for the following categories are to be imported with (bottom left window), one after another: soil nutrients, soil moisture and vegetation structure (or inundation duration and typical floodplain compartments). These are then available for further analyses through selection from the three drop-down lists. Data import is supported by a wizard. First a shapefile is chosen. After displaying the associated attributes of the linked dBASE file and the input of metadata, attribute assignments for the following deficits must be made: soil nutrients, soil moisture and vegetation structure (or inundation

duration and typical floodplain compartments). Lastly, the thematic areas in which the newly imported geodata will be used must be defined.

After the four options (e.g. Vegetation Suitability - general, soil nutrients, soil moisture and vegetation structure) have been chosen, the Compute Vegetation Suitability button becomes active. Herewith, the area distribution of the vegetation suitability can be determined (see /2/, /3/ and /4/, listed in Appendix F, for the methodology used in this determination). Fig. 6.3-1 shows an example for the display of results.

Navigation in the map and the addition of new topics, as well as the activation of individual layers in the map, is performed according to the procedures and conventions as described in Chapter 3.4. After activating i in the GIS Viewer toolbar, information about nutrients, ground moisture, vegetation structure and vegetation suitability are displayed as a context window when moving the mouse across the map.

The generated geodata can be integrated into the nofdp IDSS database by . This procedure is supported by a wizard (see Chapter 3.4).

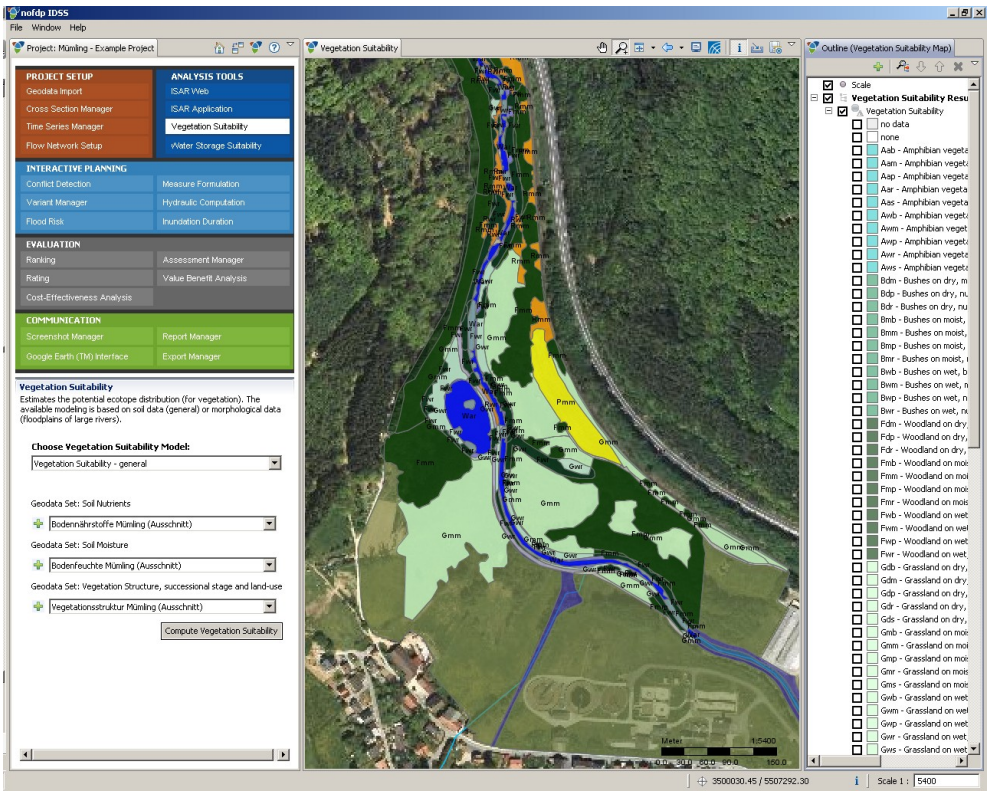


Fig. 6.3-1: Vegetation Suitability

6.4 Water Storage Suitability

The determination of water storage suitability is differentiated according to a general method for streams in summer and in winter as well as a method for floodplains of large flee flowing rivers in the summer and in winter. Geodata of flood frequency, flood duration, water depth and vegetation suitability are needed.

First, the method (Water Storage Suitability - general (summer), Water Storage Suitability - general (winter), Water Storage Suitability - floodplains of large rivers (sum-

mer), floodplains of large rivers (winter)) is chosen for the water storage model from a drop-down list . Then, shapefiles for the following categories are to be imported with ✚ (bottom left window), one after another: flood frequency, flood duration, water depth and vegetation suitability (result of the Vegetation Suitability analysis, see **Chapter 6.3**). These are then available for further analyses through selection from the four drop-down lists. Data import is supported by a wizard. First a shapefile is chosen. After displaying the associated attributes of the linked dBASE file and the input of metadata, attribute assignments for the following deficits must be made: flood frequency, flood duration, water depth and vegetation suitability (attribute designation: VSGEN or VSLARGE). Lastly, the thematic areas in which the newly imported geodata will be used must be defined.

After the five options (method, flood frequency, flood duration, water depth and vegetation suitability) have been chosen, the Compute Water Storage Suitability button becomes active. By this, the area distribution of water storage suitability can be determined (see **/5/**, listed in Appendix F, for the methodology used in this determination). **Fig. 6.4-1** shows an example of the displayed results.

Navigation in the map and the addition of new topics, as well as the activation of individual layers in the map, is performed according to the procedures and conventions as described in **Chapter 3.4**. After activating i in the GIS Viewer toolbar, information about frequency, duration, depth, vegetation suitability and water storage capacity are displayed as a context window when moving the mouse across the map.

The generated geodata can be integrated into the nofdp IDSS database by . This procedure is supported by a wizard (see **Chapter 3.4**).

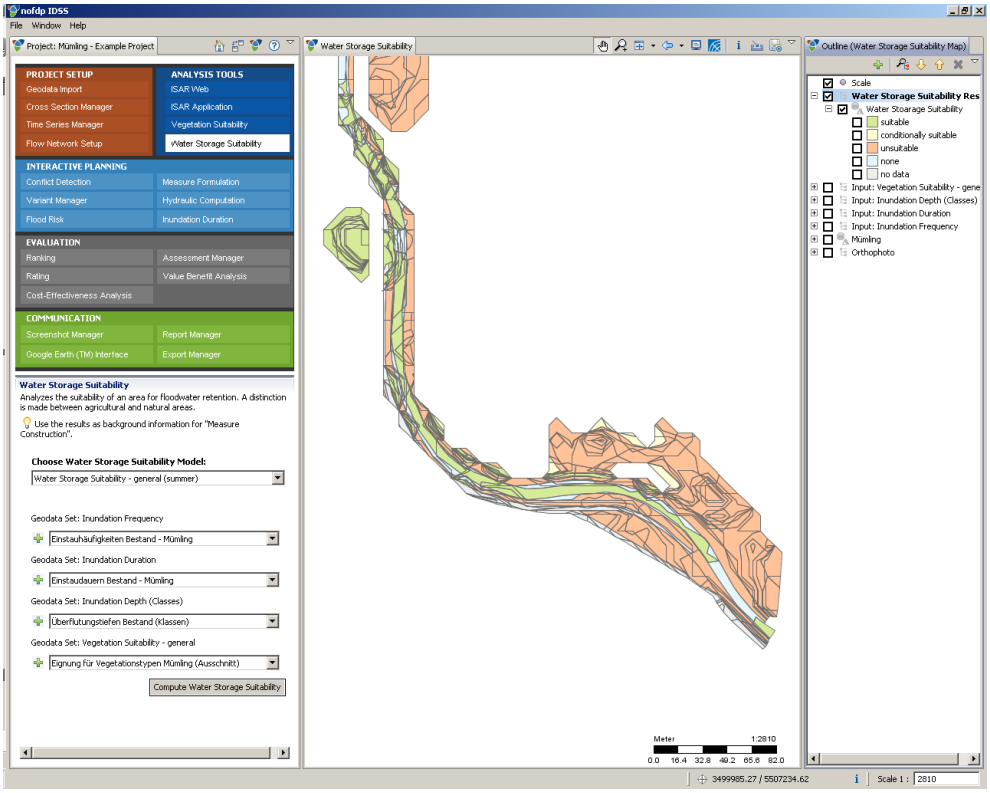


Fig. 6.4-1: Water Storage Suitability

7 INTERACTIVE PLANNING

The nofdp IDSS comprises a broad spectrum of powerful planning tools, which are presented in the following subchapters.

7.1 Conflict Detection

Using this function, spatial conflicts between individual topics can be determined. This takes place in GIS terms through the intersection of topics. An example for this is the intersection of the use classification according to CORINE (***Co**or**d**ination of **In**formation on the **E**nvironment*) and the Inundation Area, in order to identify particularly vulnerable areas of use.

The selection or new definition of a conflict detection takes place in the lower left part of the window.

A new conflict detection is created with . A wizard appears, in which a name and description (metadata) can be assigned. Then, the geodata categories to be used in the analysis are selected from the defined geodata list. This is achieved by marking an entry in the geodata list (left side) and then transferring it with into the selection list on the right side. With , a selected entry can be removed from selection list. With or , the selected entry can be moved up or down in the selection list. Fig. 7.1-1 shows this selection window. After completing this procedure, the selected categories are displayed in the specified order in the upper right part of the main window and the new conflict detection function is added to the list of existing conflict detection functions.

With , the metadata and the category configuration for the respective conflict detection function can be modified, and deletes the selected conflict detection function. By clicking on the icon, the conflict detection function can be opened; then this template is opened () and the associated categories are displayed on the right side of the window.

In conclusion, the selected categories are assigned geodata (shapefiles) with . Data import is supported by a wizard. First, a shapefile is selected. After the associated attributes of the linked dBASE file are displayed and metadata is entered, attributes must be assigned dependent on the scope. Several geodata sets can thereby be assigned to one category. If no geodata has yet been assigned to a category, this is symbolized in the drop-down geodata selection list by the symbol next to the corresponding category.

Before conducting the actual conflict analysis, the attributes to be taken into consideration for the intersection are selected from a drop-down list for each selected geodata file. With Calculate conflict combinations, a Cartesian product of all possible attribute characteristics for the selected geodata files is generated. For the conflict detection, a classification of these possible attribute combinations is necessary. This is performed in the *Conflict* column of the conflict table (see Fig. 7.1-2). The relevant field (under conflict) must be activated with a mouse click, whereupon a drop-down list appears with the following values for selection: *none*, *low*, *medium*, *high*, *very high*, *individual analysis needed*, *not yet considered* and *no data*.

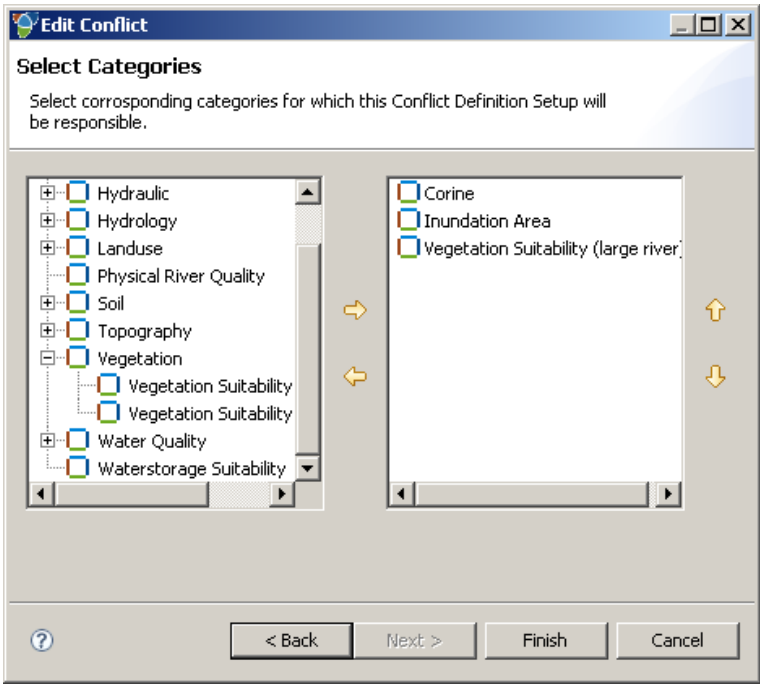


Fig. 7.1-1: Specification of categories for conflict detection and order of priority

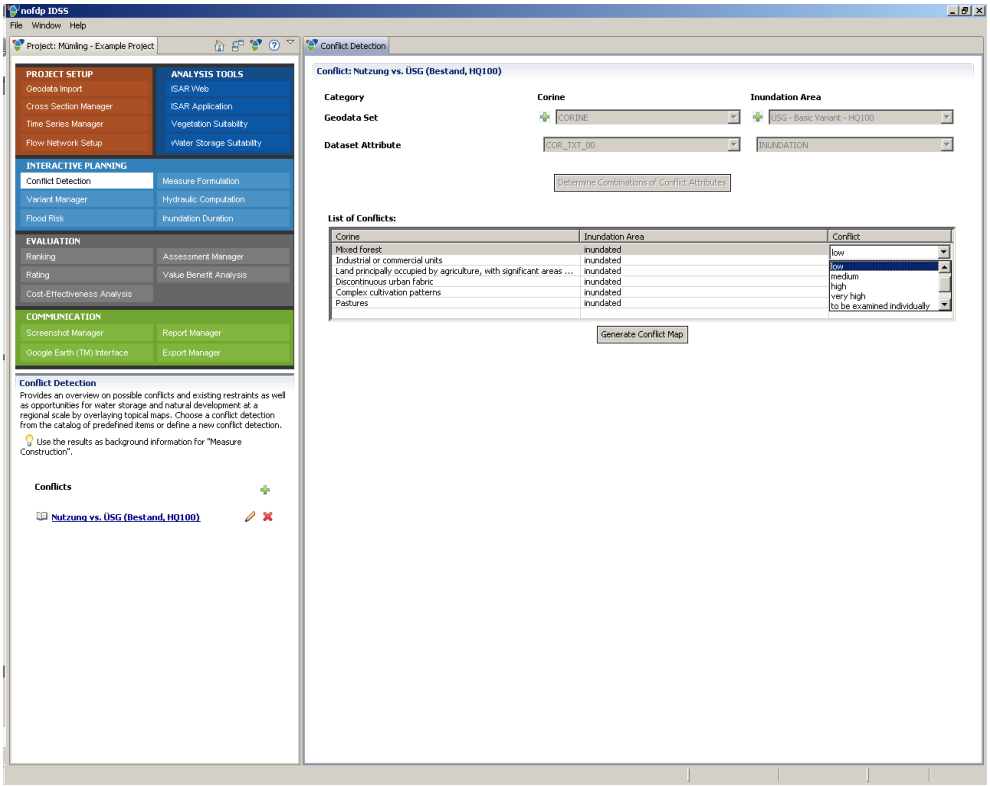


Fig. 7.1-2: Conflict Detection

With Generate conflict map, the intersection is initiated and the result displayed in a map in the lower right part of the window. Fig. 7.1-3 shows the result of this operation.

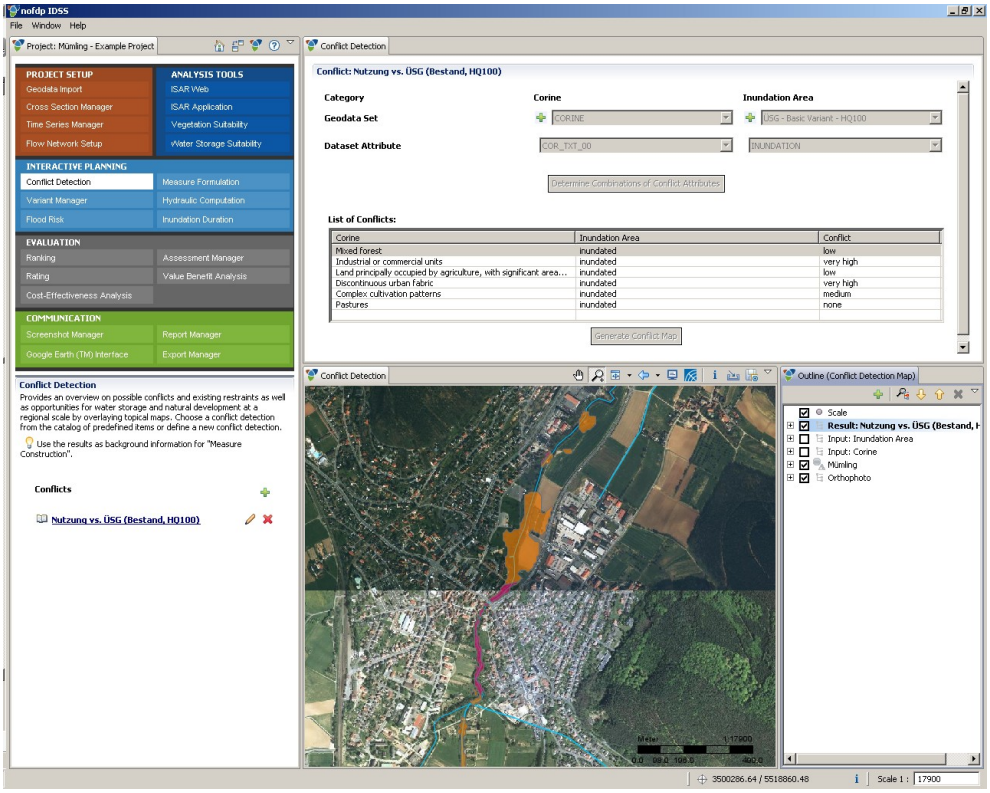


Fig. 7.1-3: Spatial Conflict Analysis

Navigation in the map and loading of new topics as well as the activation of individual layers in the map takes place according to the procedures and conventions as described in Chapter 3.4. After activating the i button in the map view toolbar, the characteristics of the selected attributes and the conflict status are displayed in a context window when moving the mouse over the map. With , the generated geodata can be integrated into the nofdp IDSS database. This procedure is supported by a wizard (see Chapter 3.4).

Hint:

The intersection operation is laborious in computing terms. It is therefore recommended wherever possible to only intersect two data sets with each other at any one time in the course of performing a conflict analysis. This is more efficient and at the same time, not so many attribute combinations must be assigned in one step for the conflict analysis.

7.2 Measure Formulation

In the Measure Formulation area, the planning measures that are to be defined are centrally compiled for all variants. The measures are differentiated into two category groups: *Ecological Measures* (icon) and *Constructive Measures* (icon). Thereby, the categories are in turn distinguished by measures for *Flood Retention* (icon), for *Increasing the Hydraulic Capacity* (icon), for *Activation of Retention Areas* (icon) and for *Flood Protection* (icon).

Table 7.2-1: Implemented Measure Types

Ecological Measures Measure Category	Measure Type and Geometric Characteristics
Flood Retention	1.1.1 Ecological Flooding of Polders and Floodplains (Polygon)
Hydraulic Conveyance Capacity	1.2.1 Definition of Buffer Strips (Polygon or Line)
	1.2.2 Remeandering of the River (Line)
Activation of Retention Areas	1.3.1 Adapted Agriculture (Polygon)
	1.3.2 Adapted Forestry (Polygon)
	1.3.3 Floodplain Reforestation (Polygon)
	1.3.4 Zoning Plan Modification, giving preference to the aims of nofdp (Polygon)
Flood Protection	1.4.1 Adapted Urban Land Use (Polygon)
Constructive Measures **Measure Category**	**Measure Type and Geometric Characteristics**
Flood Retention	2.1.1 Polder (Polygon and Connection Point to the Water Body)
	2.1.2 Retarding Basin (Polygon)
	2.1.3 Foreshore Excavation (Polygon)
	2.1.4 Floodplain Lowering (Line)
Hydraulic Conveyance Capacity	2.2.1 Riverbank Relocation (Line)
	2.2.2 Riverbed Elevation Change (Start and End Points on the river course)
	2.2.3 Obstacle Removal within the Flood-plain (Polygon)
	2.2.4 Diversion of Flood Discharge (Line)
	2.2.5 Weir (Line)
Activation of Retention Areas	2.3.1 Dike Relocation (Line and Polygon for the Protected Area)
	2.3.2 Floodplain Earth Wall (Polygon)
Flood Protection	2.4.1 Dike Construction (Line and Polygon for the Protected Area)
	2.4.2 Mobile Floodwall (Line and Polygon for the Protected Area)

Management of the measures is conducted with the list of measures in the lower left area of the Measure Formulation window.

With , a selected measure can be edited. At present, only the metadata and technical attributes of the respective measure can be changed hereby. A change to the measure's geometry is not currently possible. zooms to a selected measure in the map view. With , the selected measure can be deleted from the list of measures.

While a measure is currently opened, it is displayed and highlighted in the map view (upper middle part of the Measure Formulation window). Under measure details (upper right part of the Measure Formulation window), metadata (name and brief description) for the currently active measure are displayed. Fig. 7.2-1 shows an example. With , the currently selected measure can also be edited there.

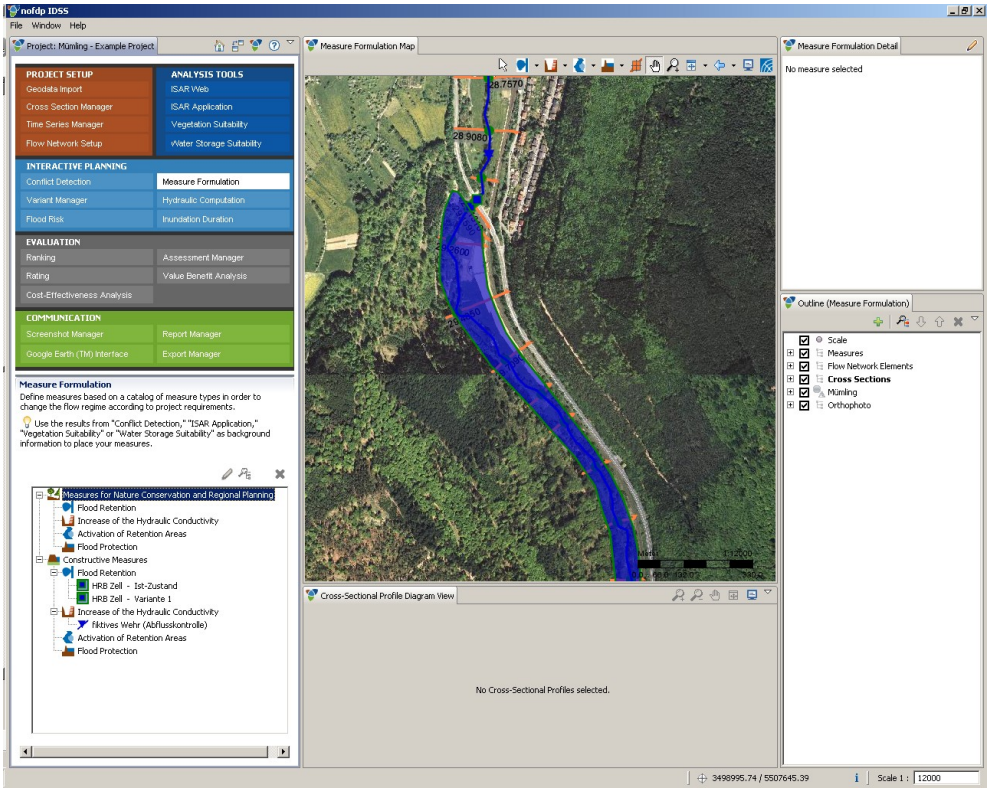


Fig. 7.2-1: Measure definition

The Navigation in the map and loading of new topics as well as the activation of individual layers in the map takes place according to the procedures and conventions as described in Chapter 3.4. With , a measure selected from the list of measures is displayed in the map in the greatest possible size. A cross section displayed in the site plan can be selected with . This cross section is then displayed in the Cross Section View. The cross section geometry for the initial state is displayed there. Navigation in the Cross Section View follows the procedures and conventions described in Chapter 3.5.

Functions for the definition of new measures are found beneath the buttons , , and . The individual measures are itemized in Table 7.2-1. In the upper part of these pull-down menus, the measures belonging to the category group

Measures for Nature Conservation and Regional Planning are listed. Beneath the dividing line, the measures belonging to the category group *Constructive Measures* are listed. The definition of these measures are made using the same procedure as for the creation of measures from the list of measures. In conclusion, the measures created this way are also integrated into the list of measures. In some cases the type of measure geometry must be specified after selecting a measure (see **Table 7.2-1**). In the next step the geometry of the measure will be captured by mouse. During capturing a help manual is display at the top left corner of the map view. When digitizing is finished a wizard appears. This wizard is for entring attributes and meta data of the captured measure (see **Table 7.2-2**).

The cursor () switches over to a neutral mode; neither measures nor Cross Sections are selected in the map.

Assigning attributes for the measure types *Polder* and *Retarding Basin* is supplemented here in comparison to assigning attributes for the structural elements *Polder* and *Retarding Basin* (see **Chapter 5.4.4**). The reason is that for the formulation of measures in the nofdp IDSS, ecological matters are also to be taken into account.

