



QKan

QGIS and database based system for managing urban drainage system data

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QKan – Managing Urban Drainage Systems with QGIS

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Introduction

Objectives

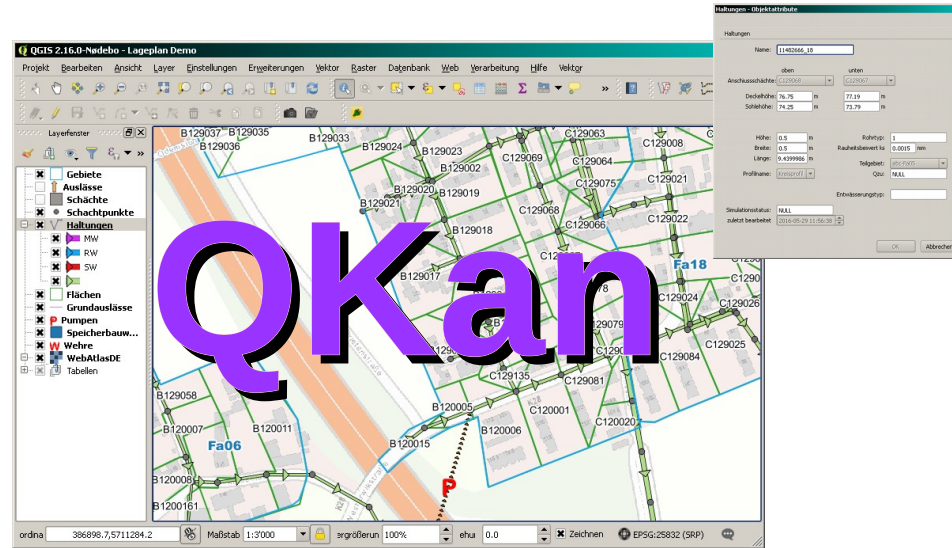
Design characteristics

Functionality

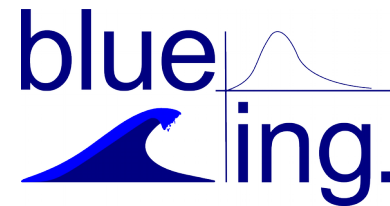
Experiences with writing plugins

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Partners:



Government funded by:

NRW – Mittelstand.Innovativ! - Innovationsgutschein F+E

QKan – Managing Urban Drainage Systems with QGIS

Introduction



What is QKan?

- Set of plugins for QGIS
- Database model

What can QKan be used for?


- Design of urban drainage systems in combination with hydraulic simulation software

Who can use QKan?

- Engineers in consulting offices

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Introduction



Why did the consultant offices give money for open-source software?

- Need for a software aiming at the specific workflow of an engineer
- Good opportunity to (*make staff*) learn QGIS

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Objectives

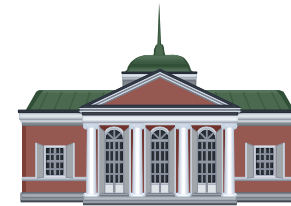
1. Urban drainage system data

- Verification
- Preprocessing

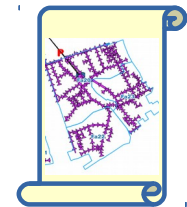
2. *Hydraulic simulation (external)*

3. Results

- Analysis
- Plans
 - Map of sewage system
 - Cross section



municipal
office



consulting
office

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Objectives

What do consulting offices **need**?

1. Workflow **independent** from simulation software
2. **Simple** data structure
3. **Flexible** import of sewage system data
 - Table data: ASCII, CSV, Excel
 - Database data: ACCESS tables
 - Data exchange formats: ISYBAU-XML, DWA-XML