Table 7.2-2: Attributes of Measure Types

Measure Type	Metadata	Technical Attributes		
		Designation	Type*)	Unit
1.1.1 Ecological Flooding	Name Description Image	River Characteristic	W	-
		Vegetation Suitability considering Salinity (yes, no)	W	-
		Suitability for Water Storage in the Season	W	-
		Soil Nutrients	W	-
		Soil Moisture	W	-
		Vegetation Structure	W	-
		Inundation Frequency	W	-
		Inundation Duration	W	-
		Inundation Depth	W	-
1.2.1 Buffer Strip	Name Description Image	Roughness Class	W	-
1.2.2 Remeandering	Name Description Image	Take Digital Elevation Model (DEM) into Consideration (yes, no)	W	-
		Bed Level Upstream	F	m NHN
		Bed Level Downstream	F	m NHN
		Roughness Class Main Channel	W	-
		Roughness Class Left Fore Shore	W	-
		Roughness Class Right Fore Shore	W	-
1.3.1 Adapted Agriculture	Name Description Image	Roughness Class	W	-

Measure Type	Metadata	Technical Attributes		
		Designation	Type*)	Unit
1.3.2 Adapted Forestry	Name Description Image	Roughness Class	W	-
		River Characteristic	W	-
		Vegetation Suitability considering Salinity (yes, no)	W	-
		Suitability for Water Storage in the Season	W	-
		Soil Nutrients	W	-
		Soil Moisture	W	-
		Vegetation Structure	W	-
		Inundation Frequency	W	-
		Inundation Duration	W	-
		Inundation Depth	W	-
1.3.3 Floodplain Re-forestation	Name Description Image	Roughness Class	W	-
		River Characteristic	W	-
		Vegetation Suitability considering Salinity (yes, no)	W	-
		Suitability for Water Storage in the Season	W	-
		Soil Nutrients	W	-
		Soil Moisture	W	-
		Vegetation Structure	W	-
		Inundation Frequency	W	-
		Inundation Duration	W	-
		Inundation Depth	W	-
1.3.4 Zoning Plan Modification	Name Description Image	None		
1.4.1 Adapted Urban Land Use	Name Description Image	None		
2.1.1 Polder	Name Description Image	Overflow Crest Width	F	m
		Overflow Crest Height	F	m NHN
		Effective Discharge Coefficient Ce	F	-
		Contraction Coefficient Cc	F	-
		Flow Direction (negative, positive, negative and positive)	W	-
		Mean Bed Elevation	F	m NHN
		Storage Area	F	m^2
		Drawdown Rate, to empty the polder	F	m^3/s
		Flow Depth in the River, below which the polder will be emptied	F	m NHN
		Flow Depth in the River, above which the polder will not be emptied	F	m NHN

Measure Type	Metadata	Technical Attributes		
		Designation	Type*)	Unit
		River Characteristic	W	-
		Vegetation Suitability considering Salinity (yes, no)	W	-
		Suitability for Water Storage in the Season	W	-
		Soil Nutrients	W	-
		Soil Moisture	W	-
		Vegetation Structure	W	-
		Inundation Frequency	W	-
		Inundation Duration	W	-
		Inundation Depth	W	-
2.1.2 Retarding Basin	Name Description Image	Controlled Discharge (yes, no)	W	-
		Overflow Crest Width	F	m
		Overflow Crest Height	F	m NHN
		Mean Bed Elevation	F	m NHN
		Storage Area	F	m²
		Bottom of Outlet	F	m NHN
		Outlet Width	F	m
		Outlet Height	F	m
		River Characteristic	W	-
		Vegetation Suitability considering Salinity (yes, no)	W	-
		Suitability for Water Storage in the Season	W	-
		Soil Nutrients	W	-
		Soil Moisture	W	-
		Vegetation Structure	W	-
		Inundation Frequency	W	-
		Inundation Duration	W	-
		Inundation Depth	W	-
2.1.3 Foreshore Excavation	Name Description Image	Influence on the Digital Elevation Model (yes, no)	W	-
		Mean Bottom Level	F	m NHN
		Volumes	F	m³
		River Characteristic	W	-
		Vegetation Suitability considering Salinity (yes, no)	W	-
		Suitability for Water Storage in the Season	W	-
		Soil Nutrients	W	-
		Soil Moisture	W	-
		Vegetation Structure	W	-
		Inundation Frequency	W	-
		Inundation Duration	W	-

Measure Type	Metadata	Technical Attributes		
		Designation	Type*)	Unit
		Inundation Depth	W	-
2.1.4 Floodplain Lowering	Name Description Image	Influence on the Digital Elevation Model (yes, no)	W	-
		Mean Bed Elevation	F	m NHN
2.2.1 Riverbank Re-location	Name Description Image	None		
2.2.2 Riverbed Eleva-tion Change	Name Description Image	Change of Riverbed Elevation	F	m
2.2.3 Obstacle Re-moval	Name Description Image	None		
2.2.4 Diversion of Flood Discharge	Name Description Image	Affects Digital Terrain Model (yes, no)	W	-
		Bed Level Upstream	F	m NHN
		Bed Level Downstream	F	m NHN
		Channel Bed Width	F	m
		Depth of the Channel below Ground Surface	F	m
		Roughness Class Main Channel	W	-
		Roughness Class Right Fore Shore	W	-
		Roughness Class Left Fore Shore	W	-
		Bank Slope Waterside (1:X)	F	-
		Overall Channel Width in the Flood-plain	F	m
		Dam Height above Ground Surface	F	m
		Bank Slope Landside (1:X)	F	-
2.2.5 Weir	Name Description Image	Overflow Crest Width	F	m
		Overflow Crest Height	F	m NHN
		Effective Discharge Coefficient Ce	F	-
		Contraction Coefficient Cc	F	-
		Flow Direction (negative, positive, negative and positive)	W	-
2.3.1 Dike Relocation	Name Description Image	Footprint Width of the Old Dike	F	m
		Volume of the Old Dike	F	m^3
		Volume of the New Dike	F	m^3
		Dike Crest Width	F	m
		Dike Height Upstream	F	m NHN
		Dike Height Downstream	F	m NHN
		Dike Slope Landside (1:X)	F	-
		Dike Slope Waterside (1:X)	F	-
2.3.2 Floodplain Earth Wall	Name Description Image	Earth Wall Height	F	m NHN

Measure Type	Metadata	Technical Attributes		
		Designation	Type*)	Unit
2.4.1 Dike Construction	Name Description Image	Dike Crest Width	F	m
		Dike Height Upstream	F	m NHN
		Dike Height Downstream	F	m NHN
		Dike Slope landside (1:X)	F	-
		Dike Slope waterside (1:X)	F	-
2.4.2 Mobile Floodwall	Name Description Image	Floodwall Height Upstream	F	m NHN
		Floodwall Height Downstream	F	m NHN

*) Abbreviations for the attribute characteristics:
C: text (character), F: decimal number (float), I: whole number (integer), W: selection list

7.3 Variant Manager

Variants combine measures into analysis scenarios. The hydraulic calculation and observations about inundation risk and inundation duration that are based thereupon, as well as the area of evaluation, are all based on the variants specified here.

Variants are managed in the lower left part of the window. A new variant is generated with . A wizard appears, in which a name and description (metadata) can be assigned. With the metadata for the variant can be modified, duplicates the selected variant and deletes it. By clicking on the icon, the variant can be opened; the icon then changes to . Then, the assignment of measures for this variant can be viewed and changed in the upper middle part of the Variant Manager window.

From the defined list of measures, the selected variant can be assigned to measures. This is achieved by marking an entry in the list of measures (left side) and then transferring it with into the selection list on the right side. With , a selected entry can be removed from selection list. With or , the selected entry can be moved up or down in the selection list for changing the display order for evaluation of the variants (see **Chapter 8**). **Fig. 7.3-1** shows this selection window. The registered metadata for the currently selected measure are displayed in the upper right part of the window. The sequence of measures also defines the sequence of applying the measures to the flow network, i.e. the hydraulic model (see **Chapter 7.4**). The measure on the top of the list will be applied first to the hydraulic model.

In the lower middle part of the window, the geometries of the selected individual measures are displayed in a map. Navigation within the map and the procedure for loading new topics, as well as the activation of individual layers in the map takes place according to the procedures and conventions as described in **Chapter 3.4**.

generates a polygon Shape file that consists of measure geometries of a selected variant. This Shape file will be imported to the nofdp IDSS geodata database, and can be used for further analysis, e.g. conflict detection (see **Chapter 7.1**).

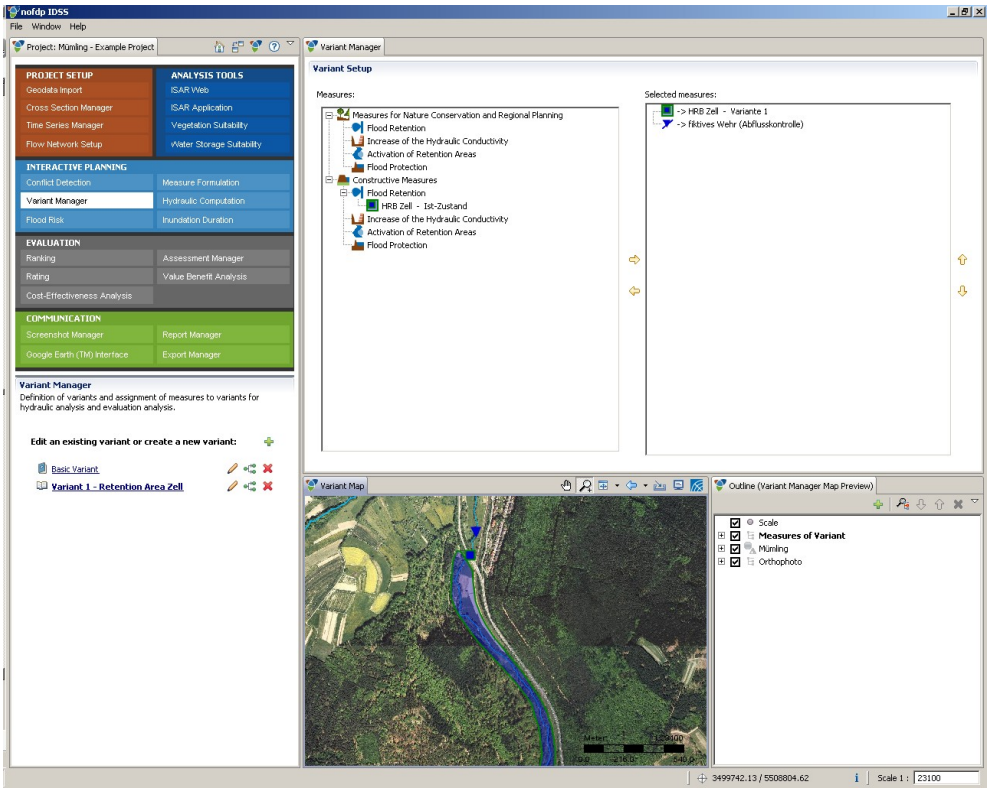


Fig. 7.3-1: Variant Manager

7.4 Hydraulic Calculation

The hydraulic calculation serves to start the transient hydraulic calculations and view the results (see **Fig 7.4-1**).

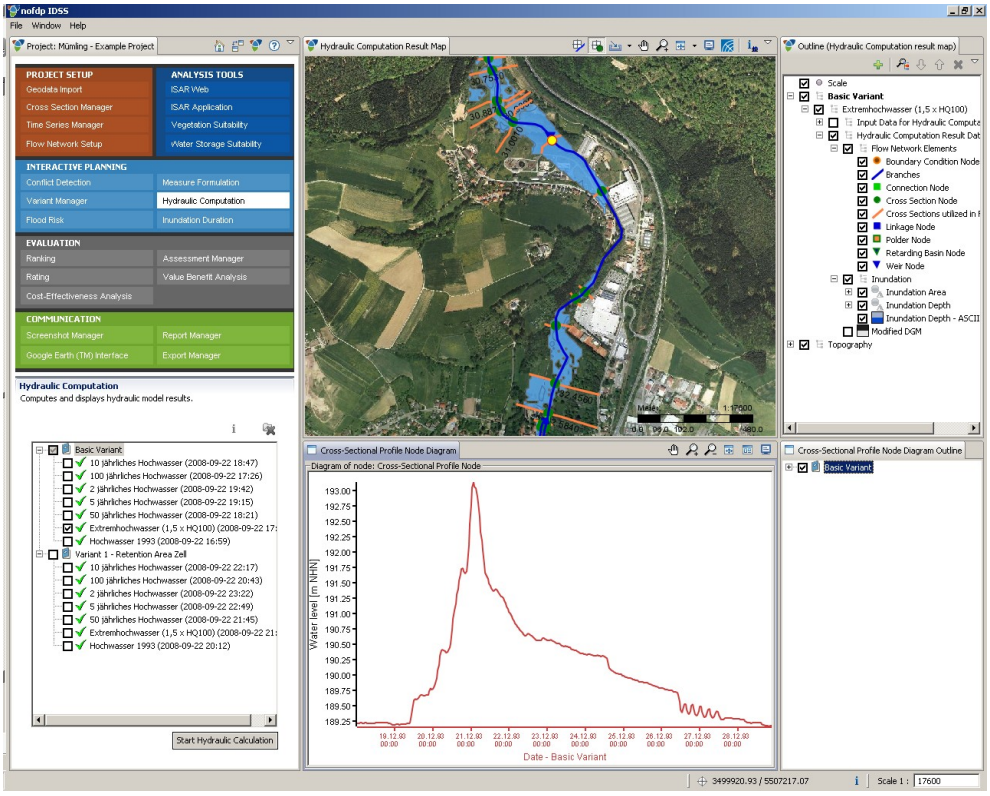


Fig. 7.4-1: Hydraulic calculation

The graphic user interface consists of the following elements:

- *Status Overview* gives information about the variants and calculation cases defined in the project, including the calculation status of each of the individual calculation cases (see **Figure 7.4-1**, bottom left)
- *Map View* (see **Figure 7.4-1**, top middle)
- *Outline View* to control the Map View (see **Figure 7.4-1**, top right)
- *Diagram View* (see **Figure 7.4-1** bottom middle)
- *Outline View* to control the Diagram View (see **Figure 7.4-1**, bottom right)

The last two elements are first displayed after using tools to activate the Diagram View (and from the Map View toolbar).

The wizard for conducting the hydraulic calculations is started with Start Hydraulic Calculation (bottom left). In the first dialog box, the variants to be calculated and the calculation cases are selected. The procedure is started in the second dialog box with Start. During the entire calculation process, progress information is displayed in both text fields of the dialog. After completing the calculation, details Details and log files Log Files can be viewed. Detailed information is nested where applicable (see **Chapter 5.4.8**). The overall status of this calculation is automatically saved and can be called up again at a later point in time from the Status View (tree view, bottom left) using i after first highlighting a calculation with the mouse.

The content and organization of the log files and the detailed information are oriented on the overall process of the calculation. For each selected calculation case of the selected variants, the following steps are carried out:

- Flow Network validation (see **Chapter 5.4.8** and **Appendix D**)
- Conversion of the measures for the hydraulic calculation (see **Appendix C**)
- Translation of Flow Network elements in ones in conformance with the computational module (see **Appendix E**), including compilation of a modified elevation model
- Compilation of the input files for the computational module
- Executing the calculation
- Converting the time series results from the computational module into nofdp IDSS formats
- Generation of additional result data (Inundation Area, Inundation Depth)

The success or failure of a calculation is shown with the ✓ and ⊗ icons. These are also used in the Status View. Calculations that have not yet been executed are identified in this view with .
Results of an executed calculation are displayed in the map if the corresponding checkmark is placed in the Status View. No results can be displayed for calculations that have not yet been executed. In the map, the input data (Flow Network, Measures for Variants) and result data (modified Flow Network, modified Elevation Model, Inundation Area and Depth) are displayed for each calculation.

If a calculation could not be executed successfully, the partial results that have been obtained are displayed. This serves to isolate the circumstances leading to the disruption in the process.
By placing checkmarks on multiple calculations in the Status View, their results are superimposed in the map. Thus a synopsis of the (partial) results is made possible. Navigation in the map as well as the loading of new topics and layers takes place according to the procedures and conventions described in **Chapter 3.4**.

Complementing the general tools, the Map View includes tools for displaying longitudinal sections along Flow Network Branches, for displaying hydrographs at nodes and for incorporating the generated geodata into the geodata database.

From the calculation results of the computational module, the maximal occurring water levels are determined at the Connection-, Time Series Connection-, Weir- and Cross Section Nodes and then displayed in the longitudinal sections. Selection of the Flow Network Branch for which the longitudinal section should be displayed takes place after activating the tool by subsequently selecting the branch in the map. Display takes place in the Diagram View, which is located beneath the map (see **Figure 7.4-2**). For each of the calculations selected in the Status View, a longitudinal section is added to the diagram (graph). The Outline View for controlling the Diagram View is located at the right next to the diagram and allows individual longitudinal sections to be displayed or hidden as desired.

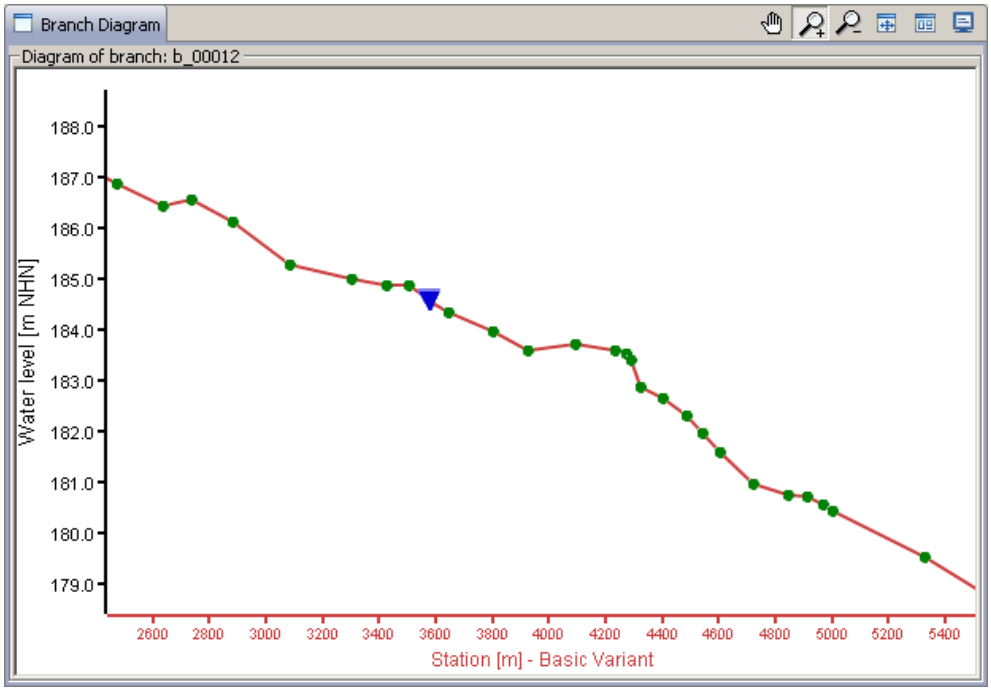


Fig. 7.4-2: Diagram view of the hydraulic calculation

Various tools are available in the Diagram View (see **Figure 7.4-2**). The view is moved with . If the tool is used in the diagram surface, then all the diagrams are moved. If the tool is used along the x-axis, the x-axes of the individual diagrams are moved in relation to one another. This makes the overlay or equalization of diagram depictions possible. The view is enlarged with and reduced with . nullifies all axis shifts previously made and maximizes the display to the entire extent of the dia-

gram. Maximization of the overall view is achieved using . With , a screenshot can be created and incorporated into the Screenshot Manager (see **Chapter 9.1**).

Along with a longitudinal section view of the maximal water level along the Flow Network Branches, hydrographs can also be displayed for the individual nodes. For this purpose, a node is selected in the map using . For all the calculations selected in the Status View, the result curves are displayed in the Diagram View. The same options as for the longitudinal sections exist for controlling the view. In particular, the possibility for shifting the x-axes in relation to one another proves to be a good aid for analysis.

The following **Table 7.4-1** provides an overview of the data types that are displayed as curves for the individual node types.

Table 7.4-1: Hydrograph overview

Node Type	Data Type
Connection nodes	Water level [m NHN]
Time series connection nodes	Water level [m NHN]
Cross section nodes	Water level [m NHN]
Weir	Water level upstream [m NHN] Water level downstream [m NHN] Discharge rate [m³/s]
Polder	Inflow rate [m³/s] Discharge rate [m³/s]
Retarding Basin	Water level [m NHN] Bottom outlet [m³/s] Spillway [m³/s]

When determining the Inundation Area and Depth, the value for the maximum water level at each of the cross section nodes is transferred to the area using the cross section geometry and subsequent triangulation. This takes place separately for each Flow Network Branch. At collision points of the Flow Network Branches, gaps in the area geometries can thereby result. Consequently, Flow Network Branches with only one cross section cannot contribute to the geometries of Inundation Area and Depth. Thus to generate the most continuous possible geodata sets for the Inundation Area and Depth, continuous digitalization of the Flow Network Branches is advantageous (see **Chapter 5.4.2**).

With , the following generated geodata can be incorporated into the nofdp IDSS geodata database:

- **Inundation Area (Shape File)**: Inundation Area can serve as input data for the module Conflict Detection.
- **Inundation Depth by Classes (Shape File)**: Inundation Depth by Classes is needed as input data for the module Water Storage Suitability.
- **Inundation Depth (Grid)**: Inundation Depth (Grid) is needed as input data for the module Flood Risk.
- **Modified Digital Elevation Model**: Some measures modify the Digital Elevation Model. This modified Digital Elevation Model can be incorporated to the nofdp IDSS geodata database.

An incorporation of geodata into the nofdp IDSS geodata database is done separately for each geodata type and calculation case. For each of the calculations selected in the Status View, the selected geodata type is incorporated into the geodata database with the help of a wizard (see **Chapter 3.4**).

7.5 Flood Risk

Under Flood Risk, the area of analysis is divided into risk zones according to land uses and flooding depths (for methodology see **/7/** and **/8/**, listed in Appendix F). The datasets for land use and inundation depth available in the geodata list are used as input data.

The *Configure Flood Risk* area is accessed by clicking on the item Flood Risk in the main menu (see **Fig. 7.5-1**). In the upper part of the window, input data necessary for the calculation are selected from the list of geodata sets. The available land uses are listed on the left side and the available inundation depths, along with the respective frequencies (annualities), are listed on the right.

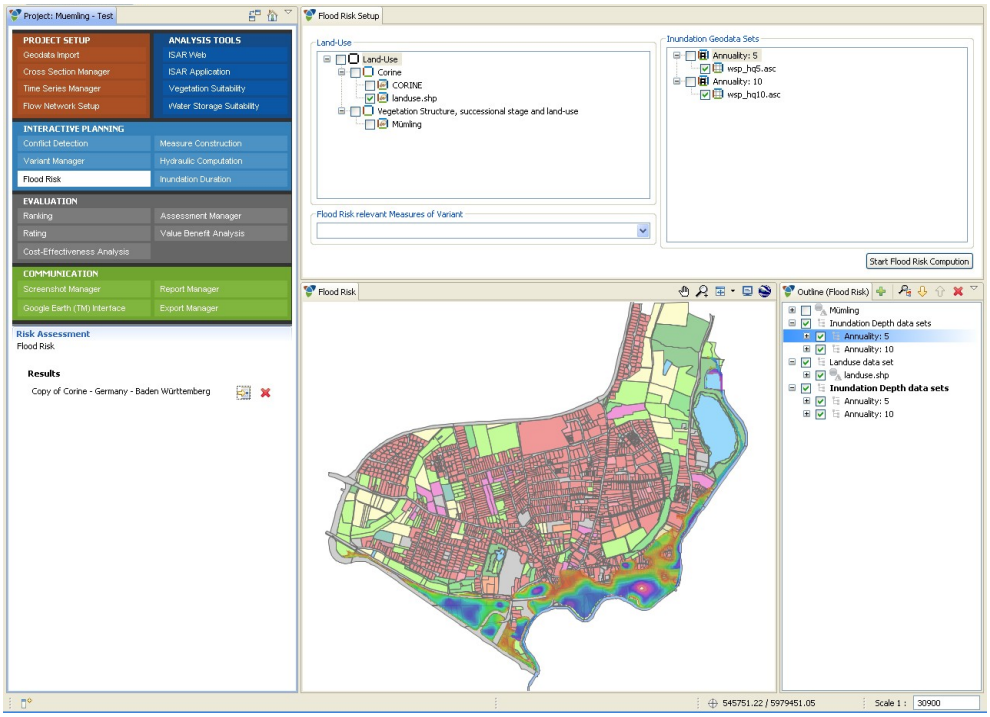


Fig. 7.5-1: Flood Risk Overview

In the lower middle part of the window, the geometries for the individually selected input data are displayed in a map. Navigation in the map as well as the loading of new topics and layers takes place according to the procedures and conventions described in **Chapter 3.4**.

Independent from the selected datasets, a Variant can be selected from the drop-down list *Variant Measures Relevant to the Flood Risk*, which have direct impact on the land use or the risk zone due to the implemented measures contained therein.

Once the desired land use and at least two inundation datasets with differing frequencies are selected for the area to be evaluated, the User receives guidance for providing the input needed to determine the damage risk by pressing Start Flood Risk Compution.

Hint:
The selected variant should match the datasets of Inundation Depth, i.e. the Inundation Depths are results of a hydraulic computation of the selected variant.

The data field defining the land use class is selected for the respective land use in the Assistant that then opens. On the following page, the asset values and damage functions to be used are then specified. Three sources are available to the User for this purpose:

- Template database,
- Templates that have been created during a previous flood risk calculation, and
- Creation of a new, user-specified template.

In conclusion, the name and a description for the flood risk calculation is entered.

All occurring land uses, along with their respectively assigned damage functions and asset values, are listed in a table in the upper section of the next page of the Assistant (see **Fig. 7.5-2**). Here the User can change assignments by clicking with the mouse on the corresponding entry and selecting a different entry from the list that appears. The definitions of the damage functions and asset values are listed in the lower section of the page. The functions and values listed here can also be changed by the User.

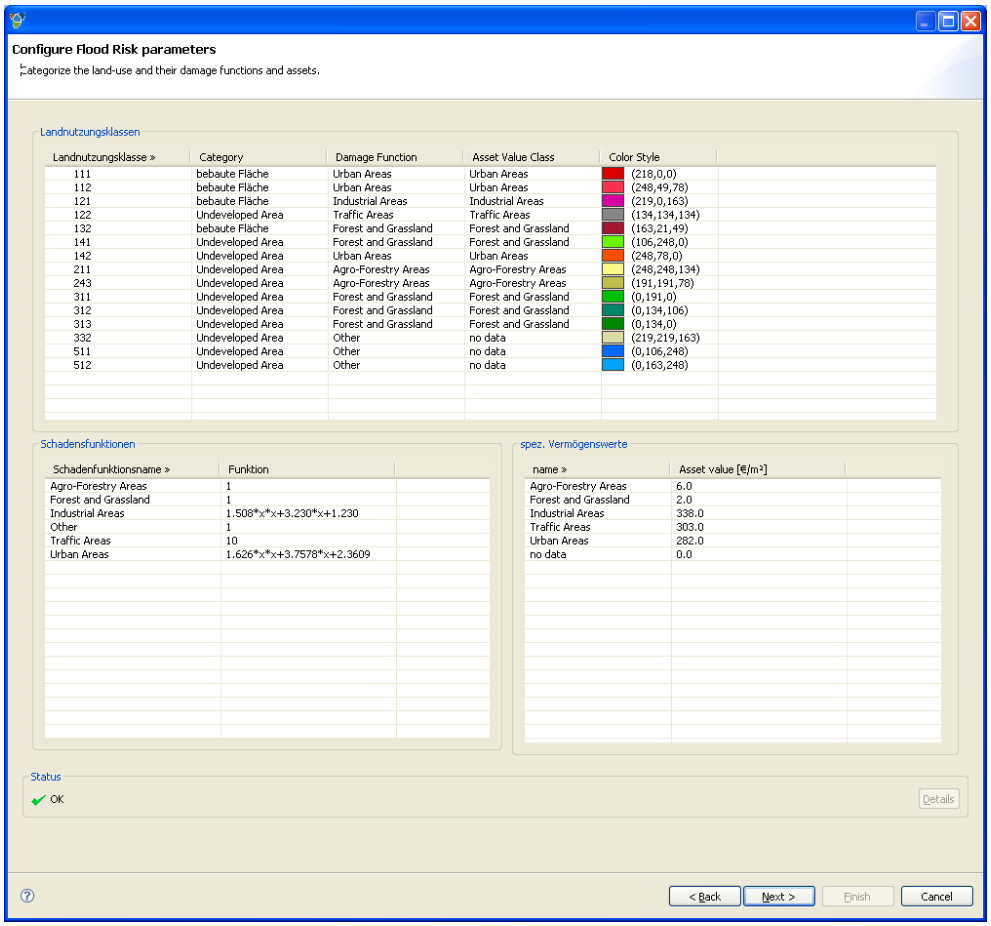
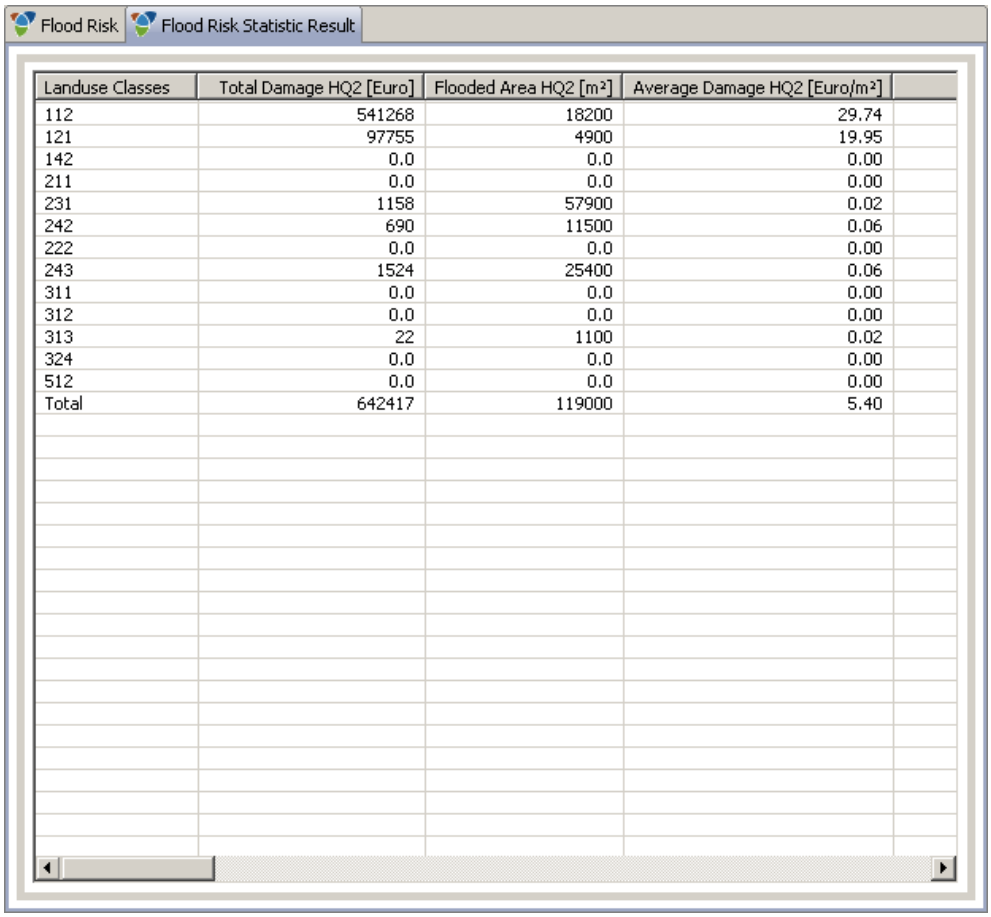


Fig. 7.5-2: Overview of land uses

On the last page, the underlying definitions of the risk zones are represented. By pressing *Finish,* the calculation of the risk zones is started. Once the calculation is completed, the resulting risk zones are displayed in the map. Additionally, a tabular overview is created, in which the damage values for the individual land uses are listed for each flood event and also as an annual mean (see **Fig. 7.5-3**).