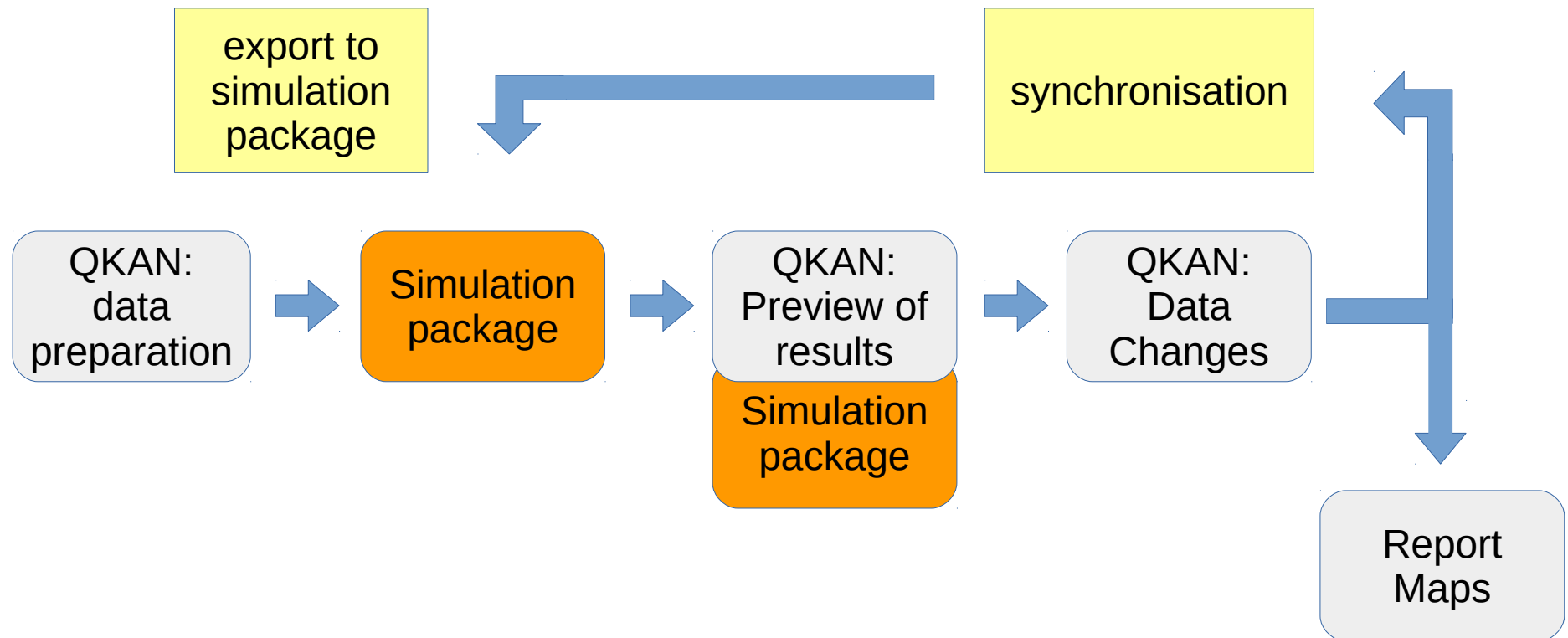


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Objectives

Typical workflow...

1. Design of sewage system in an iterative process



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Objectives

Widely used simulation packages

- HYSTEM-EXTRAN (ITWH, Hannover)
- Kanal++ (tandler.com, Buch am Erlbach)
- *Mike Urban (DHI, Hørsholm, Denmark)*
- *Rehm Software (DHI, Hørsholm, Denmark)*
- SWMM (EPA, USA)



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Objectives

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Not widely used in Germany...
... but several software
packages originate from
SWMM

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Functionality

Main functionality

1. Data import
2. Prepare data for simulation
3. Analysis of simulation results
4. Creating maps for printing

... using:

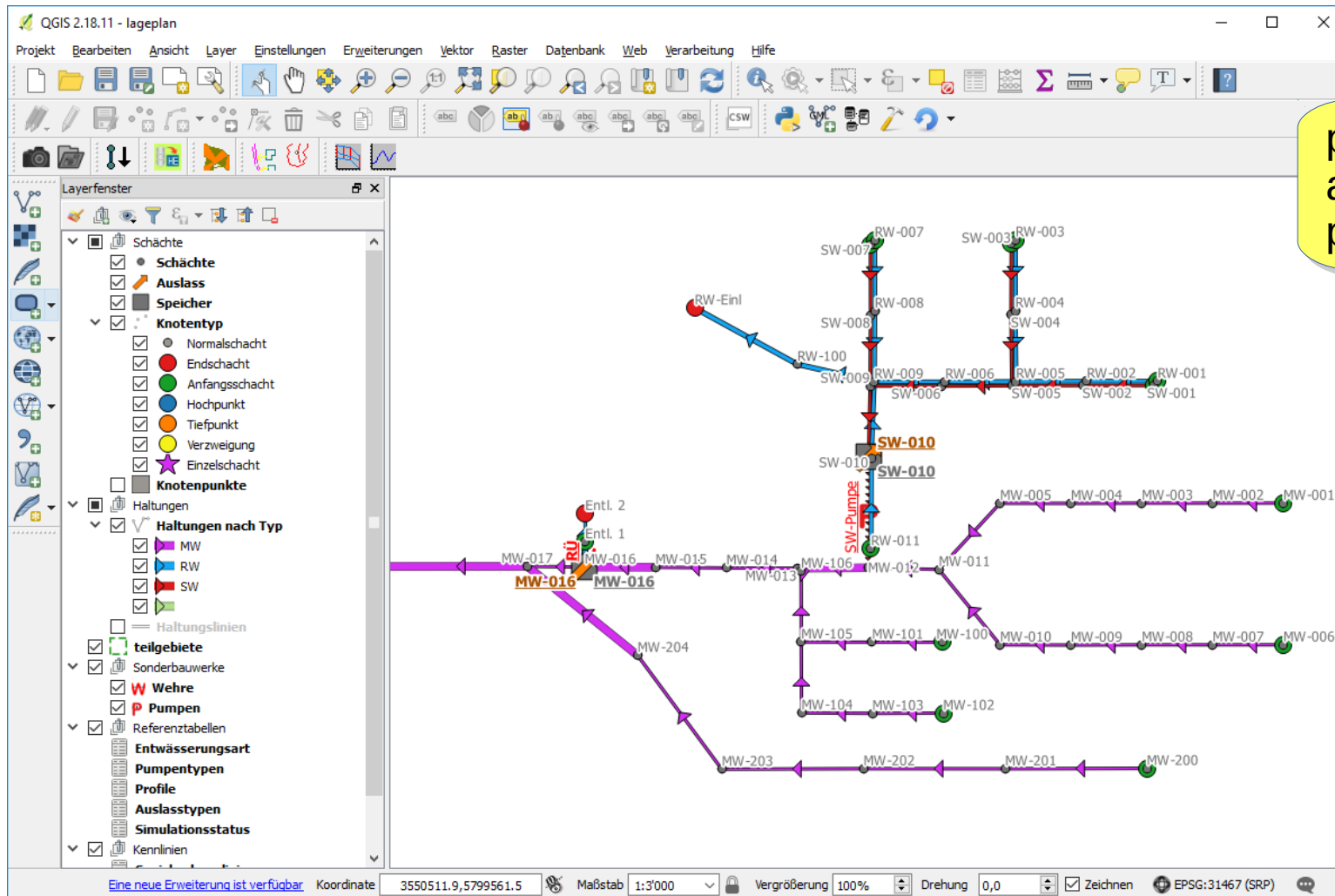
- QGIS
- QKan-Plugins



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Functionality

Import of network data



provided with a meaningful project file

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Forms for data editing:

The image displays three overlapping data editing forms from the QKan plugin in QGIS, used for managing urban drainage systems. The forms are:

- Flächen nach Abflussparameter - Objektattribute**: Contains fields for Name (2012415), Neignungsklasse (NULL), Regenschreib (NULL), Abflussparameter (EG Dach), Abfluss-Typ (HE), Anzahl Speich (NULL), and Speicherkonstante (NULL). It also includes a checkbox for 'auf mehrere TEZG-Flächen aufteilen (Verschne)' and a 'Kommentar' field.
- Haltungen nach Typ - Objektattribute**: Contains fields for Name (E120183I1), Schacht oben (Schachtnam: E120183, Sohlhöhe: 67.65 m NH), Schacht unten (Schachtnam: E120180, Sohlhöhe: 67.42 m NH), Profiltyp (Kreisquerschnitt), Profilhöhe (0.4 m), Profilbreite (0.4 m), Profillänge (36.5 m), Rauheitsbeiw (1.5 mm), Entwässerungssystem (Mischwasser), Teilgebiet (Huckarder Bruch), Simulationsstat (keine Angabe), and Erstellungsdatum (2017-08-15). It also has a 'Kommentar' field.
- Schächte - Objektattribute**: Contains fields for Name (E120180), Sohlhöhe (67.42 m NH), Deckelhöhe (71.11 m NH), X-Koordinate (389137.558 m), Y-Koordinate (5710896.968 m), Durchmesser (1000 mm), Überstaufäche (NULL m²), Simulationsstatus (keine Angabe), Entwässerungssyst (Mischwasser), Straße (NULL), Druckdichter Deck (checkbox), and Erstellungsdatum (15.08.2017 15:42:37). It also has a 'Kommentar' field.