Landuse Classes	Total Damage HQ2 [Euro]	Flooded Area HQ2 [m²]	Average Damage HQ2 [Euro/m²]
112	541268	18200	29.74
121	97755	4900	19.95
142	0.0	0.0	0.00
211	0.0	0.0	0.00
231	1158	57900	0.02
242	690	11500	0.06
222	0.0	0.0	0.00
243	1524	25400	0.06
311	0.0	0.0	0.00
312	0.0	0.0	0.00
313	22	1100	0.02
324	0.0	0.0	0.00
512	0.0	0.0	0.00
Total	642417	119000	5.40

Fig. 7.5-3: Tabular representation of the flood risk

7.6 Inundation Duration and Frequency

For determination of inundation frequencies and durations, the following procedures are available:

- Inundation frequency
- Inundation duration (event-based, i.e. for a specific flood)
- Inundation duration (on the basis of a duration curve)

The geodata datasets / results generated with these methods are suitable as input data for the methods Vegetation Suitability and Water Storage Suitability (see **Chapter 6.3** and **Chapter 6.4**).

Depending upon the selected procedure (selection list at bottom left), the graphic user interface adjusts itself for the respective process.

7.6.1 Inundation Frequency

GIS-based determination of the inundation frequency take place based on raster data about the inundation depth of differing annualities. For processing, all the raster data sets for inundation depth present in the geodata database, which had previously been stored there after hydraulic calculation and subsequent geodata export, are thus made available. An inundation frequency class must be assigned to the annualities. Subsequently, the raster data are intersected with one another and the frequency

class assigned to the resulting polygons as an attribute during the conversion of the result into a shapefile.

The needed input is made in the upper area of the graphic user interface (see **Figure 7.6.1-1**).

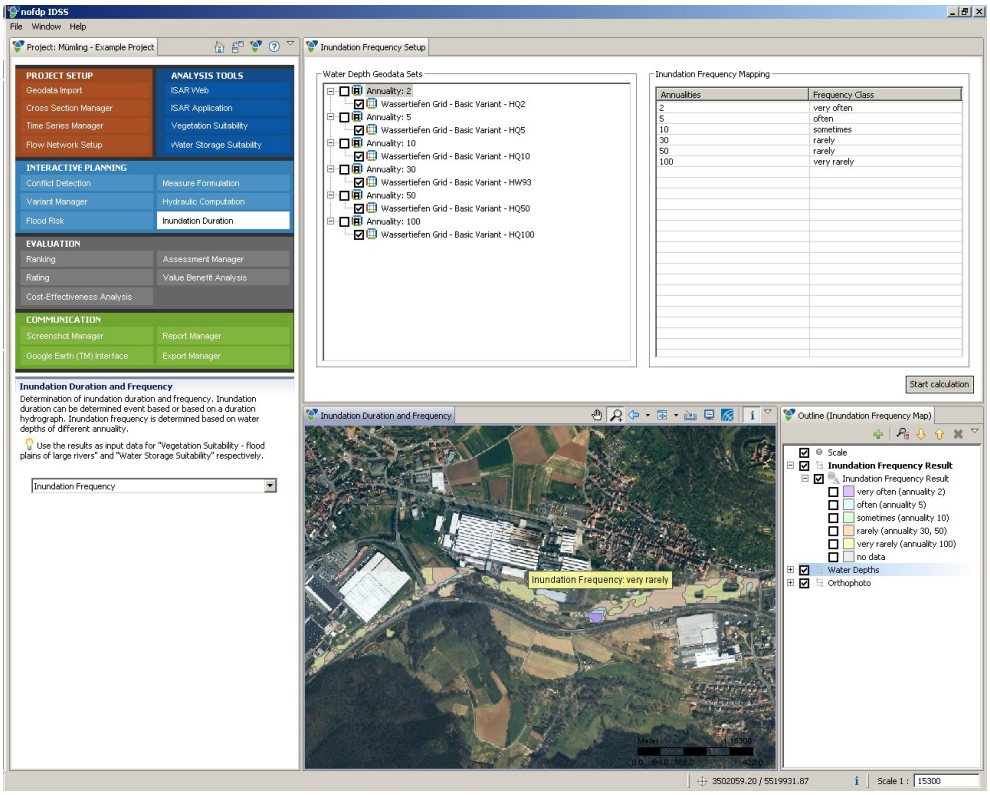


Fig. 7.6.1-1: GIS-based determination of inundation frequency

The usable datasets from the geodata database are grouped according to annuality in a tree view for selection. The procedure already functions when using two geodata datasets. To increase the explanatory power of the results, however, datasets should use a range of annualities that is as broad as possible. To check the location of the input data, these are immediately displayed in the map.
After selecting the geodata datasets, the annualities are assigned to the classes of inundation frequency in the table with the help of selection lists.
Once all the settings have been made, the calculation is started with Start calculation.
The settings for assignment of the classes are saved and are thus available again when using the method for event-based determination of inundation frequency.
After completing the calculation, the result dataset is entered into the map.

Navigation within the map and the procedure for loading new topics, as well as the activation of individual layers in the map takes place according to the procedures and conventions as described in **Chapter 3.4**. After activating i in the Map View toolbar, the class of the inundation frequency is displayed as a context window when moving the mouse across the map.

The generated geodata can be integrated into the nofdp IDSS database with . This procedure is supported by a wizard (see **Chapter 3.4**).

7.6.2 Inundation Duration (Event-Based)

Event-based determination of inundation durations relies on the analysis of water level time series results at the cross sections of a transient hydraulic calculation (see **Chapter 7.4**).
Each group of inundation durations must be assigned a duration class. To determine the results, the maximum water level that is reached for the assigned duration class is determined for each cross section and for each class of inundation duration. By transferring the water level to the area using the cross section geometries with consideration of the Flow Network elevation model, the spatial extent is ascertained for each duration class. In a final step, the geometries are intersected with one another and the overall result is generated.

The needed input is entered in the upper area of the graphic user interface (see **Figure 7.6.2-1**).

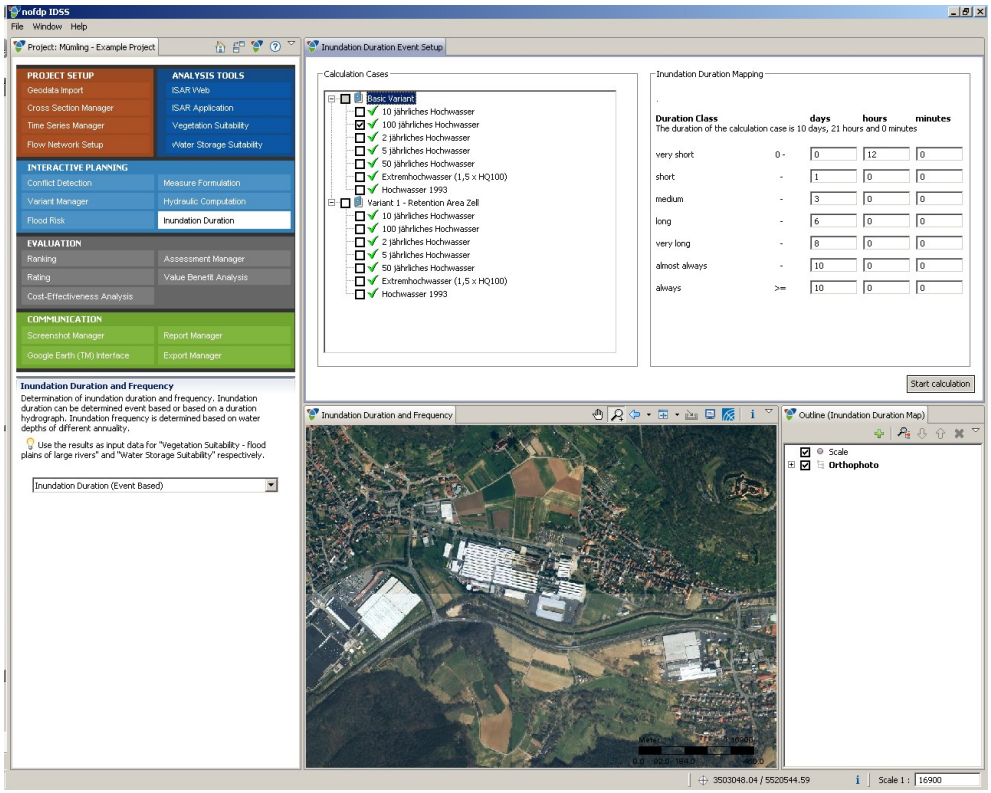


Fig. 7.6.2-1: Event-based determination of the inundation duration

From the list of previously executed hydraulic calculations, which are displayed in a tree view together with information on their status, one of the successfully completed calculations must be selected with a checkmark. In the table at the right, next to the list of hydraulic calculations (calculation cases), the interval upper limits for the six principle duration classes must each be defined. For the duration class “always,” the value is automatically set based on the setting entered for the duration class “almost always.”

Die minimum duration of the first duration class “very short” is predetermined by the length of the result interval of the hydraulic calculation. The durations must increase in correspondence with the meaning of the classes. Directions for adjustments, if needed – e.g. if duration classes overlap – are displayed below in the table.

Once all the settings have been made, the calculation is started with Start calculation.
The settings for the duration classes are saved and are again available when using the method for event-based determination of inundation durations .
After completing the calculation, the result dataset is entered into the map.

Navigation within the map and the procedure for loading new topics, as well as the activation of individual layers in the map takes place according to the procedures and conventions as described in **Chapter 3.4**.

The generated geodata can be integrated into the nofdp IDSS database with  . This procedure is supported by a wizard (see **Chapter 3.4**).

7.6.3 Inundation Duration (Based on Duration Curve)

Determination of inundation durations based on a duration curve utilize the results of measurements over many years and their statistical analysis in the form of a duration curve. Duration curves are consequently generally available for river levels.
In a Flow Network, discharge values for a Time Series Connection Node with Discharge Hydrograph are determined from a duration curve for each duration class and then set as constant discharges. If further Time Series Connection Nodes with Discharge Hydrographs are included, constant discharge values are assumed. Time Series Connection Nodes with a Water Level Discharge Function remain unaffected.
If the Flow Network contains Time Series Connection Nodes with Water Level Hydrographs, the method cannot be applied. In such a case, these nodes must first be changed in the Flow Network Setup into nodes with Discharge Hydrographs or with a Water Level Discharge Function (see Chapter 5.4).
Altogether, a quasi-stationary calculation is thus carried out for each duration class, the results of which are subsequently superimposed.

The needed input is made with the help of a wizard, which is started using
Configure and calculate Inundation Duration.

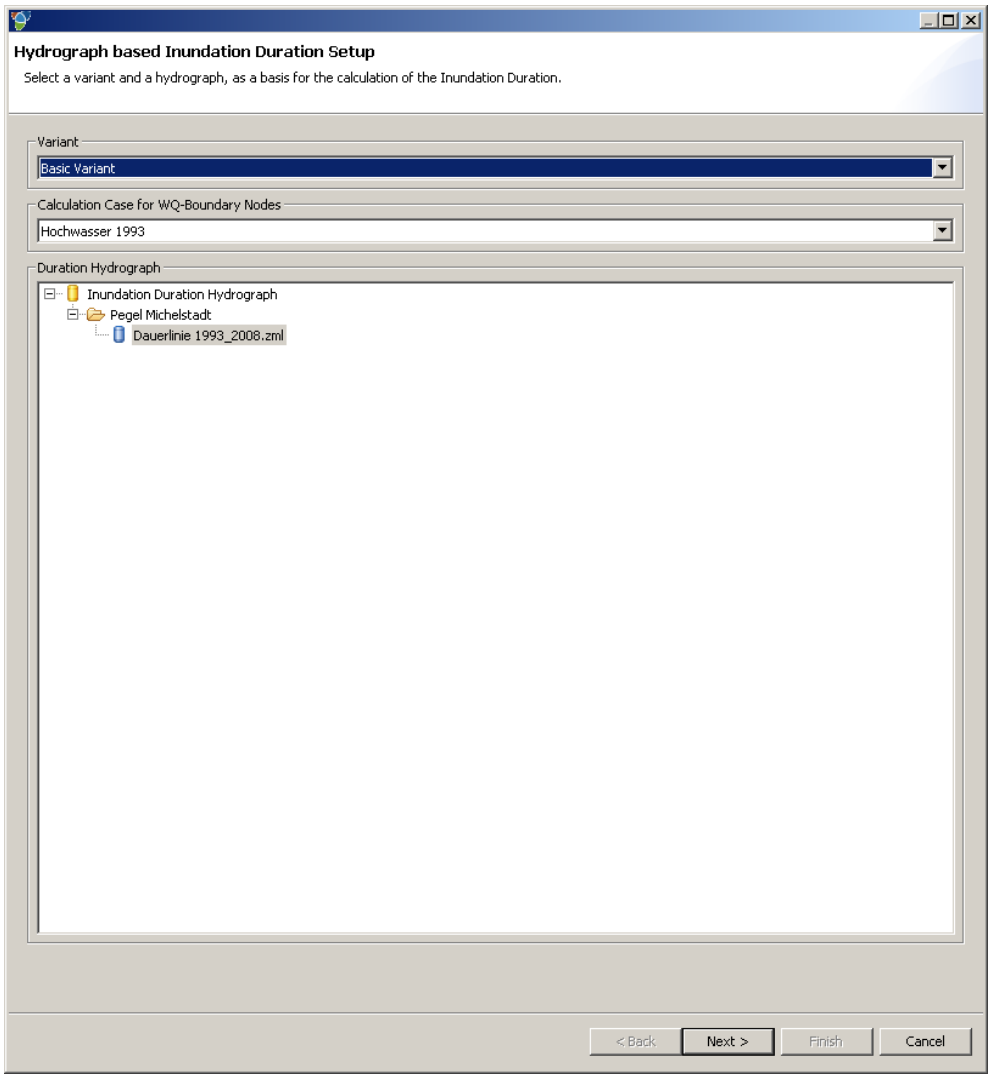


Fig. 7.6.3-1: Selection of variants, calculation case and duration curve

In the first dialog box (see **Figure 7.6.3-1**) the variant for which the inundation durations should be determined is selected. For Time Series Connection Nodes with a Water Level Discharge Function, which remain unchanged, a calculation case with a corresponding valid Water Level Discharge Function must be entered as a basis. Furthermore, a duration curve from the Time Series and Duration Curve Manager (see **Chapter 5.3**) is selected here.

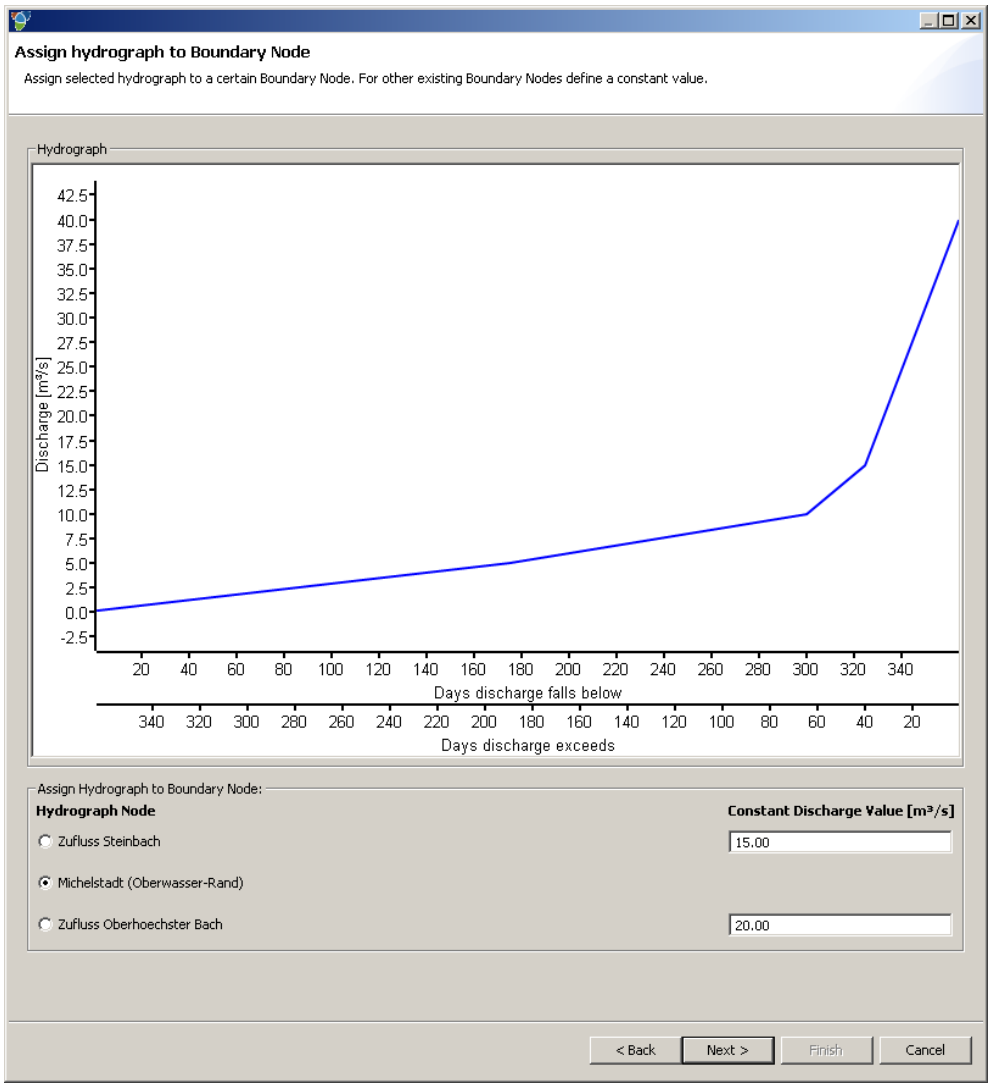


Fig. 7.6.3-2: Assignment of the duration curve

In the second dialog box (see **Figure 7.6.3-2**), the selected duration curve is displayed as a graph. The parallel x-axes support both possible interpretations of the duration curve, as representation of the duration of the discharge shortfall (upper axis) and the exceedance (lower axis).
The Time Series Connection Node with Discharge Hydrograph for which the duration curve shall apply must be selected from the list below. For this purpose, the node that is characterized by the represented duration curve should be chosen (generally the main river). For the remaining (lateral tributary) nodes, a constant value for the discharge must be entered.

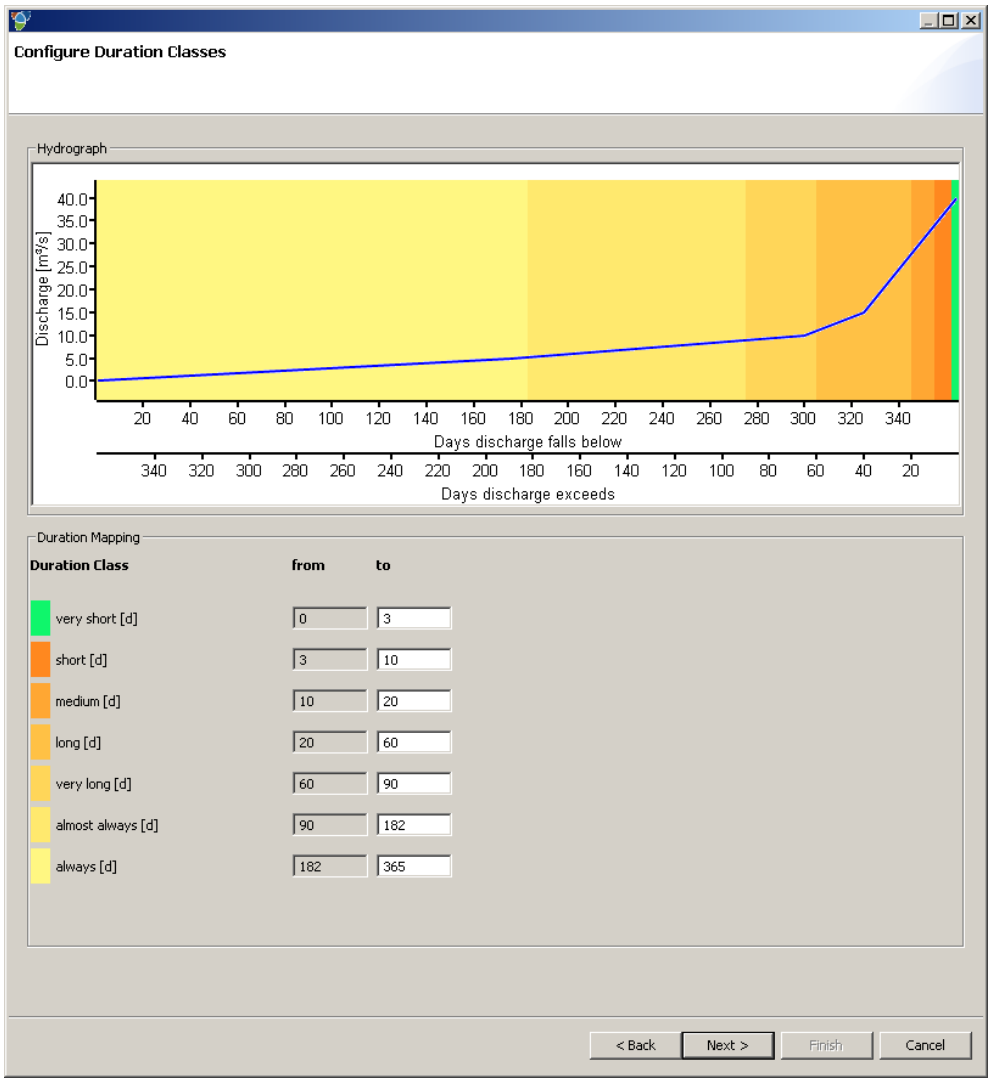


Fig. 7.6.3-3: Configuration of the interval upper limits for the duration classes

Definition of the interval upper limits for the individual duration classes then takes place (see **Figure 7.6.3-3**). For an overview, the corresponding time intervals are color-coded in the graph above.

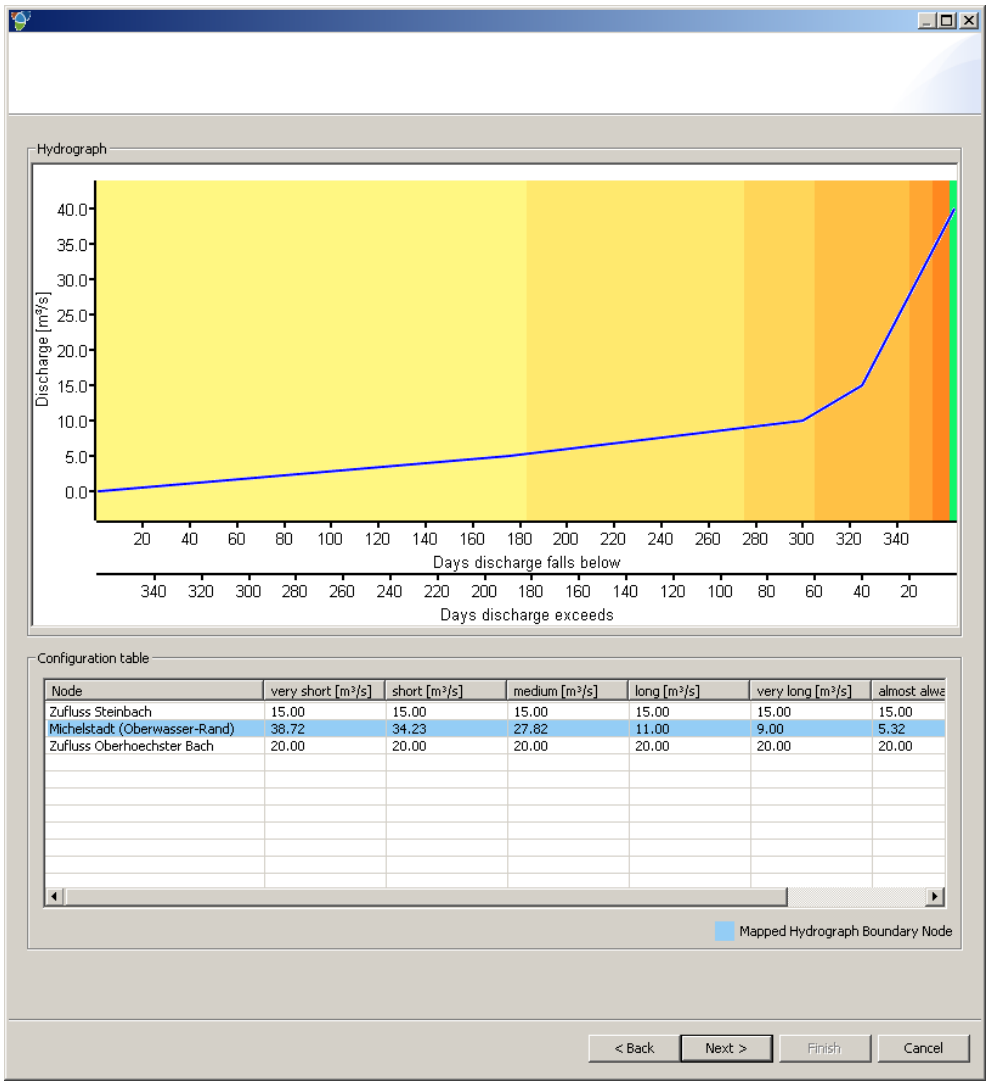


Fig. 7.6.3-4: Overview of the discharge values to be used

In the following dialog box (see **Figure 7.6.3-4**), the input and ascertained discharge values clearly compiled. Along with the Diagram View from the previous dialog box, there is a table that contains the discharge values for each of the Time Series Connection Nodes with Discharge Hydrographs and for each of the duration classes. The table shows the nodes for which the values could be extracted from the duration curve highlighted in blue. Analogous to the fixed quantity of duration classes, a total of seven quasi-stationary hydraulic calculations are defined.