The background shows a QGIS map with a drainage network overlay and a legend on the left. The status bar at the bottom indicates the current coordinate system (EPSG:3044 SRP) and other map settings.

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Functionality

Plugins for managing surface areas:

- automatic linking to nearest pipe
- intersection of large surface areas (large building, traffic area)
- creation of surface objects from the space between impervious areas



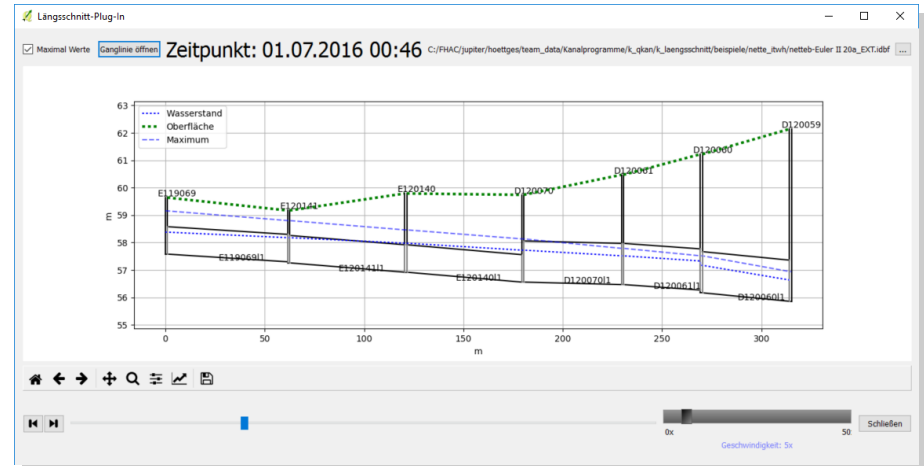
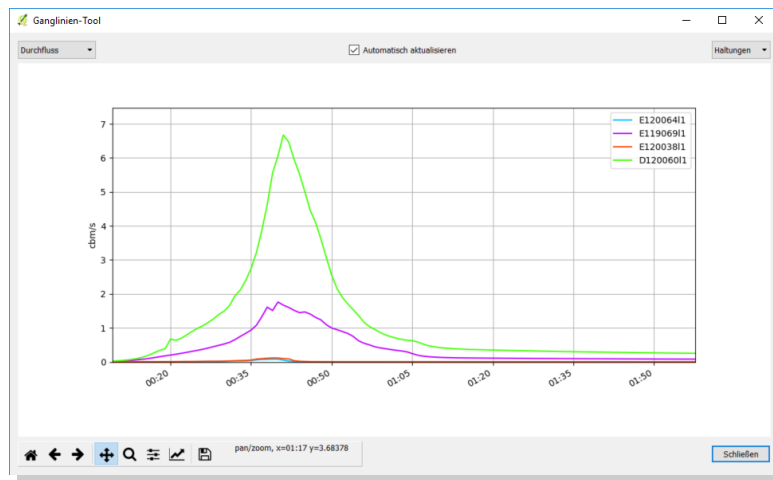
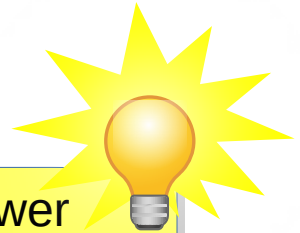
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Functionality