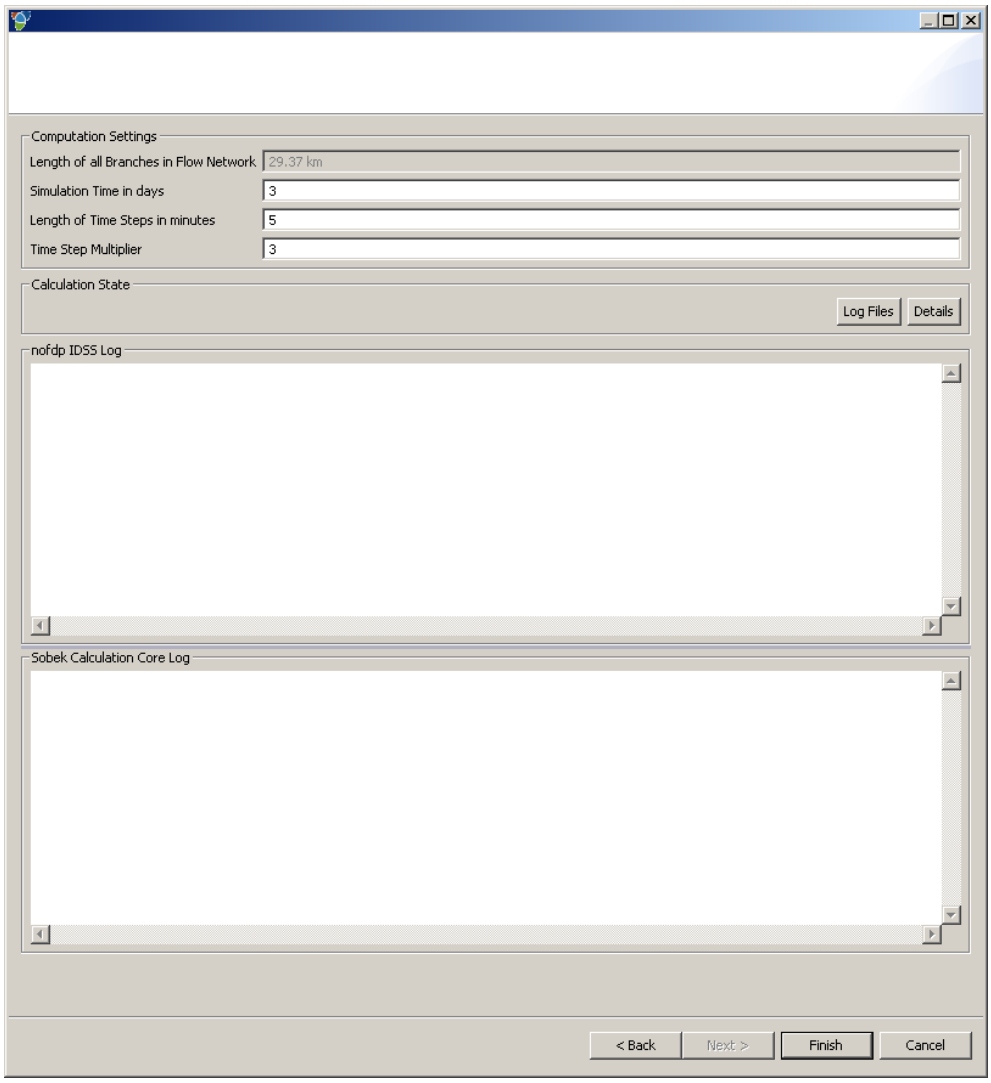


Fig. 7.6.3-5: Start of the computation

In the last dialog box (see **Figure 7.6.3-5**), settings for simulation computation must be made. These settings correspond to those for a calculation case definition (see **Chapter 5.4.6**). For the needed simulation duration [d], an estimate is suggested based on the length of the water network. The simulation durations should be selected such that, in the final state of the calculation, quasi-stationary conditions are reached.

After beginning the procedure with Finish, a calculation prepared and executed for each duration class. In order to avoid numerical instabilities, the Discharge Hydrographs that are used by the (quasi steady state) hydraulic calculations are not generated as constant hydrographs but given a linear rise.

Hint:
Seven complete hydraulic calculations are executed in batch mode. Depending on the size of the hydraulic model as well as the resolution of the elevation model, corresponding computing times must be anticipated.

In this dialog box of the wizard, the progress, details and log files for the individual calculations can be viewed, as with the hydraulic calculation (see **Chapter 7.4**).

After completion of each calculation, for the corresponding duration class, the water level of the last interval (time step) is used to ascertain the spatial extent (inundation area) using the cross section geometries and elevation model belonging to the Flow Network.

Subsequently, the overall result is generated by intersecting the inundation areas of the duration classes with one another. In a final step, the overall result is inserted into the map.

Navigation within the map and the procedure for loading new topics, as well as the activation of individual layers in the map takes place according to the procedures and conventions as described in **Chapter 3.4**. After activating i in the Map View toolbar, the duration class is displayed as a context window when moving the mouse across the map.

The generated geodata can be integrated into the nofdp IDSS database with  . This procedure is supported by a wizard (see **Chapter 3.4**).

8 VARIANT EVALUATION

The evaluation of individual planning variants makes an important contribution to the decision-making process. The individual methods implemented as part of the nofdp IDSS are presented below.

8.1 Ranking Determination

In determining the ranking order, a comparison of the advantages and disadvantages for the project variants can be made. Fig. 8.1-1 shows an example for the ranking order determination.

On the basis of these comparisons, the user can establish a ranking for the project variants according to his or her own perception. A comparison of the advantages and disadvantages of the individual variants can be made in terms of *ecological*, *economic*, *legal*, *political*, *socio-cultural* and *technical* categories.

The topics can be selected from a list. This list is found in the lower left part of the window. All topics can be selected with Check all and all can be deselected with Uncheck all. No previously entered text is lost in the process of selection and de-selection. It solely serves to improve clarity for the comparison of individual variants with regard to chosen topics.

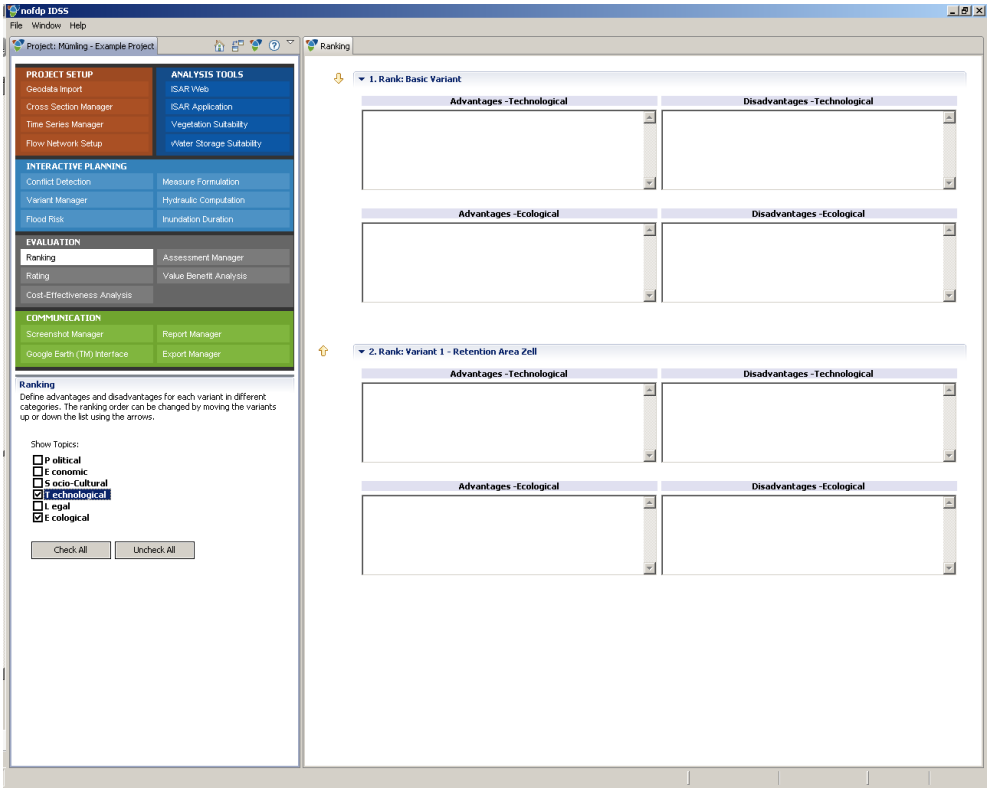


Fig. 8.1-1: Ranking determination

A comparison of the advantages and disadvantages for chosen topics of individual variants is made in the right area of the window. For each variant, the topic descriptions can be separately hidden with ▾ and subsequently displayed again with ▸. The variants are identified by a descriptive title in the heading. The ranking is also identified in the heading, preceding the variant's title. By clicking on ⇩, the respective variant is moved down one position in the ranking; by clicking on ⇧, the respective variant is moved up one position in the ranking.

8.2 Rating Scales

Rating scales are defined in two steps. First, an assessment scale must be defined or selected. Additional criteria can then be added successively to this scale. The rating scales are selected in the lower left part of the window.

A new assessment template can be generated with ✚. A wizard appears, in which a name and description (metadata) can be assigned. Lastly, labels for the tabular depiction of the assessment template, which is displayed for the user in the right half of the window, can be individually defined. If no entries are made, the table headings are labeled as shown in Fig. 8.2-1 by default. The new template subsequently appears in the existing template list. With ✎, the metadata for the respective templates can be edited, ⧉ duplicates the selected template and ✖ deletes it. A template that is currently open cannot be deleted. An assessment template can be opened by clicking on the 🗎 icon; thereupon the template is opened (🕮) and the associated criteria are displayed on the right side of the window. All modifications to the assessment template are saved.

New assessment criteria can be fed into the project specific pool by activating ✚ under criteria. A wizard appears, with which the type of criteria must first be defined: measure (), cost (€) or variant (). Then a name, a brief description and the units for the criterion (e.g. Euro, cm, ha) must be defined. An aggregate function (sum or mean value) must also be selected in the case of a measure or cost criterion. The new assessment criterion subsequently appears in the existing criteria list.

The metadata for the selected criterion can be modified with ✎. The previously defined criteria assignment cannot however be subsequently modified. ⧉ duplicates the selected criterion and ✖ deletes it.

In the right part of the window, the assessment template and the defined variants are displayed one below another. Each of these entries can be collapsed to a single line with ▾ and then fully expanded again with ▸.

The assessment templates are created successively by the user. As part of this process, the criteria are each assigned to three main categories, which are variously color-coded. By default, these categories are ecology (green), water (blue) and human (rot). These categories are themselves each divided again into two subcategories. By default, a distinction is made between local (lighter tone) and regional (darker tone) scales. The choice of criteria and their assignment to categories is made by choosing an entry from the criteria selection list, in the relevant area of the assessment template. In each of these lists, all the defined criteria are contained by default.

There is no limitation to the quantity of the criteria to be regarded per category. If a criterion is selected in any location, an additional criteria selection list is automatically displayed beneath.

The selected criteria are assigned line-by-line to all variants. Along with the criteria names, the color of each corresponding category is used to provide orientation. Each criterion can be removed by selecting “delete” (first entry in the selection list).

Prerequisite for a differentiated assessment is that specific measures are assigned to the defined variants in the Variant Manager (see **Chapter 7.3**). Only then can a mean value or summation of the measure-related criteria values be calculated. The measures assigned to the variants are assigned to the relevant variants column by column (see **Fig. 8.2-1**). The user can overwrite the aggregate values in the column “value.” Missing values or values deviating from the selected aggregate rule are identified with .

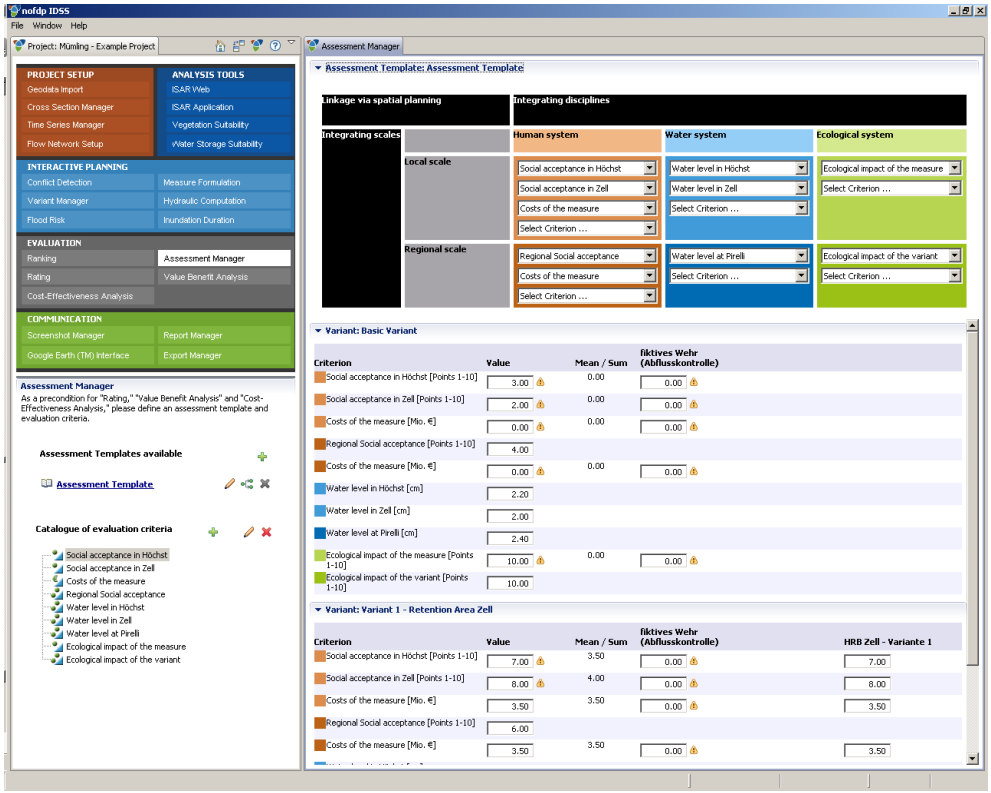


Fig. 8.2-1: Definition of rating scales

8.3 Variant Assessment

Variant assessment (see **Fig. 8.3-1**) takes place in this area on the basis of the defined assessment templates and assessment criteria, including value assignments for the individual variants (see **Chapter 8.2**). A change in these values can only take place under the heading Rating Scales (see **Chapter 8.2**).

The user first chooses an assessment template in the lower left area of the window. Then, the catalogs for this assessment template are displayed on the right side of the window. Each of these areas can be collapsed to a single line with and then fully expanded with .

In the upper area of the right side, the criteria assigned to the assessment template are displayed. There, each criterion for the selected assessment can be weighted by percentage. The weightings are automatically updated from the Value Benefit Analysis if they have been changed there (see **Chapter 8.4**). The sum of these weightings must total 100%; particular attention should be given to this requirement during input. If this criterion is not met, the symbol appears next to the weighting sum. An equal distribution of the weightings can be established using .

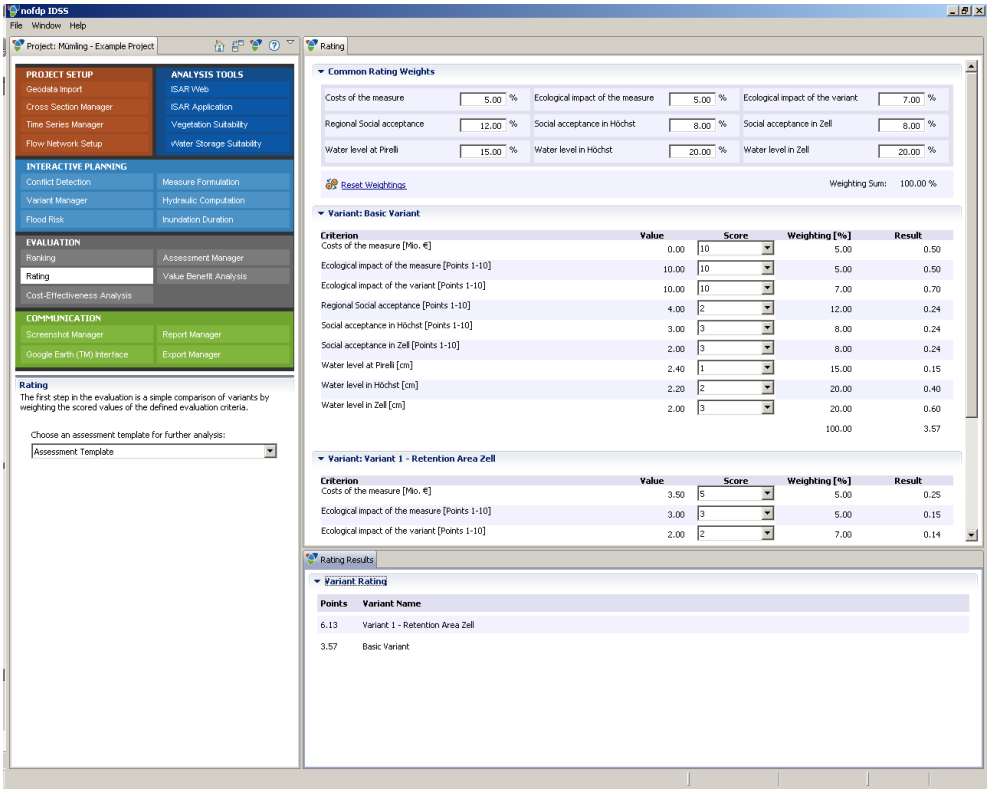


Fig. 8.3-1: Variant evaluation

The defined variants are listed below. The individual criteria are thereby assigned line-by-line to each variant. The values for these criteria are displayed for the user as defined under **Chapter 8.2**. Under “assessment,” the user can assign value between 1 and 10 from a selection list to each criterion. This valuation is automatically annotated with the associated weighting and used to calculate the total score for the variant.

The variants are listed in the lower part of the right side of the window, sorted according to their total resulting point score (ranking).

8.4 Value Benefit Analysis

Value benefit analysis (see **Fig. 8.4-1**, for methodology see **/6/**, listed in Appendix F) takes place in this area on the basis of the defined assessment templates and assessment criteria, including value assignments for the individual variants (see **Chapter 8.2**). A change in these values can only take place under the heading Rating Scales (see **Chapter 8.2**).

The user first chooses an assessment template in the lower left area of the window. Then, the catalogs for value benefit analysis are displayed on the right side of the window. Each of these areas can be collapsed to a single line with ▾ and then fully expanded with ▸.

The comparison of individual variants is made with bar charts. The variants are identified there by an abbreviation code. A legend of these abbreviations is found in the lower left area of the window.

In the upper area of the right side, the criteria assigned to the assessment template are displayed. There, each criterion for the selected assessment can be weighted by percentage. The weightings are automatically adopted from the variant evaluation (see **Chapter 8.3**). The sum of these weightings must total 100 %; particular attention should be given to this requirement during input. If this criterion is not met, , a ⊗ symbol appears next to the sum of the weightings. Using ⚙, an equal distribution of the weightings can be established.

For each criterion contained in the chosen assessment template, a particular weighting function can be defined. The value benefit functions are defined in a table using nodal pairs (x-coordinate and weighting function value). The path of each curve is shown at the right, next to the tabular function registry. For this criterion, in the right part of this section, the utility values for the differing variants are compared and contrasted in a bar chart. Both the linear graphic and the bar chart can each be enlarged in a separate window by using ⊞ .

When defining the function, attention must be given to ensure that the weighting function values are between 1 and 10. Furthermore, the x-coordinate values must include the entire spectrum of the appraisals for the respective criterion (see **Chapter 8.2**).

By selecting the “display variant evaluation ” checkbox, the utility value for the respective criterion is displayed from the variant evaluation as point scores in the value benefit function depiction (unweighted utility values). Furthermore, the weighted utility values from the variant evaluation (see **Chapter 8.3**) and the results from the value benefit analysis for the individual criteria are compared.

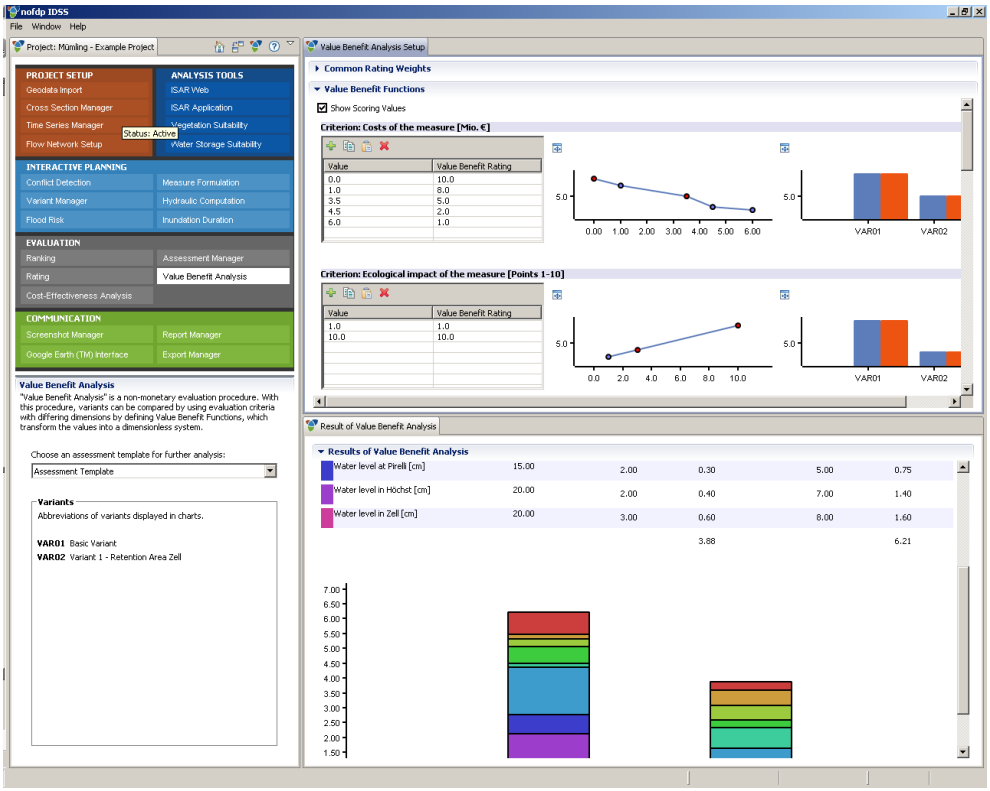


Fig. 8.4-1: Value benefit analysis

In the lower part of the right window, the variants are compared with regard to their total utility value in respect to the individual criteria. The criteria are displayed using differentiated colors. A legend defining the color assignments for the criteria is displayed in the upper area.

8.5 Cost-Effectiveness Analysis

Lastly, cost-effectiveness analysis (see **Fig. 8.5-1**) is conducted on the basis of the defined assessment templates and assessment criteria, including value assignments for the individual variants (see **Chapter 8.2**) and for the implemented value benefit analysis (see **Chapter 8.4**).

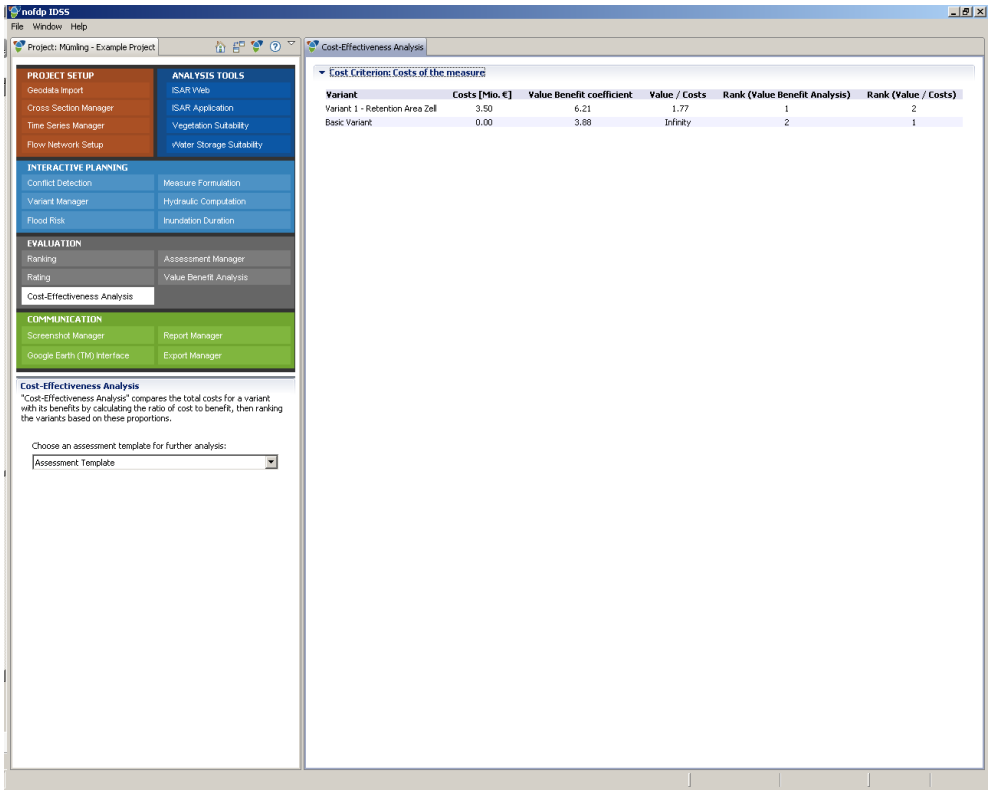


Fig. 8.5-1: Cost-effectiveness analysis

The user chooses an assessment template in the lower left area of the window. On the right side of the window, the costs, utility values and the cost-effectiveness ratios for the individual variants are then displayed. Rankings of the variants, on the basis of the ascertained utility values and the cost-effectiveness ratios, are displayed in the last two columns. These ascertained rankings can possibly differ from one another.

9 COMMUNICATION

Ultimately, the nofdp IDSS offers a series of possibilities to prepare, in the respective technical context, and export intermediate and final results that have been generated in the project. These functions are explained below.

9.1 Screenshot Manager

In the course of the project execution, individual graphics of the maps, images of cross sections and business graphics can be created as screenshots and collected. These screenshots contain a designation and can be tagged with a brief description. They are collected centrally and the Screenshot Manager enables access to these images.

The existing screenshots are displayed for the user in a list in the lower left area of the Screenshot Manager window and divided by functional areas (see Fig. 9.1-1). A screenshot is opened by clicking on the icon; the icon then changes to , indicating that the file is open. The images are displayed in the upper right area of the window. In the lower part of the right window area, the metadata (*Designation*, *Brief Description*, *Creation Date*) belonging to the screenshot are displayed.

With , all metadata for the selected screenshot can be modified with the exception of the creation date. deletes the selected screenshot. The Data Export area offers possibilities for export of the screenshot (see Chapter 9.4).

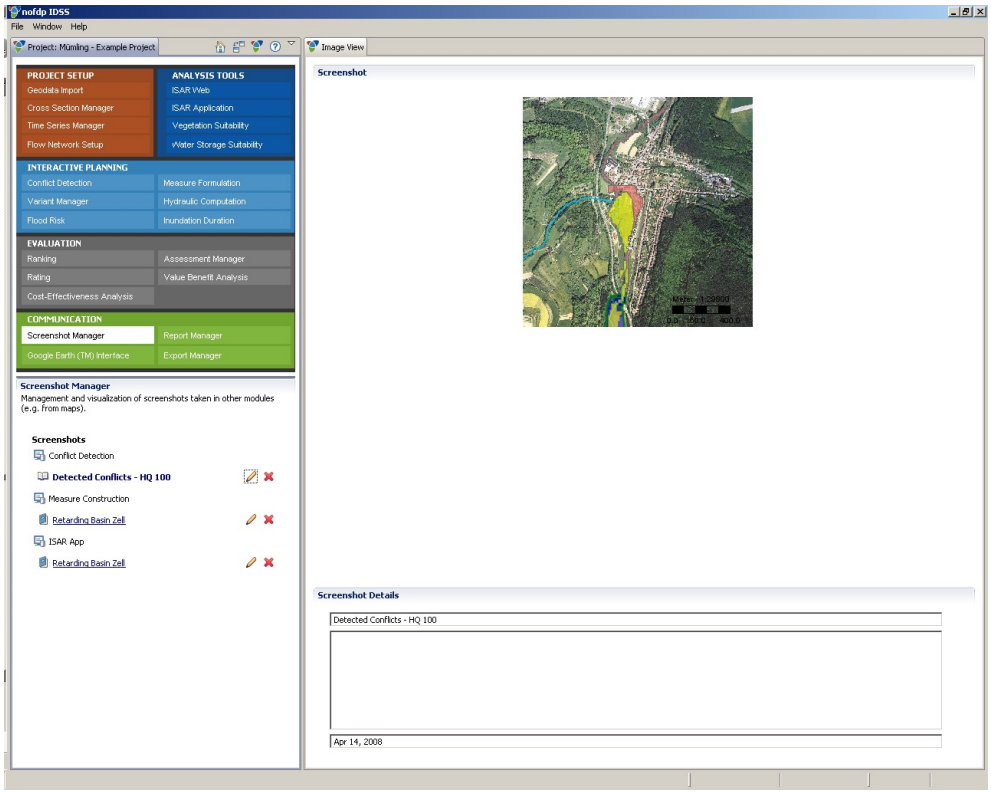


Fig. 9.1-1: Screenshot Manager

9.2 Google Earth™ Interface

The nofdp IDSS is supplied with an interface to Google Earth™.

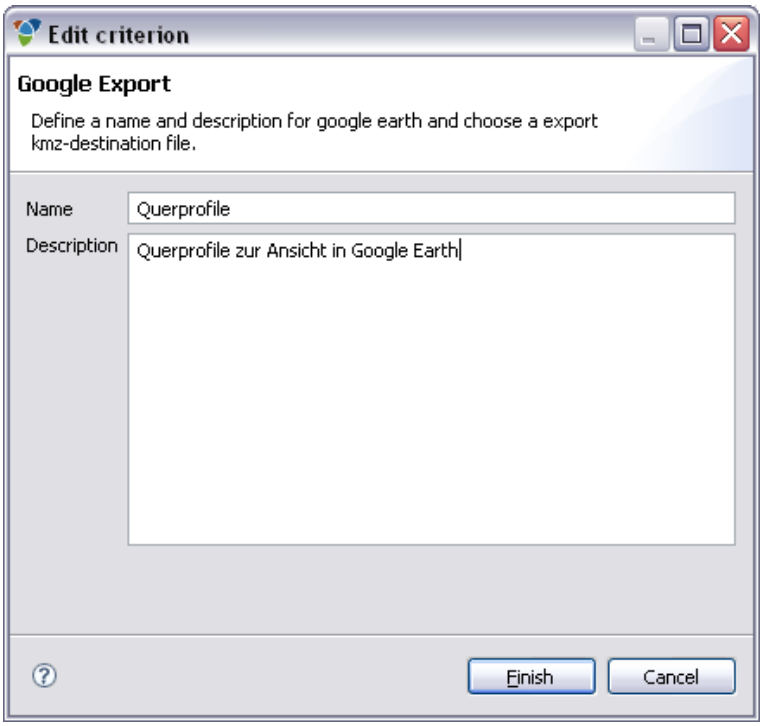


Fig. 9.2-1: Example for the definition of Google Earth™ Export in the nofdp IDSS

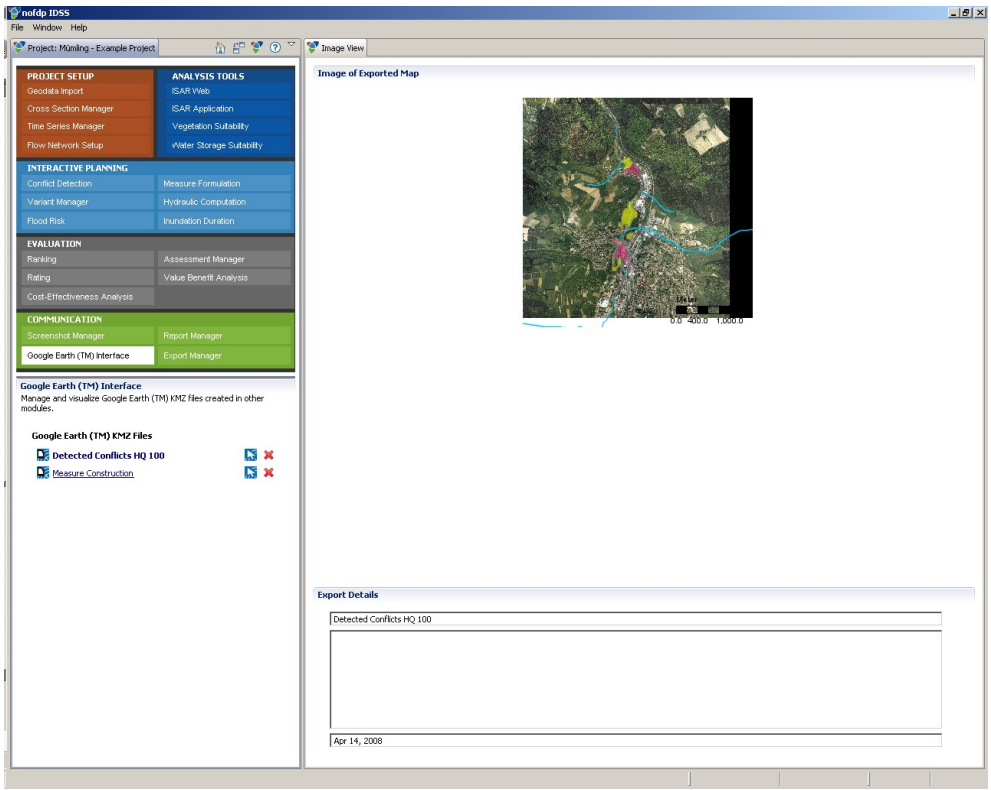


Fig. 9.2-2: Google Earth™ Interface

In each map, the map topics can be exported as KMZ files. This process is initiated by using the tool. After entering a name and a description (see Fig. 9.2-1 and Fig. 9.2-2), the KMZ file and a preview image are created and stored.

The Google Earth™ interface can be invoked using the navigation. Beneath the navigation, a list of the KMZ files available in the project is maintained. With a click on the name, the preview image is displayed on the right side of the window. The file can be deleted using and with , the file can be opened in Google Earth™ (see Fig. 9.2-3). This requires an installation of Google Earth™ (see Chapter 2.3.3).

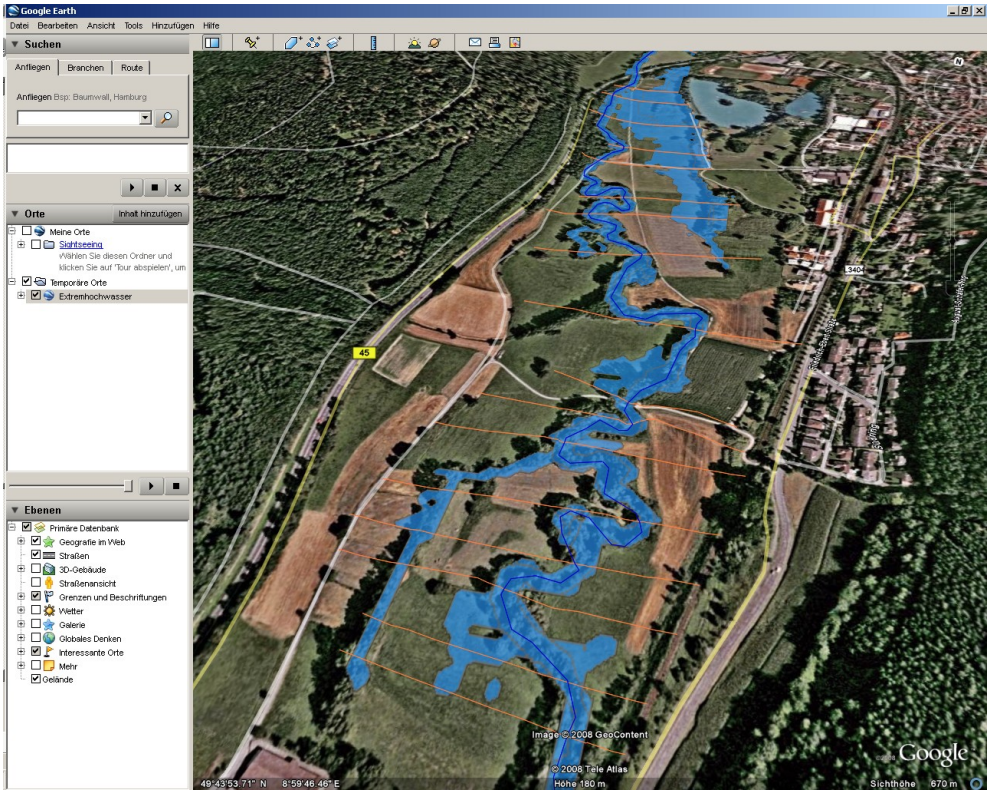


Fig. 9.2-3: Depiction of floodwater in Google Earth™

9.3 Report Manager

Report Manager enables user-specific creation of project reports. Fig. 9.3-1 shows the Report Manager window. Previously defined reports are displayed here as a list in the lower left part of the window.

Existing reports are opened by clicking on the icon. The report is then opened in OpenOffice.org (see Fig. 9.3-2), and the icon changes to , indicating that the file is open. With , the selected report can be deleted.

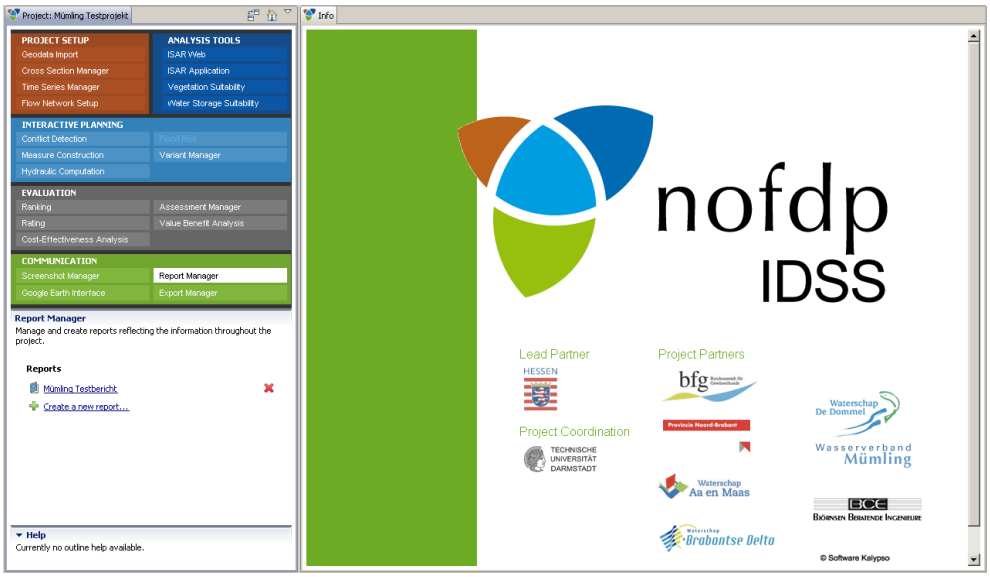


Fig. 9.3-1: Report Manager

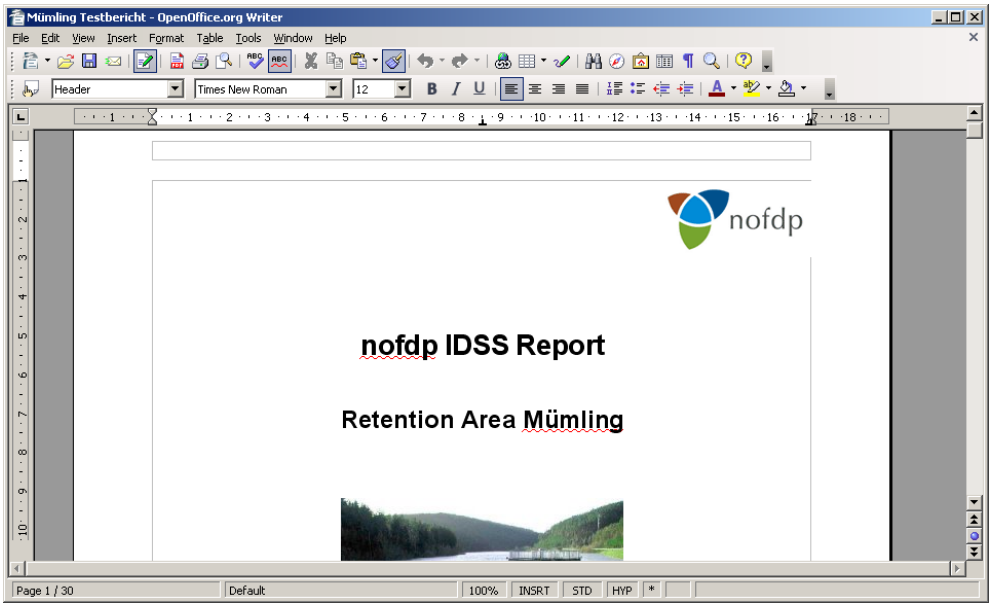


Fig. 9.3-2: Project Report in OpenOffice

A new report is created with ✚. A wizard appears (see **Fig. 9.3-3**), in which a name and a brief description (metadata) for the report can be entered. Furthermore, the variants that are to be included in the report (lower left area) as well as the individual parts of the report (right area) are selected there. Select all selects all the variants displayed in the list, whereas Deselect all deselects all the entries in the list. The report consists of individual parts, which can be selected from a report list (see **Fig. 9.3-3** right side). This is arranged into the areas *General Project Details*, *Measure Formulation*, *Variant Manager*, *Evaluation Manager* and *Maps*. The desired parts of the report can selected (☑) and deselected (☐).

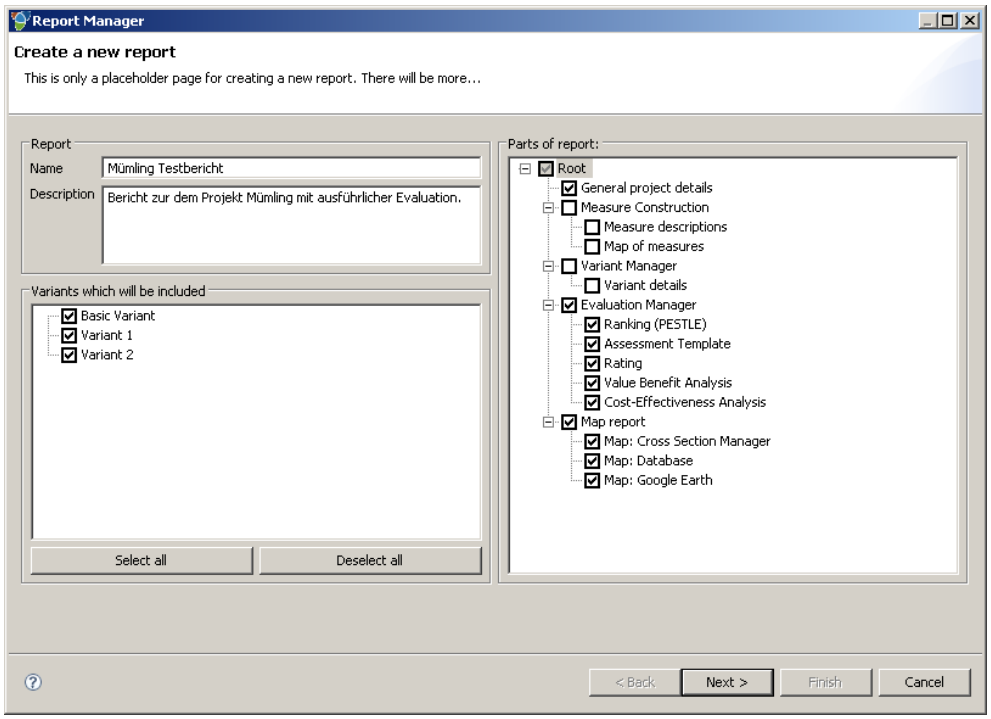


Fig. 9.3-3: Definition of Project Report, page 1

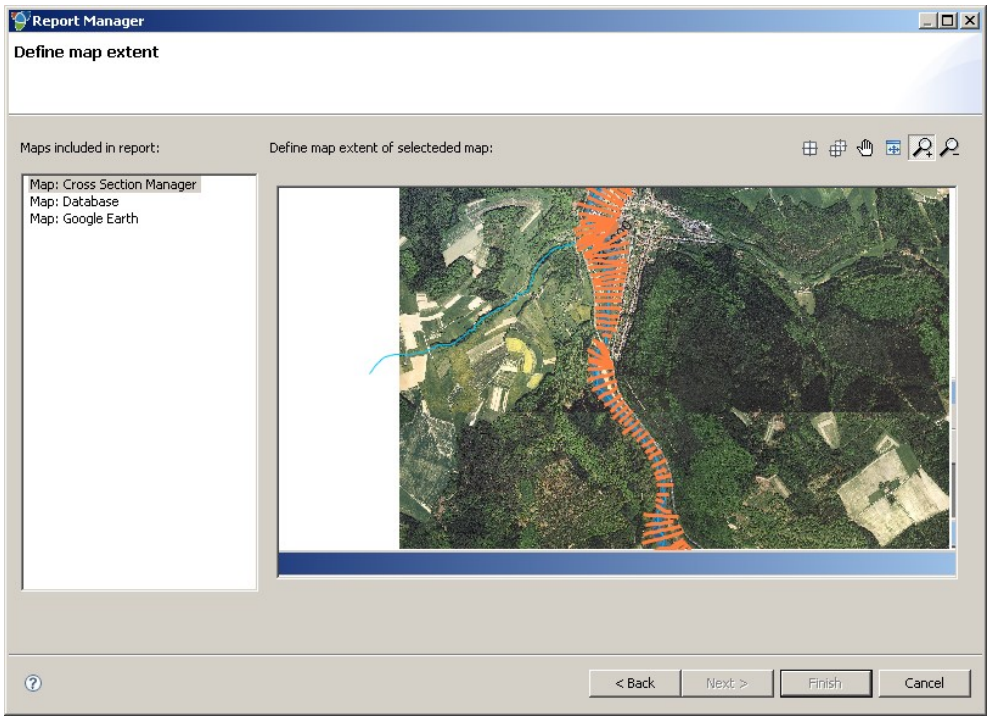


Fig. 9.3-4: Definition of Project Report, page 2

In the second page of the wizard, the areas to be displayed for the selected maps are selected (see **Fig. 9.3-4**). Attention should thereby be given to ensure that an area of view is chosen for each of these maps. Navigation in the map takes place according to the procedures and conventions as described in **Chapter 3.4**. With , the currently displayed area of view for the selected map is selected for the report. sets the currently displayed area of view for all maps simultaneously. Appropriate mes-

sages are shown in the header. Afterwards, the generated report is added to the report list. From there, it can be opened using OpenOffice, as described above.

9.4 Export Manager

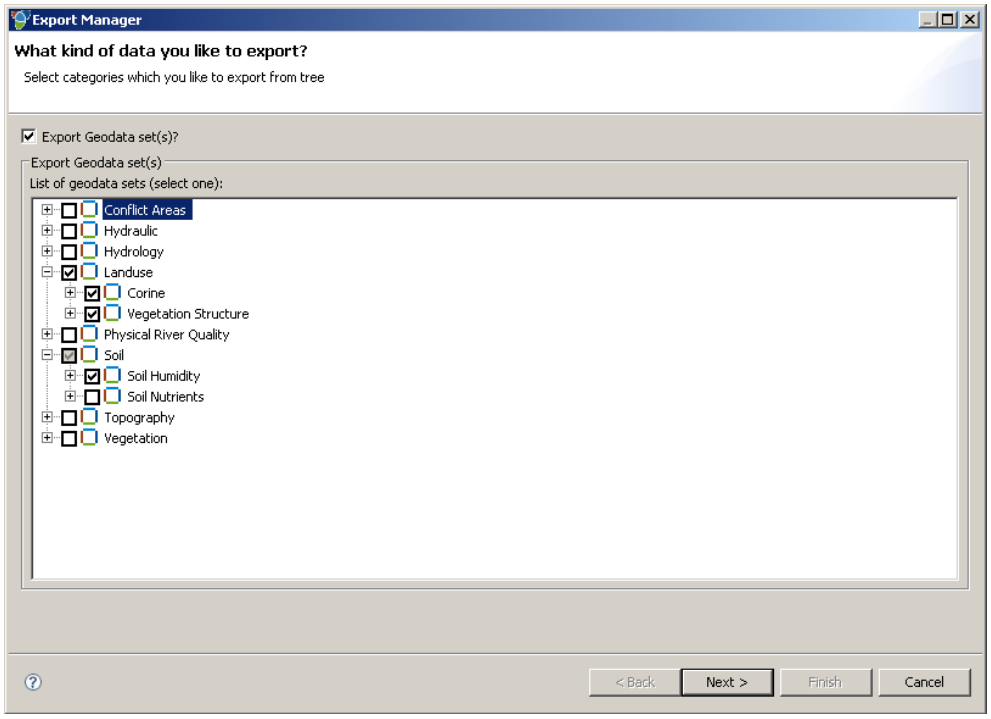


Fig. 9.4-1: Export of geodata

The Data Export function enables the compact export of user-selected data belonging to the nofdp IDSS project that is currently open. This function is initiated with Export data.... A wizard appears, in which exportable data can be selected one after another by the user.

The exported data will be placed into a archive (Format ZIP). The user defines name and place of the archive.

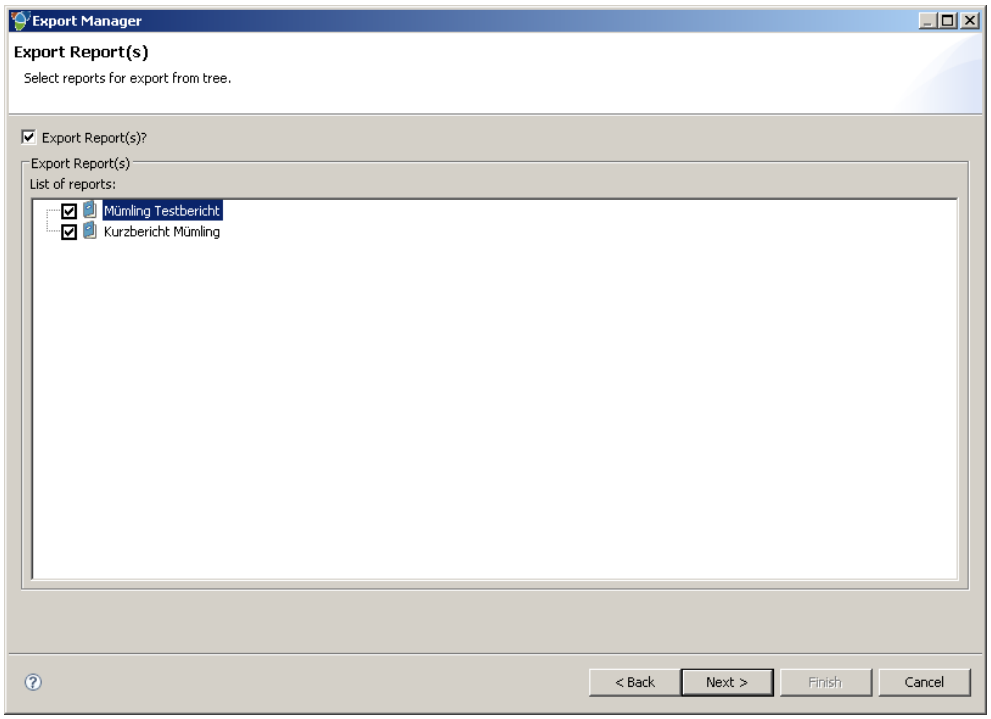


Fig. 9.4-2: Export of project reports

Fig. 9.4-1 and Fig. 9.4-2 show examples for the procedure of defining geodata exports from the project geodata list and the report list. For each data type (e.g. geodata, existing project reports, Google Earth™ GMZ files and screenshots), in the upper area of the selection window individually with ☑ is to be selected, whether data of this type should be exported. The databases to be exported can only then first be selected for export: ☑ indicates selected data sets and ☐ indicates unselected or deselected data sets.

The following export options are available:

- **Geodata**: Geodata within the nofdp IDSS geodata database can be exported. Geodata are exported depending on their position in the geodata tree.

- **SOBEK PI Flow Network Model**: The Flow Network is exported as a SOBEK PI Model.

- **Results of Hydraulic Computation**: All results of the hydraulic computation can be exported. This is done by selecting calculation cases. All results are exported into corresponding CSV tables.

- **Project Reports**: Project Reports are exported as Word-, OpenOffice.org and PDF documents.

- **Google Earth™ KMZ Files**: Google Earth™ KMZ archives are exported by the Export Manager.

APPENDIX A: GEOGRAPHIC COORDINATE SYSTEMS AND PROJECTIONS

The following ***geographic coordinate systems*** are supported by the nofdp IDSS:

Designation	EPSG Identifier [1)]
Amersfoort	4289
ATF (Paris)	4901
Belge 1950	4215
Belge 1950 (Brussels)	4809
Belge 1972	4313
Bern 1898 (Bern)	4801
Bern 1938	4306
CH1903	4149
CH1903+	4150
DHDN (Bessel, RD/83)	4314
ETRS89	4258
Luxembourg 1930	4181
NTF	4275
NTF (Paris)	4807
RGF93	4171
WGS84	4326

The following ***projections*** can be used in the nofdp IDSS:

Designation	EPSG Identifier [1)]
Amersfoort / RD New	28992
Amersfoort / RD Old	28991
ATF (Paris) / Nord de Guerre	27500
Belge 1950 (Brussels) / Belge Lambert 50	21500
Belge 1972 / Belge Lambert 72	31300
Belge 1972 / Belgian Lambert 72	31370
DHDN / Gauss-Kruger zone 2	31466
DHDN / Gauss-Kruger zone 3	31467

Designation	EPSG Identifier [1)]
DHDN / Gauss-Kruger zone 4	31468
DHDN / Gauss-Kruger zone 5	31469
ETRS89 / ETRS-LAEA	3035
ETRS89 / ETRS-LCC	3034
ETRS89 / UTM zone 31N	25831
ETRS89 / UTM zone 32N	25832
ETRS89 / UTM zone 33N	25833
Luxembourg 1930 / Gauss	2169
NTF (Paris) / Centre France (deprecated)	27592
NTF (Paris) / Corse (deprecated)	27594
NTF (Paris) / France I (deprecated)	27581
NTF (Paris) / France II (deprecated)	27582
NTF (Paris) / France III (deprecated)	27583
NTF (Paris) / France IV (deprecated)	27584
NTF (Paris) / Lambert Centre France	27562
NTF (Paris) / Lambert Corse	27564
NTF (Paris) / Lambert Nord France	27561
NTF (Paris) / Lambert Sud France	27563
NTF (Paris) / Lambert zone I	27571
NTF (Paris) / Lambert zone II	27572
NTF (Paris) / Lambert zone III	27573
NTF (Paris) / Lambert zone IV	27574
NTF (Paris) / Nord France (deprecated)	27591
NTF (Paris) / Sud France (deprecated)	27593
RGF93 / Lambert-93	2154
WGS 84 / UTM zone 31N	32631
WGS 84 / UTM zone 32N	32632
WGS 84 / UTM zone 33N	32633
OSGB 1936 / British National Grid	27700
OSGB 1936	4277

Designation	EPSG Identifier [1)]
OSGB70	4278

[1)] The EPSG (European Petroleum Survey Group) established a register of coordinate reference systems and descriptions of coordinate transformations, the EPSG Geodetic Parameter Data Set, which is now maintained by the OGP Surveying and Positioning Committee. The EPSG Identifiers corresponding to each coordinate reference system in this registry are also used within the specifications of the Open Geospatial Consortium (OGC).

APPENDIX B: DESCRIPTION OF GEODATA SETS AND FORMATS

Hint:
In the nodfp IDSS, each shape file with a polygon shape type can be intersected with others, already imported shape files having the polygon shape type

The necessary files and those generated, along with the corresponding attributes and attribute characteristics, are described below:

Soil Moisture

Shapefile shape type: Polygon
Input attribute name: User-definable
Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
a	unter Wasser	Aquatic
d	trocken	Dry
m	feucht	Moist
w	nass	Wet

Soil Nutrients

Shapefile shape type: Polygon
Input attribute name: User-definable
Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
m	mittelmäßig nährstoffreich	Moderately nutrient-rich
p	nährstoffarm (und oft sauer)	Nutrient-poor (and often acidic)
r	nährstoffreich (und oft basisch)	Nutrient-rich (and often alkaline)

Duration Hydrograph (Curve)

Type ASCII File: CSV Table

Number of days with discharge below a certain value

Format description:

ASCII format, delimiter: semicolon

line 1-365: day; discharge value

- day as integer, interval [1; 365]
- discharge Q in [m³/s]

Example:

```
1;10
2;9
3;8
...
365;1
```

Type ZML file: XML

Format description:

XML-Format

Example:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<ns3:observation xmlns:ns3="zml.kalypso.org" xmlns:xlink="http://www.w3.org/1999/
xlink" editable="false">
   <ns3:name>example</ns3:name>
   <ns3:axis unit="d" type="DAY" name="day" key="true" datatype="TYPE=integer">
      <ns3:valueArray separator=";">
        365;350;335;320;305;290;275;50;35;5;2;1
      </ns3:valueArray>
   </ns3:axis>
   <ns3:axis unit="m³/s" type="Q" name="Discharge" key="false"
    datatype="TYPE=double">
      <ns3:valueArray separator=";">
        40.0;37.0;35.0;30.0;28.0;22.0;17.0;10.0;5.0;4.0;3.0;1.0
      </ns3:valueArray>
   </ns3:axis>
</ns3:observation>
```

Digital Terrain Model

Geometry type for ASCII file: ASCII_GRID

Format description:

- ASCII format
- HEADER
  - NCOLS xxx
  - NROWS xxx
  - XLLCENTER xxx | XLLCORNER xxx
  - YLLCENTER xxx | YLLCORNER xxx
  - CELLSIZE xxx
  - NODATA_VALUE xxx
- Values
  - Line 1
  - Line 2
  - ...
  - Line n

Example:

```
NCOLS 480
NROWS 450
XLLCORNER 378923
YLLCORNER 4072345
CELLSIZE 30
NODATA_VALUE -32768
43 2 45 7 3 56 2 5 23 65 34 6 32 54 57 34 2 2 54 6
35 45 65 34 2 6 78 4 2 6 89 3 2 7 45 23 5 8 4 1 62 ...
```

NODATA_VALUE designates the value in the ASCII file that is used for “no data.” Each line ends with a line break. The values can either be the *integer* or *float* type.

Drainage Network

Shapefile shape type: PolyLine

Input attribute name: User-definable

Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
2	Gewässer der Klasse 2	Class 2 river
3	Gewässer der Klasse 3	Class 3 river
4	Gewässer der Klasse 4	Class 4 river
5	Gewässer der Klasse 5	Class 5 river
6	Gewässer der Klasse 6	Class 6 river
7	Gewässer der Klasse 7	Class 7 river

Physical River Quality

Shapefile shape type: PolyLine

Input attribute names: User-definable for the following five attributes:

Gewässerlauf, Sohlerosion, Regelprofil and Sohlenverbau, Gewässerdurchgängigkeit, Uferverbau

Input attribute data type: char

Result attribute names: (predefined) ***NOFDP_DEF, NOFDP_MEA1, NOFDP_MEA2, NOFDP_MEA3, NOFDP_MEA4, NOFDP_MEA5, NOFDP_DES1, NOFDP_DES2, NOFDP_DES3, NOFDP_DES4, NOFDP_DES5***

Result attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
0	kein Defizit	No deficit
1	Defizit	Deficit

Conflict Detection

Shapefile shape type: Polygon

Result attribute name: (predefined) ***CONFLICT***

Result attribute data type: char

Characteristics of the attribute CONFLICT:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
not yet considered	noch nicht betrachtet	Not yet considered
very_high	sehr hoch	Very high
high	hoch	High
medium	mittel	Medium
low	gering	Low
none	kein	None
To be considered individually	Im Einzelfall zu prüfen	To be examined individually

CORINE Land Use[1]

Shapefile shape type: Polygon

Input attribute name: User-definable

Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
111	Flächen durchgängig städtischer Prägung	Continuous urban fabric
112	Flächen nicht-durchgängig städtischer Prägung	Discontinuous urban fabric
121	Industrie- and Gewerbeflächen	Industrial or commercial area
122	Straßen and Eisenbahn	Roads and Railways
123	Hafengebiete	Harbor areas
124	Flughäfen	Airports
131	Abbauflächen	Mineral extraction sites

[1] Further information concerning CORINE http://reports.eea.europa.eu/search_results?type=search&SearchTitle=corine&Submit2=Search

Attribute Value	German Denotation	English Denotation
132	Deponien and Abraumhalden	Dump sites and slag heaps
133	Baustellen	Construction sites
141	Städtische Grünflächen	Urban green space
142	Sport and Freizeitanlagen	Sport and Leisure facilities
211	Nicht bewässertes Ackerland	Non-irrigated arable land
212	Permanent bewässertes Ackerland	Permanently irrigated arable land
213	Reisfelder	Rice fields
221	Weinbauflächen	Vineyards
222	Obst- and Beerenobstbestände	Fruit and Berry trees/bushes
223	Olivenhaine	Olive groves
231	Wiesen and Weiden	Meadows and Pastures
241	Mischung einjähriger Früchte mit Dauerkulturen	Mixture of annual fruits and perennial crops
242	Komplexe Parzellenstrukturen	Complex cultivation patterns
243	Landwirtschaft mit natürlicher Bodenbedeckung	Agriculture with natural canopy vegetation
244	Agrarforstlich genutzte Flächen	Agroforestry areas
311	Laubwald	Deciduous forest
312	Nadelwald	Coniferous forest
313	Mischwald	Mixed forest
321	Natürliches Grasland	Natural grasslands
322	Heiden and Moorheiden	Moors and Heath
323	Hartlaubgewächse	Sclerophyllous vegetation
324	Wald-Strauch-Übergangsstadien	Transitional woodland shrub
331	Strände, Dünen and Sandflächen	Beaches, Dunes and Sands
332	Felsflächen ohne Vegetation	Bare rocks
333	Flächen mit spärlicher Vegetation	Sparsely vegetated areas
334	Brandflächen	Burnt areas
335	Gletscher and Dauerschneegebiete	Glaciers and Regions with perpetual snow
411	Sümpfe	Swamps/marshes
412	Torfmoore	Peat bogs
421	Salzwiesen	Salt marshes
422	Salinen	Saltworks
423	In der Gezeitenzone liegende Flächen	Intertidal flats
511	Gewässerläufe	Water courses
512	Wasserflächen	Water bodies

Attribute Value	German Denotation	English Denotation
521	Lagunen	Lagoons
522	Mündungsgebiet	Estuaries
523	Meere and Ozeane	Seas and Oceans
999	Flächen außerhalb des Bearbeitungs-gebietes	Areas beyond the area of examination

Vegetation Structure Land Use

Shapefile shape type: Polygon
Input attribute name: User-definable
Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
A	amphibische Vegetation	Amphibious Vegetation
B	Gebüsch	Scrubland
F	Wald	Woodland
G	Grasland	Grassland
P	Pioniervegetation	Pioneer Vegetation
R	Stauden, hohe Ruderalvegetation	Bushes, Tall ruderal vegetation
W	Wasservegetation	Aquatic Vegetation

Measure Areas

Shapefile shape type: Polygon

Input attribute name: User-definable

Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
POL	Polder	Polder
RBA	Rückhaltebecken	Retarding Basin
FEX	Vorlandabgrabung, Abgrabung im Überschwemmungsgebiet	Foreshore Excavation
WEI	Wehr	Weir
FPL	Vorlandvertiefung	Floodplain Lowering
RRL	Veränderung des Fließquerschnitts	Riverbank Relocation
REC	Änderung der Sohlhöhe	Riverbed Elevation Change
OBR	Entfernen von Fließhindernissen	Obstacle Removal
DIV	Ableitung von Hochwasserabflüssen, Umflut	Diversion
DRO	Deichrückverlegung – Altdeich Geometrie	Dike Relocation – old dike geometry
DRN	Deichrückverlegung – Neudeich Geometrie	Dike Relocation – new dike geometry
FEW	Erdwall im Vorland, Querverwallung	Floodplain Earth Wall
MOW	Mobile Hochwasserschutzwand	Mobile Floodwall
DIK	Deichbau	Construction
ECO	Ökologische Überflutung	Ecological Flooding
BUS	Uferrandstreifen	Buffer Strip
MEA	Remäandrierung	Remeandering
AFO	Angepasste Forstwirtschaft	Adapted Forestry
FFO	(Au)Waldentwicklung	Floodplain Reforestration
AUL	Adapted Urban Landuse	Adapted Urban Landuse
ZPM	Änderung im Flächennutzungsplan	Zoning Plan Modification
ULP	Reduktion des Schadenspotentials eines Hochwasserereignisses im städtischem Gebiet	Urban Landuse Planning

Cross Section Data

ASCII file geometry type: Point

Format description:

ASCII format, with semicolon as delimiter
Line 1: Header, without format (this line is ignored)
From line 2: Station; X coordinate; Y coordinate; Height

Example:

```
PROFIL_KM;POINT_X;POINT_Y;HH
27.057;499469.2436;5508423.55;190.092
27.057;499482.1424;5508421.045;188.936
27.057;499487.2864;5508421.175;188.936
27.057;499496.8875;5508417.63;187.414
```

Saline Concentration

Shapefile shape type: Polygon
Input attribute name: User-definable
Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
b	brackig	Brackish
s	salzig	Saline
-	frisch	Fresh

Floodplain Areas

Shapefile shape type: Polygon
Input attribute name: User-definable
Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	no data
flood plain depression	Senke am oberen Rand der Talaue	depression near the upper flood plain margin
flood plain margin	oberer Randbereich der Talaue	flood plain margin
levee	Uferwall (Uferrehne) oft sandig und trocken	levee mostly sandy and dry
river bank	Flussufer über Mittelwasser	river bank above mean water level
shoreline	am Ufer zwischen Mittel- und Niedrigwasser	at shoreline between mean and low water level
shoreline depression	Senke nahe dem Ufer	depression near shoreline

Inundation Area

Shapefile shape type: Polygon
Input attribute name: User-definable
Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
inundated	überflutet	Inundated
not inundated	nicht überflutet	Not inundated

Inundation Depth

Shapefile shape type: Polygon
Input attribute name: User-definable
Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
deep	tief	Deep
shallow	flach	Shallow

Inundation Duration

Shapefile shape type: Polygon
Input attribute name: User-definable
Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
almost always	fast immer	Almost always
always	immer	Always
long	lang	Long
medium	mittel	Medium
short	kurz	Short
very long	sehr lang	Very long
very short	sehr kurz	Very short

Inundation Frequency

Shapefile shape type: Polygon
Input attribute name: User-definable
Input attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht defined	No data
often	oft	Often
rarely	selten	Rarely
sometimes	manchmal	Sometimes
very often	sehr oft	Very often
very rarely	sehr selten	Very rarely

Vegetation Suitability (general)

Shapefile shape type: Polygon

Result attribute name: ***VSSMALL***

(predefined)

Result attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	no data
-	keine	none
Aab	amphibische Vegetation auf feuchten, brackigen Standorten	Amphibian vegetation on moist, brackish sites
Aam	amphibische Vegetation auf feuchten, mäßig nährstoffreichen Standorten	Amphibian vegetation on moist, moderately nutrient-rich sites
Aap	amphibische Vegetation auf feuchten, nährstoffarmen Standorten	Amphibian vegetation on moist, nutrient-poor sites
Aar	amphibische Vegetation auf feuchten, nährstoffreichen Standorten	Amphibian vegetation on moist, nutrient-rich sites
Aas	amphibische Vegetation auf feuchten, salzigen Standorten	Amphibian vegetation on moist, saline sites
Awb	amphibische Vegetation auf nassen, brackigen Standorten	Amphibian vegetation on wet, brackish sites
Awm	amphibische Vegetation auf nassen, mäßig nährstoffreichen Standorten	Amphibian vegetation on wet, moderately nutrient-rich sites
Awp	amphibische Vegetation auf nassen, nährstoffarmen Standorten	Amphibian vegetation on wet, nutrient-poor sites
Awr	amphibische Vegetation auf nassen, nährstoffreichen Standorten	Amphibian vegetation on wet, nutrient-rich sites
Aws	amphibische Vegetation auf nassen, salzigen Standorten	Amphibian vegetation on wet, saline sites
Bdm	Buschland auf trockenen, mäßig nährstoffreichen Standorten	Bushes on dry, moderately nutrient-rich sites
Bdp	Buschland auf trockenen, nährstoffarmen Standorten	Bushes on dry, nutrient-poor sites
Bdr	Buschland auf trockenen, nährstoffreichen Standorten	Bushes on dry, nutrient-rich sites
Bmb	Buschland auf feuchten, brackigen Standorten	Bushes on moist, brackish sites
Bmm	Buschland auf feuchten, mäßig nährstoffreichen Standorten	Bushes on moist, moderately nutrient-rich sites
Bmp	Buschland auf feuchten, nährstoffarmen Standorten	Bushes on moist, nutrient-poor sites

Attribute Value	German Denotation	English Denotation
Bmr	Buschland auf feuchten, nährstoffreichen Standorten	Bushes on moist, nutrient-rich sites
Bwb	Buschland auf nassen, brackigen Standorten	Bushes on wet, brackish sites
Bwm	Buschland auf nassen, mäßig nährstoffreichen Standorten	Bushes on wet, moderately nutrient-rich sites
Bwp	Buschland auf nassen, nährstoffarmen Standorten	Bushes on wet, nutrient-poor sites
Bwr	Buschland auf nassen, nährstoffreichen Standorten	Bushes on wet, nutrient-rich sites
Fdm	Wald auf trockenen, mäßig nährstoffreichen Standorten	Woodland on dry, moderately nutrient-rich sites
Fdp	Wald auf trockenen, nährstoffarmen Standorten	Woodland on dry, nutrient-poor sites
Fdr	Wald auf trockenen, nährstoffreichen Standorten	Woodland on dry, nutrient-rich sites
Fmb	Wald auf feuchten, brackigen Standorten	Woodland on moist, brackish sites
Fmm	Wald auf feuchten, mäßig nährstoffreichen Standorten	Woodland on moist, moderately nutrient-rich sites
Fmp	Wald auf feuchten, nährstoffarmen Standorten	Woodland on moist, nutrient-poor sites
Fmr	Wald auf feuchten, nährstoffreichen Standorten	Woodland on moist, nutrient-rich sites
Fwb	Wald auf nassen, brackigen Standorten	Woodland on wet, brackish sites
Fwm	Wald auf nassen, mäßig nährstoffreichen Standorten	Woodland on wet, moderately nutrient-rich sites
Fwp	Wald auf nassen, nährstoffarmen Standorten	Woodland on wet, nutrient-poor sites
Fwr	Wald auf nassen, nährstoffreichen Standorten	Woodland on wet, nutrient-rich sites
Gdb	Grasland auf trockenen, brackigen Standorten	Grassland on dry, brackish sites
Gdm	Grasland auf trockenen, mäßig nährstoffreichen Standorten	Grassland on dry, moderately nutrient-rich sites
Gdp	Grasland auf trockenen, nährstoffarmen Standorten	Grassland on dry, nutrient-poor sites
Gdr	Grasland auf trockenen, nährstoffreichen Standorten	Grassland on dry, nutrient-rich sites
Gds	Grasland auf trockenen, salzigen Standorten	Grassland on dry, saline sites
Gmb	Grasland auf feuchten, brackigen Standorten	Grassland on moist, brackish sites
Gmm	Grasland auf feuchten, mäßig nähr-	Grassland on moist, moderately nutri-

Attribute Value	German Denotation	English Denotation
	stoffreichen Standorten	ent-rich sites
Gmp	Grasland auf feuchten, nährstoffarmen Standorten	Grassland on moist, nutrient-poor sites
Gmr	Grasland auf feuchten, nährstoffreichen Standorten	Grassland on moist, nutrient-rich sites
Gms	Grasland auf feuchten, salzigen Standorten	Grassland on moist, saline sites
Gwb	Grasland auf nassen, brackigen Standorten	Grassland on wet, brackish sites
Gwm	Grasland auf nassen, mäßig nährstoffreichen Standorten	Grassland on wet, moderately nutrient-rich sites
Gwp	Grasland auf nassen, nährstoffarmen Standorten	Grassland on wet, nutrient-poor sites
Gwr	Grasland auf nassen, nährstoffreichen Standorten	Grassland on wet, nutrient-rich sites
Gws	Grasland auf nassen, salzigen Standorten	Grassland on wet, saline sites
Pdb	Pioniervegetation auf trockenen, brackigen Standorten	Pioneer vegetation on dry, brackish sites
Pdm	Pioniervegetation auf trockenen, mäßig nährstoffreichen Standorten	Pioneer vegetation on dry, moderately nutrient-rich sites
Pdp	Pioniervegetation auf trockenen, nährstoffarmen Standorten	Pioneer vegetation on dry, nutrient-poor sites
Pdr	Pioniervegetation auf trockenen, nährstoffreichen Standorten	Pioneer vegetation on dry, nutrient-rich sites
Pds	Pioniervegetation auf trockenen, salzigen Standorten	Pioneer vegetation on dry, saline sites
Pmb	Pioniervegetation auf feuchten, brackigen Standorten	Pioneer vegetation on moist, brackish sites
Pmm	Pioniervegetation auf feuchten, mäßig nährstoffreichen Standorten	Pioneer vegetation on moist, moderately nutrient-rich sites
Pmp	Pioniervegetation auf feuchten, nährstoffarmen Standorten	Pioneer vegetation on moist, nutrient-poor sites
Pmr	Pioniervegetation auf feuchten, nährstoffreichen Standorten	Pioneer vegetation on moist, nutrient-rich sites
Pms	Pioniervegetation auf feuchten, salzigen Standorten	Pioneer vegetation on moist, saline sites
Pwb	Pioniervegetation auf nassen, brackigen Standorten	Pioneer vegetation on wet, brackish sites
Pwm	Pioniervegetation auf nassen, mäßig nährstoffreichen Standorten	Pioneer vegetation on wet, moderately nutrient-rich sites
Pwp	Pioniervegetation auf nassen, nährstoffarmen Standorten	Pioneer vegetation on wet, nutrient-poor sites
Pwr	Pioniervegetation auf nassen, nährstoffreichen Standorten	Pioneer vegetation on wet, nutrient-rich sites

Attribute Value	German Denotation	English Denotation
Pws	Pioniervegetation auf nassen, salzigen Standorten	Pioneer vegetation on wet, saline sites
Rdb	Hohe Stauden, Ruderalvegetation auf trockenen, brackigen Standorten	Tall forbs, ruderal vegetation on dry, brackish sites
Rdm	Hohe Stauden, Ruderalvegetation auf trockenen, mäßig nährstoffreichen Standorten	Tall forbs, ruderal vegetation on dry, moderately nutrient-rich sites
Rdp	Hohe Stauden, Ruderalvegetation auf trockenen, nährstoffarmen Standorten	Tall forbs, ruderal vegetation on dry, nutrient-poor sites
Rdr	Hohe Stauden, Ruderalvegetation auf trockenen, nährstoffreichen Standorten	Tall forbs, ruderal vegetation on dry, nutrient-rich sites
Rds	Hohe Stauden, Ruderalvegetation auf trockenen, salzigen Standorten	Tall forbs, ruderal vegetation on dry, saline sites
Rmb	Hohe Stauden, Ruderalvegetation auf feuchten, brackigen Standorten	Tall forbs, ruderal vegetation on moist, brackish sites
Rmm	Hohe Stauden, Ruderalvegetation auf feuchten, mäßig nährstoffreichen Standorten	Tall forbs, ruderal vegetation on moist, moderately nutrient-rich sites
Rmp	Hohe Stauden, Ruderalvegetation auf feuchten, nährstoffarmen Standorten	Tall forbs, ruderal vegetation on moist, nutrient-poor sites
Rmr	Hohe Stauden, Ruderalvegetation auf feuchten, nährstoffreichen Standorten	Tall forbs, ruderal vegetation on moist, nutrient-rich sites
Rms	Hohe Stauden, Ruderalvegetation auf feuchten, salzigen Standorten	Tall forbs, ruderal vegetation on moist, saline sites
Rwb	Hohe Stauden, Ruderalvegetation auf nassen, brackigen Standorten	Tall forbs, ruderal vegetation on wet, brackish sites
Rwm	Hohe Stauden, Ruderalvegetation auf nassen, mäßig nährstoffreichen Standorten	Tall forbs, ruderal vegetation on wet, moderately nutrient-rich sites
Rwp	Hohe Stauden, Ruderalvegetation auf nassen, nährstoffarmen Standorten	Tall forbs, ruderal vegetation on wet, nutrient-poor sites
Rwr	Hohe Stauden, Ruderalvegetation auf nassen, nährstoffreichen Standorten	Tall forbs, ruderal vegetation on wet, nutrient-rich sites
Rws	Hohe Stauden, Ruderalvegetation auf nassen, salzigen Standorten	Tall forbs, ruderal vegetation on wet, saline sites
Wab	Wasservegetation auf nassen, brackigen Standorten	Waterplant vegetation on wet, brackish sites
Wam	Wasservegetation auf nassen, mäßig nährstoffreichen Standorten	Waterplant vegetation on wet, moderately nutrient-rich sites
Wap	Wasservegetation auf nassen, nährstoffarmen Standorten	Waterplant vegetation on wet, nutrient-poor sites
War	Wasservegetation auf nassen, nährstoffreichen Standorten	Waterplant vegetation on wet, nutrient-rich sites
Was	Wasservegetation auf nassen, salzigen Standorten	Waterplant vegetation on wet, saline sites

Vegetation Suitability (large river)

Shapefile shape type: Polygon

Result attribute name: (predefined) ***VSLARGE***

Result attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	no data
-	keine	none
dry tall herb vegetation	trockene hohe Krautvegetation	dry tall herb vegetation
hardwood	Hartholzwald	hardwood
riparian reed	Uferröhricht	riparian reed
riverine grassland	Flutrasen	riverine grassland
softwood	Weichholzwald	softwood
softwood / canarygrass reed	Weichholzwald / Rohrglanzgrasröhricht	softwood / canarygrass reed
softwood / riparian reed	Weichholzwald / Uferröhricht	softwood / riparian reed
water plant vegetation	Wasserpflanzenvegetation	water plant vegetation
wet riparian pioneer vegetation	Pioniervegetation nasser Uferstandorte	wet riparian pioneer vegetation

Water Storage Suitability (summer)

Shapefile shape type: Polygon

Result attribute name: ***WSS_SUMMER***

(predefined)

Result attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
-	keine	None
m	bedingt geeignet	Conditionally suitable
s	geeignet	Suitable
u	ungeeignet	Unsuitable

Water Storage Suitability (winter)

Shapefile shape type: Polygon

Result attribute name: ***WSS_WINTER***
(predefined)

Result attribute data type: char

Characteristics of the attributes:

Attribute Value	German Denotation	English Denotation
-9999	nicht definiert	No data
-	keine	None
m	bedingt geeignet	Conditionally suitable
s	geeignet	Suitable
u	ungeeignet	Unsuitable

Time Series Data

ASCII file type: CSV Table

Format description:
ASCII format, with semicolon or tab space delimiter
Line 1-n: date time; value
with value as W (cm) or Q (m³/s)

Example:

```
1998-10-23 00:00:00;0.080855
1998-10-23 00:15:00;0.080855
1998-10-23 00:30:00;0.080855
1998-10-23 00:45:00;0.080855
1998-10-23 01:00:00;0.080855
1998-10-23 01:15:00;0.080855
1998-10-23 01:30:00;0.080855
```

ZML file type: XML

Format description:
XML format

Example:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<ns0:observation xmlns:ns0="zml.kalypso.org"
xmlns:xlink="http://www.w3.org/1999/xlink" editable="false">
    <ns0:name>Rehbach-Steinbach</ns0:name>
    <ns0:metadataList>
        <ns0:metadata value="Rehbach-Steinbach" name="name">
        </ns0:metadata>
        <ns0:metadata value="UTC" name="Zeitzone">
        </ns0:metadata>
    </ns0:metadataList>
    <ns0:axis unit="cm" type="W" name="Wasserstand"
     key="false" datatype="TYPE=double">
        <ns0:valueArray separator=";">0.080855;0.080855</ns0:
         valueArray>
    </ns0:axis>
    <ns0:axis unit="" type="date" name="date" key="true"
     datatype="TYPE=date#FORMAT=yyyy-MM-dd'T'HH:mm:ss">
        <ns0:valueArray separator=";">
         1998-10-22T22:00:00;1998-10-22T22:15:00</ns0:
         valueArray>
    </ns0:axis>
</ns0:observation>
```

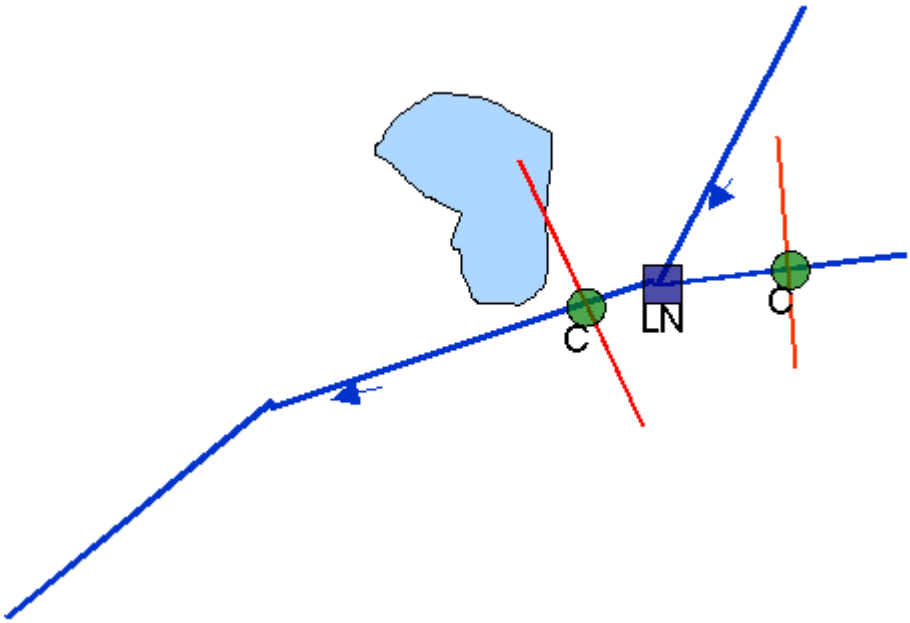
APPENDIX C TRANSFORMATION OF MEASURES FOR THE HYDRAULIC COMPUTATION

General

- Cross-Sectional Profiles will only be modfied if they define a corrosponding Cross-Sectional Profile Node.
- Changes to the digital elevation model will only be committed if a measure is applied to the digital elevation model.

C.1 Ecological Flooding

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model

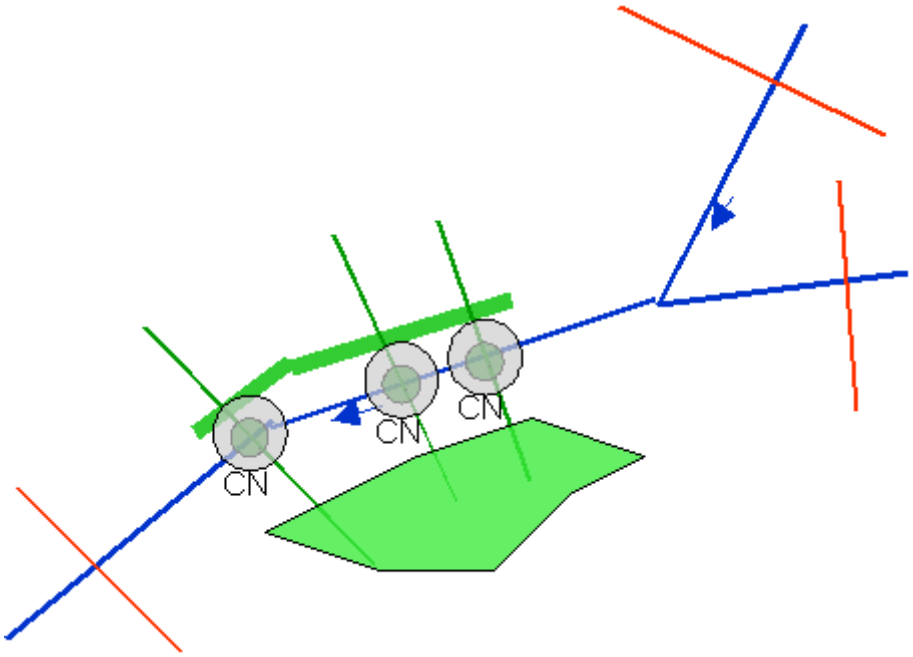


C.2 Buffer Strip

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	

Impact:

- Affected Cross-Sectional Profiles are changed by Roughness Class modification

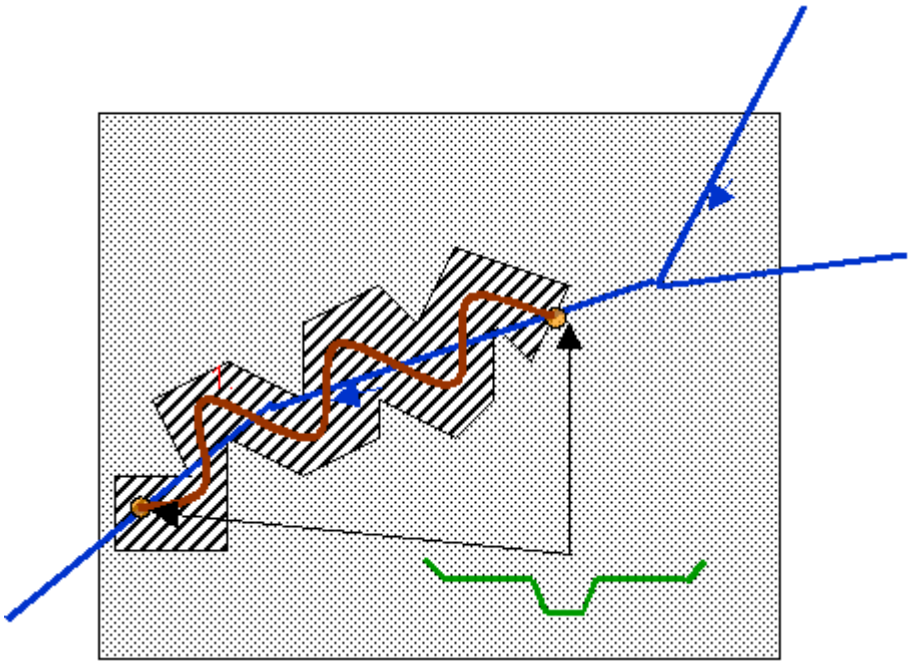


C.3 Remeandering

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
X	X	X

Impact:

- The geometry of the existing branch will be updated.
- Existing Cross-Sectional Profile Nodes between starting and ending point of re-meandering will be deleted.
- Two new Cross-Sectional Profiles and Cross-Sectional Profile Nodes will be created at starting and ending point of the remeandering.
- Optional: The created river channel will be applied to the digital elevation model.

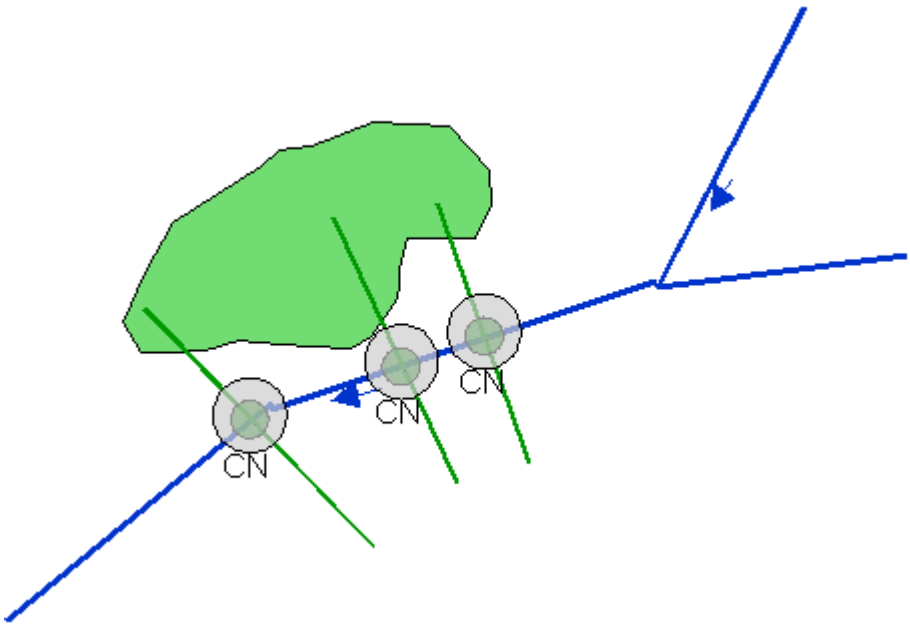


C.4 Adapted Agriculture

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	

Impact:

- Affected Cross-Sectional Profiles are changed by Roughness Class modification

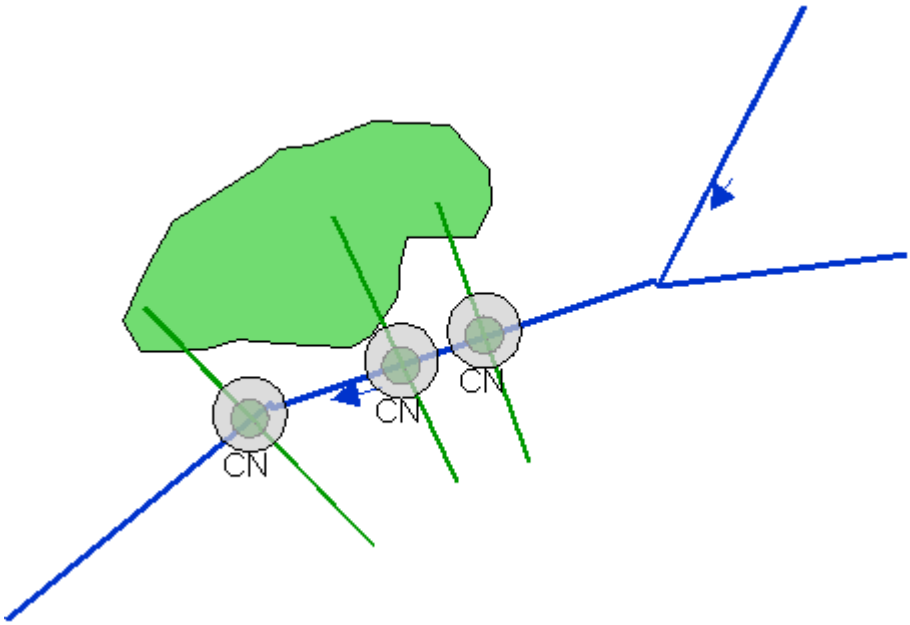


C.5 Adapted Forestry

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	

Impact:

- Affected Cross-Sectional Profiles are changed by Roughness Class modification

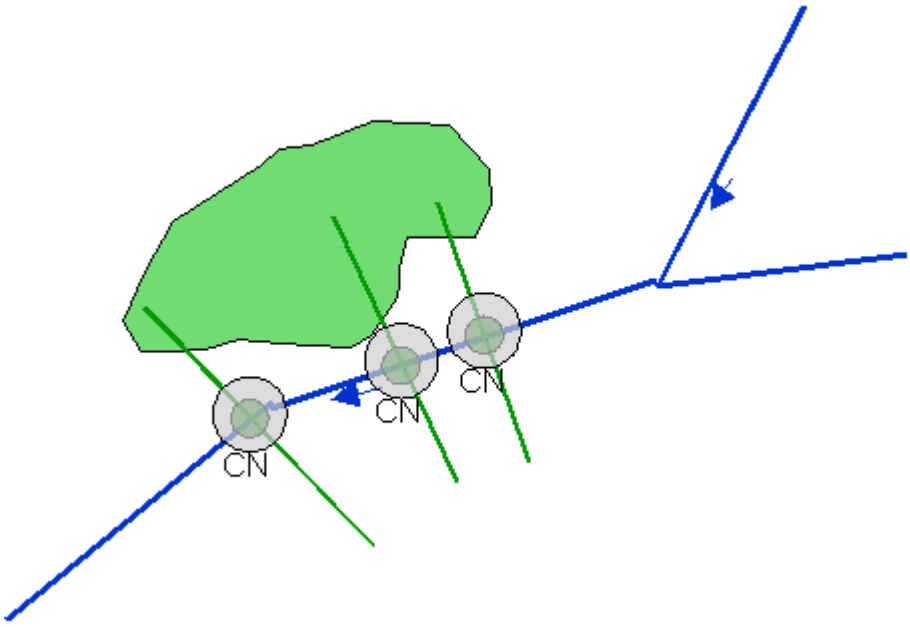


C.6 Floodplain Reforestration

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	

Impact:

- Affected Cross-Sectional Profiles are changed by Roughness Class modification



C.7 Zoning Plan modification

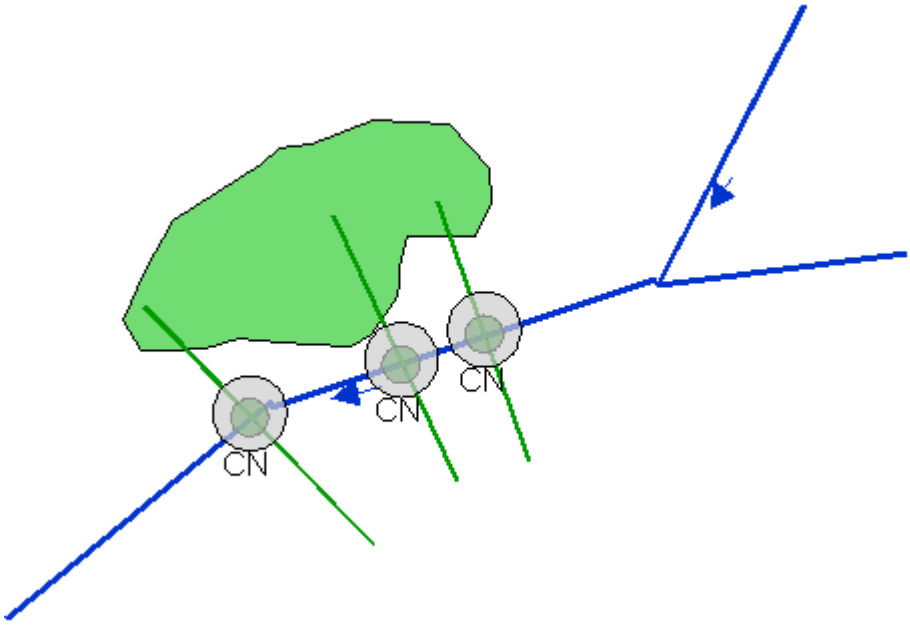
Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	

Impact:

- Affected Cross-Sectional Profiles are changed by Roughness Class modification

Impact Flood Risk:

- Input data of Flood Risk can be updated by applying this measure. Existing Corine Land Use or Vegetation Structure data will be modified.

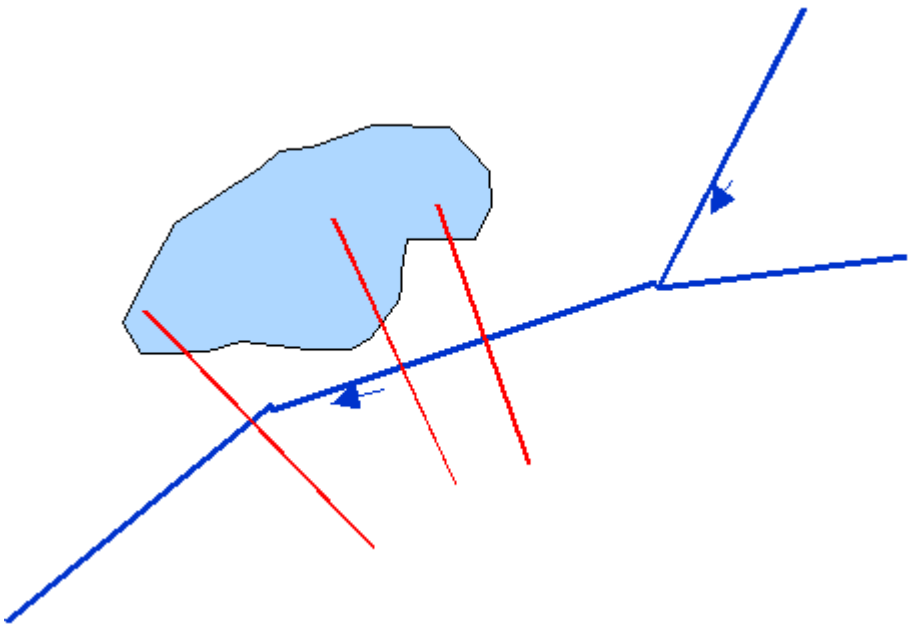


C.8 Adapted urban landuse

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model

Impact Flood Risk:

- Result Risk Classes can be modified by applying this measure

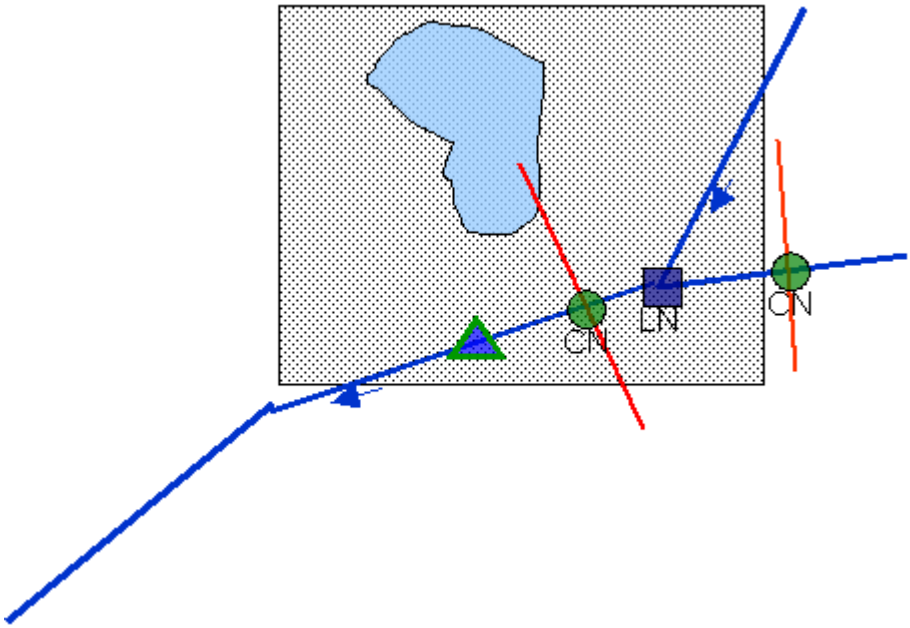


C.9 Polder

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
X		X

Impact:

- A new polder node is inserted into Flow Network model
- Optional: Polder area is applied to the digital elevation model

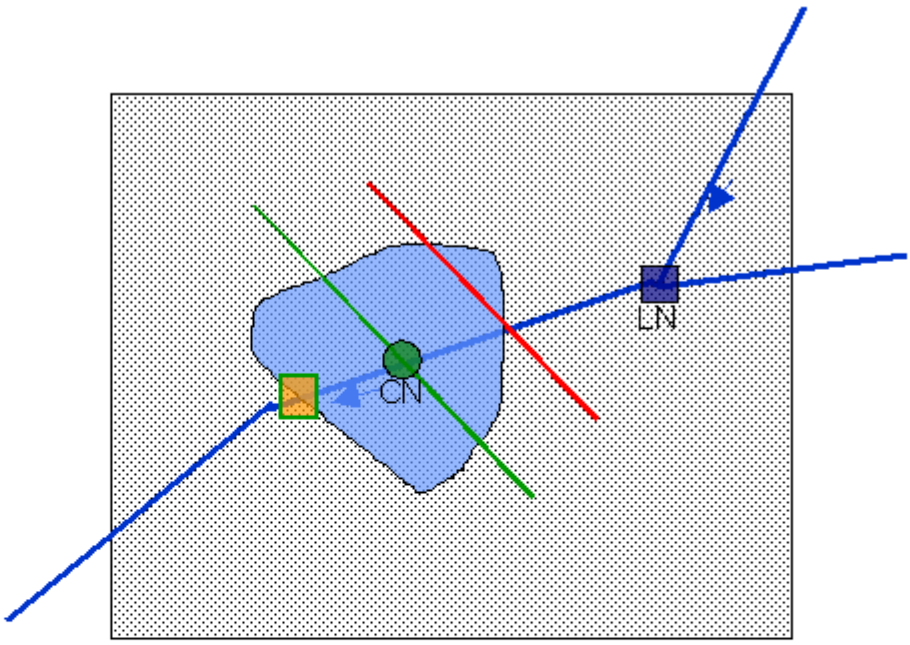


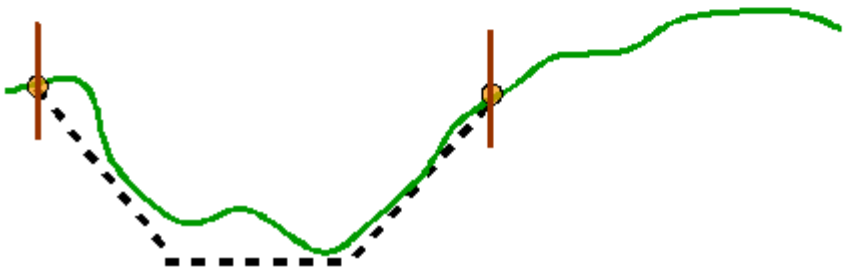
C.10 Retarding basin

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
X	X	X

Impact:

- A new Retarding Basin node is inserted into the Flow Network model
- Optional: Area of the Retarding Basin will be applied to the digital elevation model



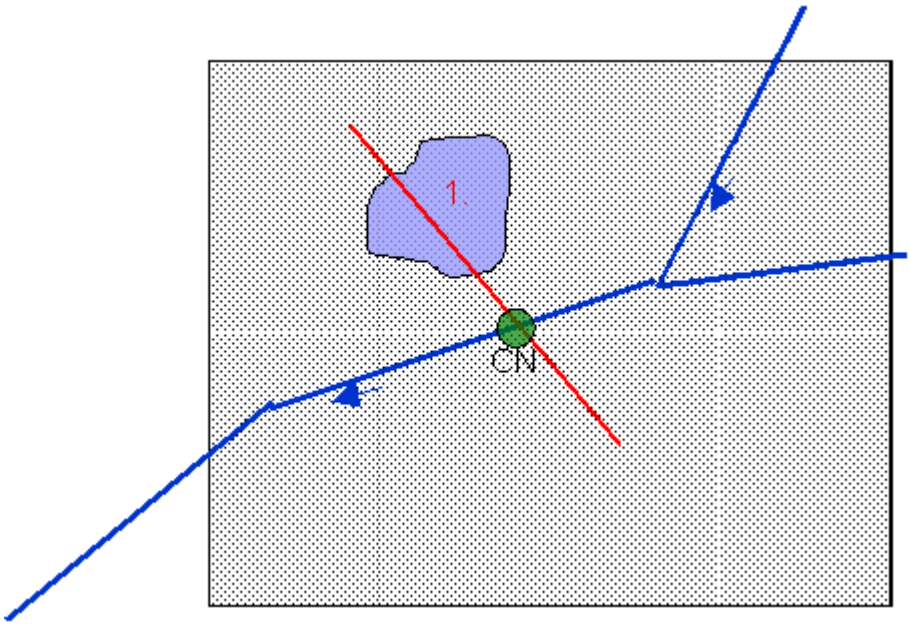


C.11 Foreshore Excavation

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
		X

Impact:

- Optional: Area of Foreshore Excavation is applied to digital elevation model

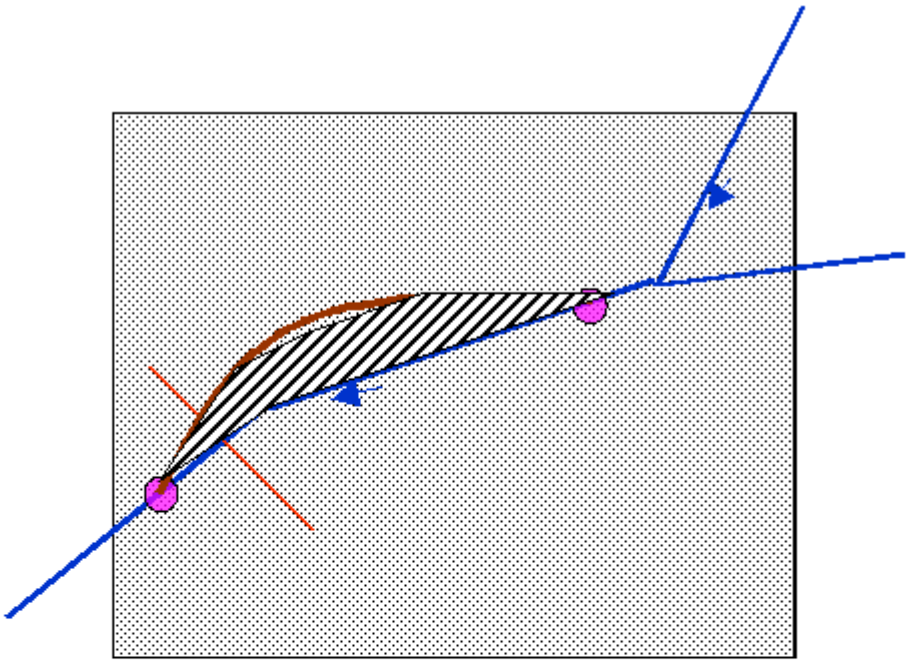


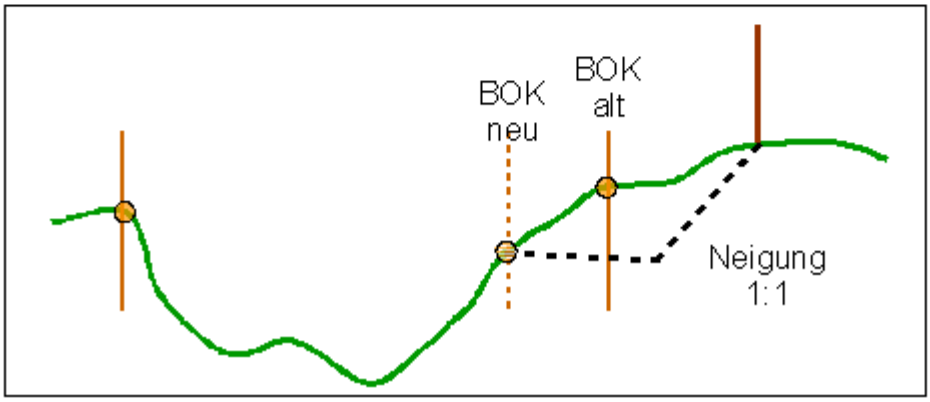
C.12 Floodplain Lowering

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	X

Impact:

- Lowering / Excavation is applied to Cross-Sectional Profile.
- Optional: Height difference of area between Floodplain Lowering and river branch is applied to the digital elevation model.





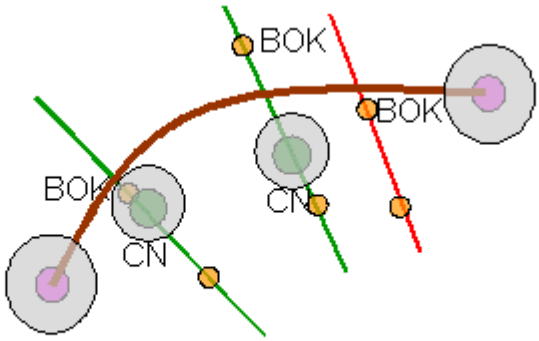
C.13 Riverbank Relocation

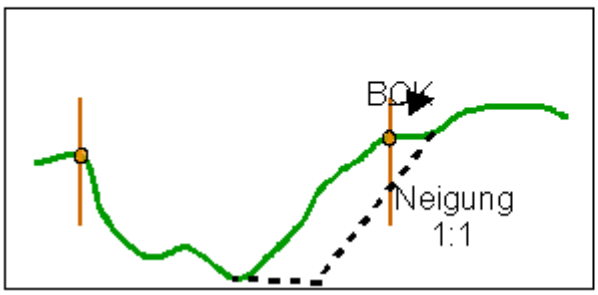
Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	

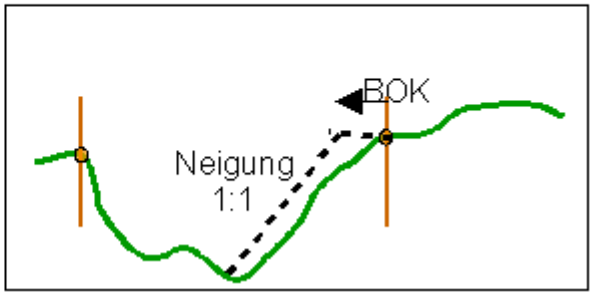
Impact:

- **Case 1**: Intersection of measure geometry and Cross-Sectional Profile is in between the markers "Main Channel – Foreshore Transition" (BOK)
    - Filling between old BOK and riverbed (Slope 1:1).
- **Case 2**: Intersection of measure geometry and Cross-Sectional Profile is outside the markers "Main Channel – Foreshore Transition" (BOK)
    - Excavation between intersection of Cross-Sectional Profile / Measure and riverbed (Slope 1:1).

- New position of marker "Main Channel – Foreshore Transition" is set at intersection of measure and Cross-Sectional Profile geometry.
- Roughness Classes in Cross-Sectional Profiles are updated.





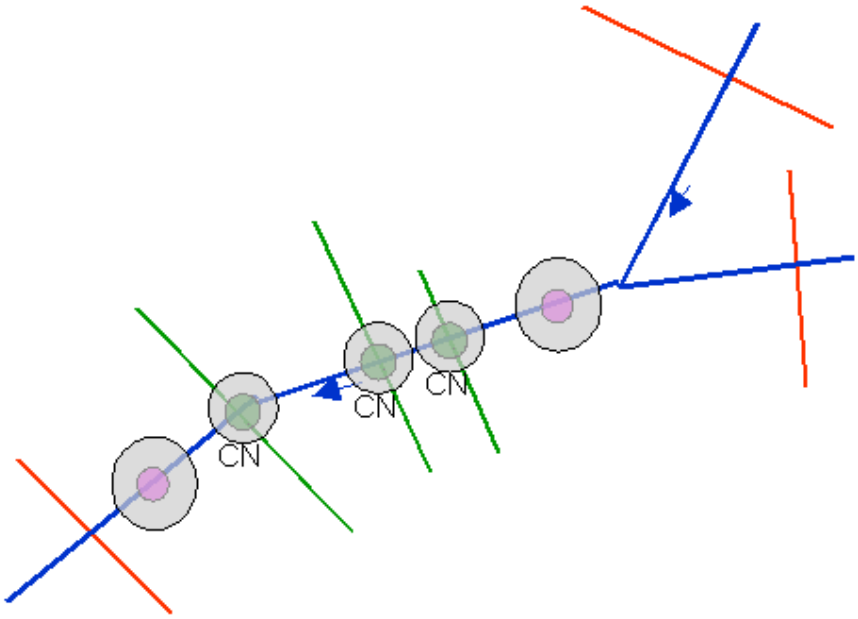


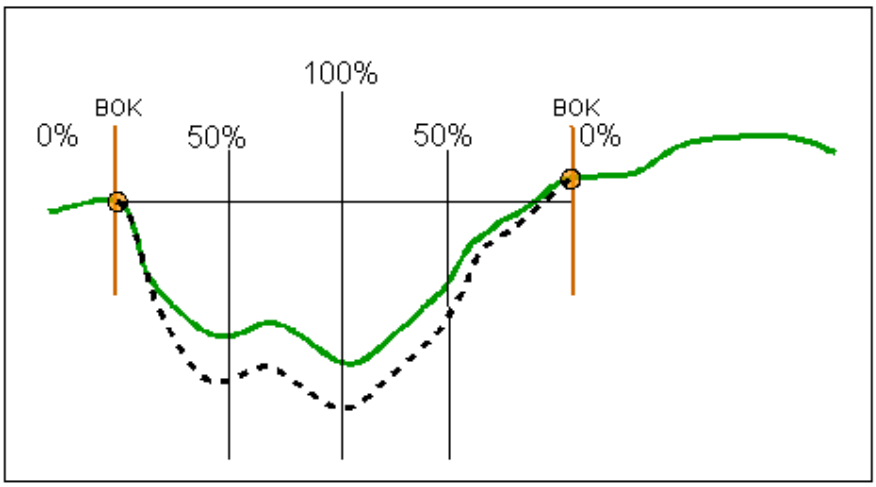
C.14 Riverbed Elevation Change

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	

Impact:

- Lowering of Cross-Sectional Profile between the markers of „Main Channel – Foreshore Transition“ (BOK)
- Center point of distance between „Main Channel – Foreshore Transition“ markers - 100 % Lowering (Delta)
- Otherwise linear between marker „Main Channel – Foreshore Transition” and center point



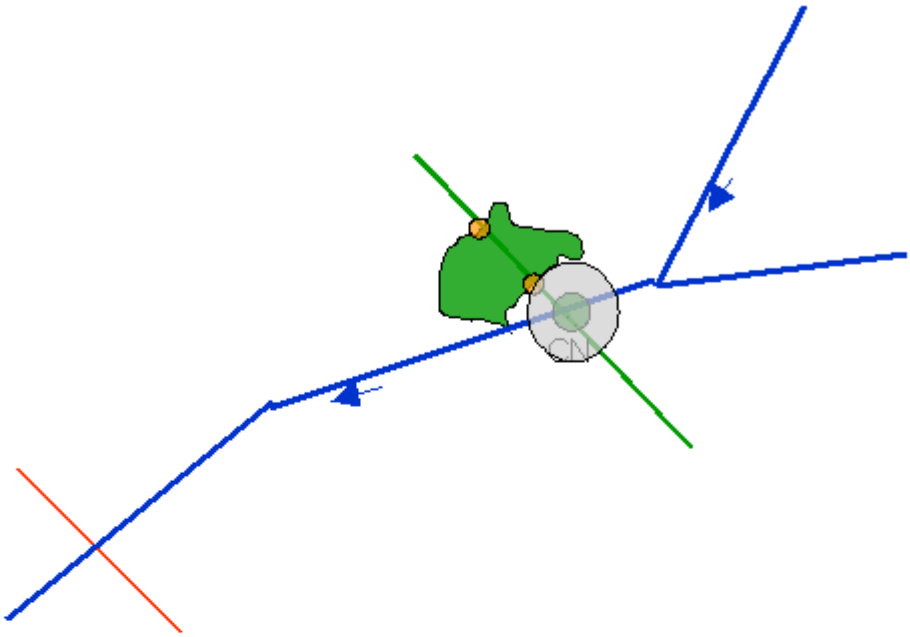


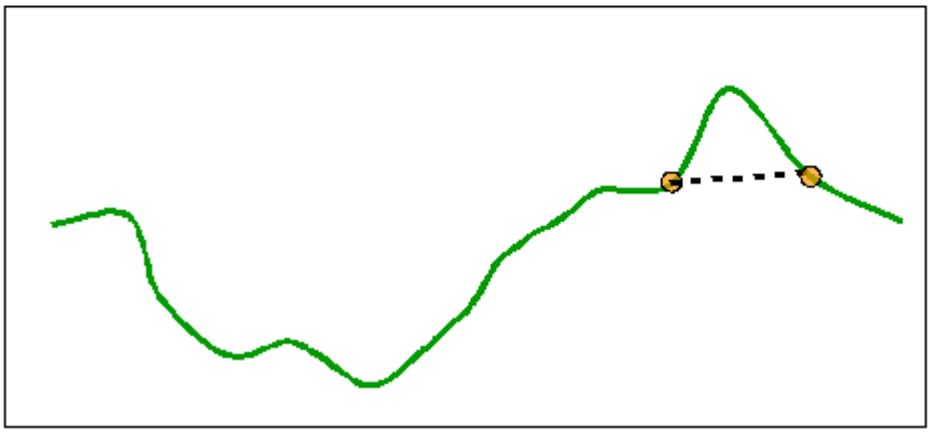
C.15 Obstacle Removal

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	

Impact:

- Elevation change between intersection of Cross-Sectional Profile and measure geometry



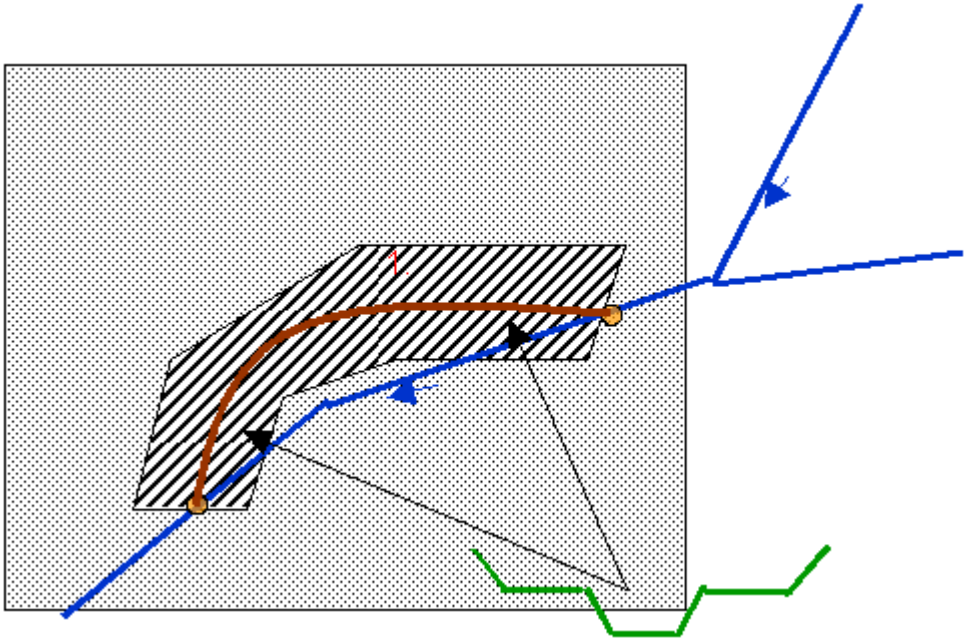


C.16 Diversion of Flood Discharge

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
X	X	X

Impact:

- A new branch is added to the Flow Network Model
- Two new Cross-Sectional Profiles and Cross-Sectional Profile Nodes are created at starting and ending point of the diversion
- Optional: The created river channel is applied to the digital elevation model

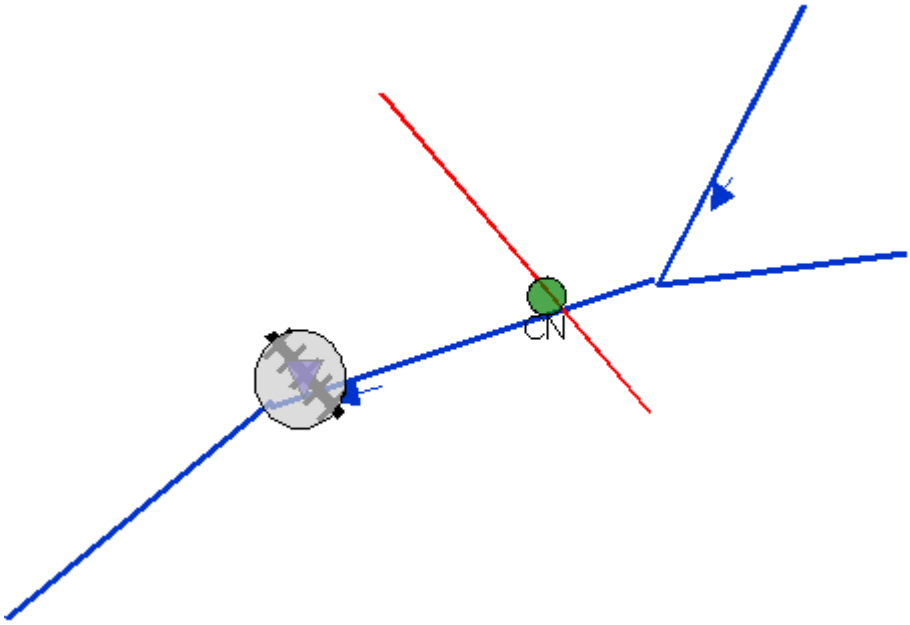


C.17 Weir

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
X		

Impact:

- A new Weir is added to the Flow Network Model

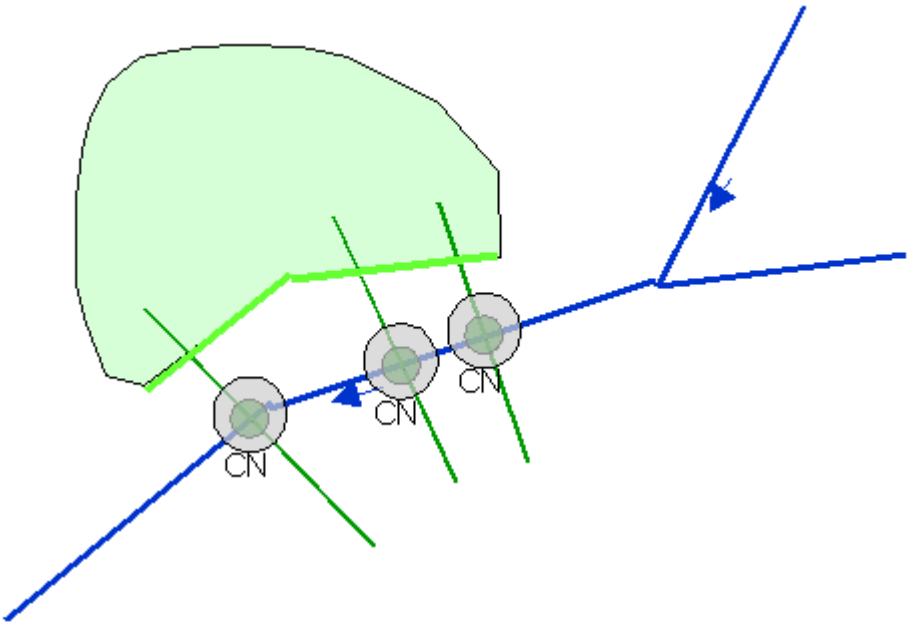


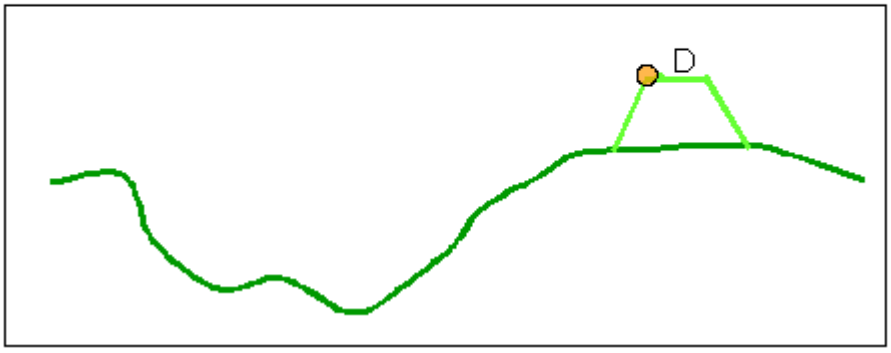
C.18 Dike Relocation

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	(X)

Impact:

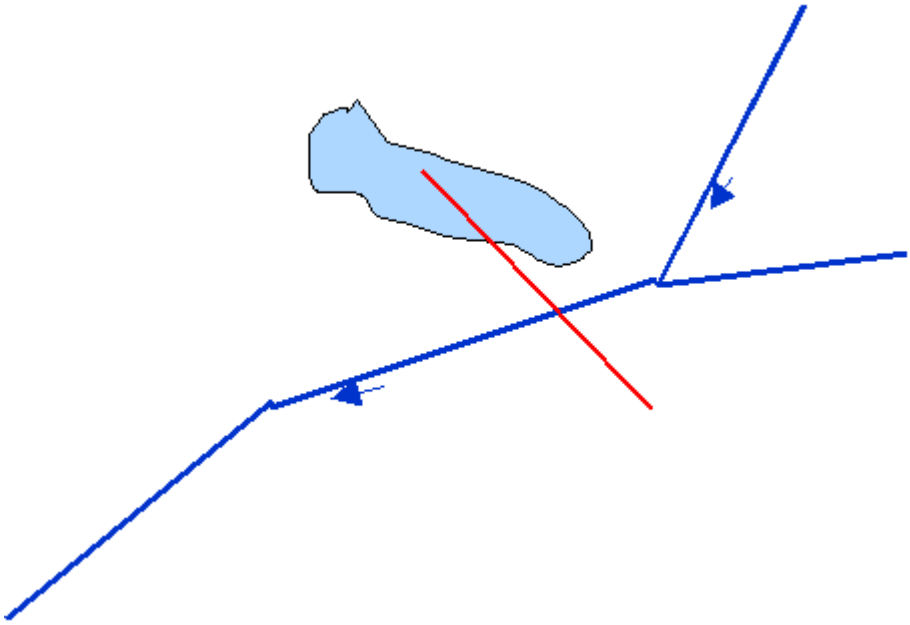
- Old Dike geometry is removed from Cross-Sectional Profiles
- New Dike geometry is applied to Cross-Sectional Profiles
- Position of markers „Main Channel – Foreshore Transition“ and „Hydraulic Active Area“ are modified
- Protected Areas will not be flooded by calculating Inundation Areas and Inundation Depths





C.19 Earth Wall in Valley

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model

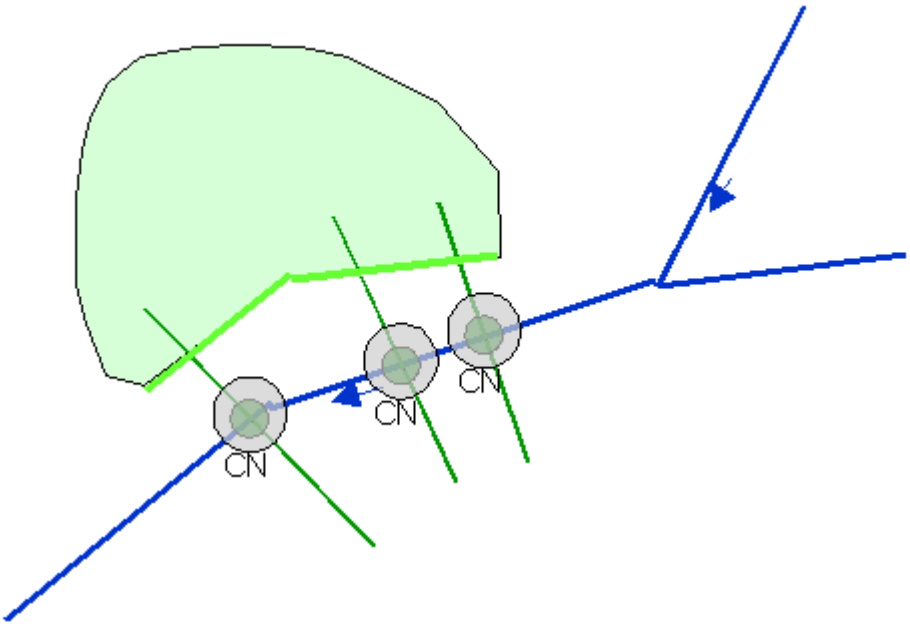


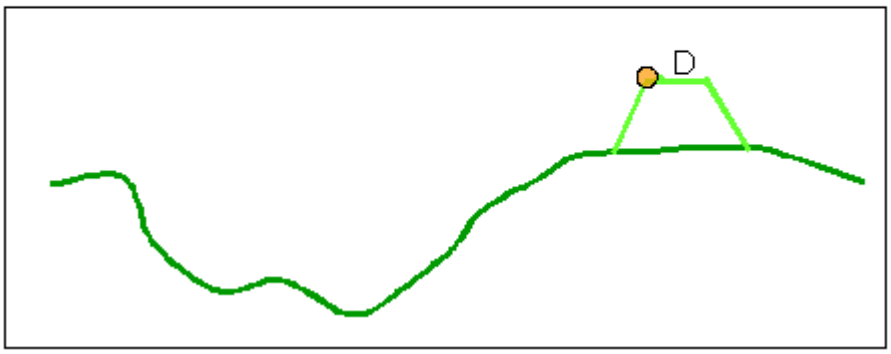
C.20 Dike Construction

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	(X)

Impact:

- Dike geometry is applied to Cross-Sectional Profiles
- Position of markers „Main Channel – Foreshore Transition“ and „Hydraulic Active Area“ is modified
- Protected Areas will not be flooded by calculating Inundation Areas and Inundation Depths



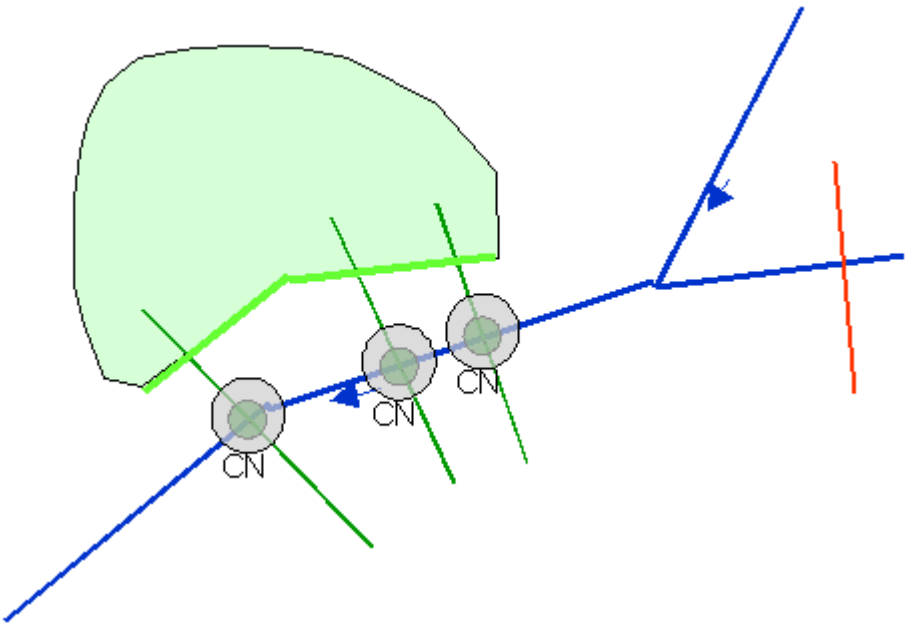


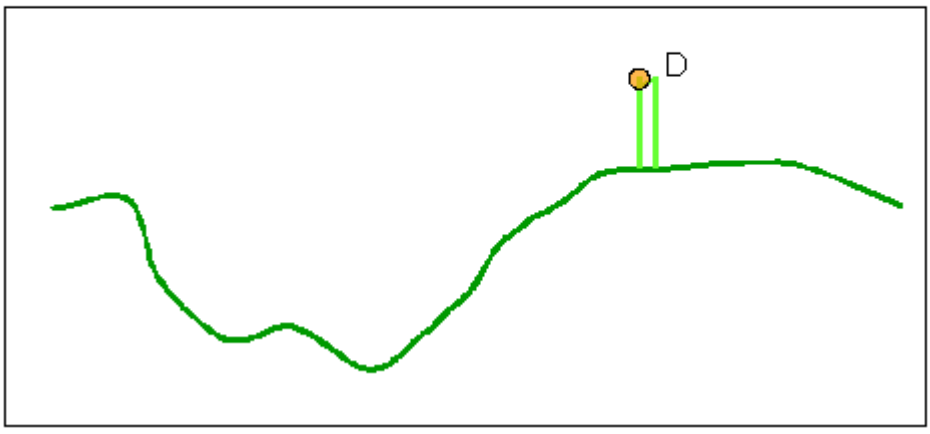
C.21 Mobile Floodwall

Impact on ...		
Flow Network	Cross-Sectional Profiles	Digital Elevation Model
	X	(X)

Impact:

- Mobile Floodwall geometry is applied to Cross-Sectional Profiles
- Position of markers „Main Channel – Foreshore Transition“ and „Hydraulic Active Area“ is modified
- Protected Areas will not be flooded by calculating Inundation Areas and Inundation Depths





APPENDIX D VALIDATION RULES FOR FLOW NETWORK MODEL

Rules applied for validation of the Flow Network model:

- Existing SOBEK Installation at „D:\Sobek211\“?
- More than 500 Nodes defined in the model?
- All elements and geometries define a coordinate system?
- The model defines Boundary Conditions?
- Time Series of Boundary Conditions fits period of Calculation Cases?
- At least one Q and W/Q or W Boundary Condition exists?
- Are all measures of a variant valid?
- All branches define starting and ending nodes?
- Length of all branches is at least 20 m?
- Do all branches have at least one Cross-Sectional Profile node?
- Do Cross-Sectional Profiles contain flybacks?

A validation can be done manually. In addition, a validation is performed each time a hydraulic computation is started.

APPENDIX E CONVERSION OF FLOW NETWORK MODEL ELEMENTS IN CALCULATION CORE CONFORM ELEMENTS (SOBEK)

nofdp	Sobek
Branch	Reach
Connection Node	Linkage Node, Connection Node
Time Series Nodes	Boundary Condition
Cross-Sectional Profile Nodes	Cross Section
Weir	Weir
Polder	Two Linkage Nodes connected to the Reaches N1 respectively N2, which are joined via a Connection Node to Reach N3. All Reaches are provided with a standard Cross Section geometry. Inflow is represented by Reach N1 (Weir structure), outflow is represented by Reach N2 (pump structure), Reach N3 is representing the retention volume of the Polder.
Retarding Basin	Incorporation into the Flow Network by inserting a Linkage Node. The Linkage Node is connected to Reach N1, which again is connected to a second Reach N2 by a Connection Node. Both Reaches are provided with a standard Cross Section geometry. Reach N1 is representing a short inflow “channel” and Reach N2 is representing the retention volume of the Retarding Basin. In addition, a Compound Structure is implemented downstream representing the dam. Discharge via spillway is calculated by means of a River Weir. The outlet can be controlled or uncontrolled. In case of uncontrolled discharge, a General Structure represents the outlet. A Database Structure calculates uncontrolled discharge.

APPENDIX F: LITERATURE

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/2/ Klijn, F. & de Waal, R. (1992): “Ecologische bodemclassificatie: een pragmatische aanpak vanuit de standplaatsbenadering,” *Landschap* 9(3), pp 175-187.

/3/ Klijn, F., Groen, C.L.G. and Witte, J.P.M. (1996): “Ecoseries for potential site mapping, an example from the Netherlands,” *Landscape and Urban Planning* 35, pp 53-70.

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/5/ Runhaar, J., Arts, G., Knol, W.C., Makaske, B., van den Brink, N. (2004): “Waterberging en Natuur,” *Kennisoverzicht ten behoeve van regionale waterbeheerders*, STOWA Rapport 2004-16, www.stowa.nl/.

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