Visualisation of simulation results

1. Network data
2. Hydrographs
3. Longitudinal section

... if there is no (free) viewer available



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Functionality

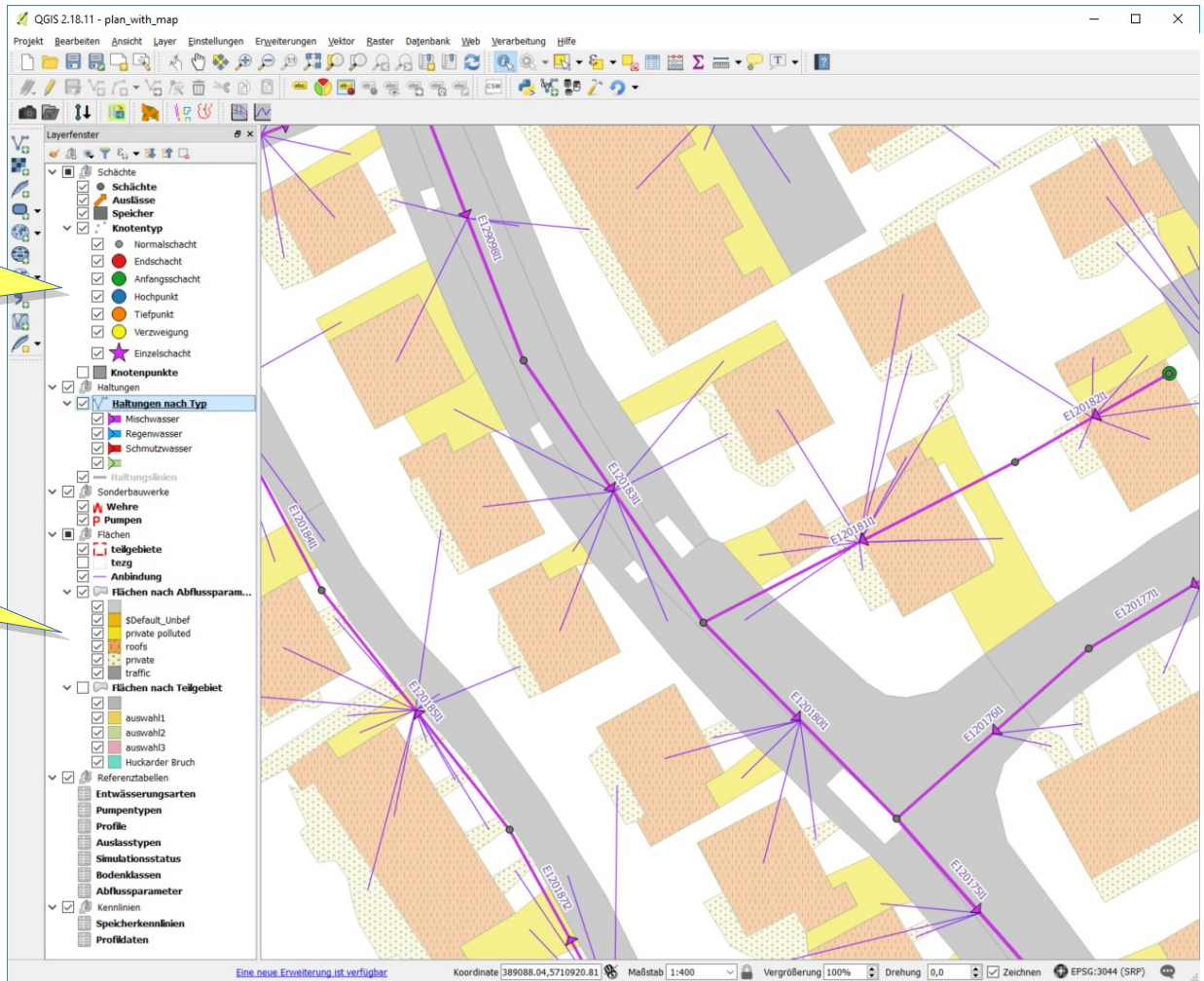
Thematic mapping

Special node types:

- Start node
- End node
- High point
- Low point
- Outfall node

Subcatchment types:

- im-/pervious
- user defined pervious types

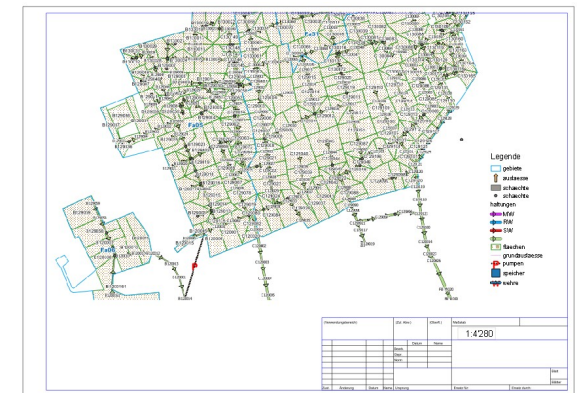
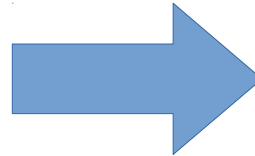
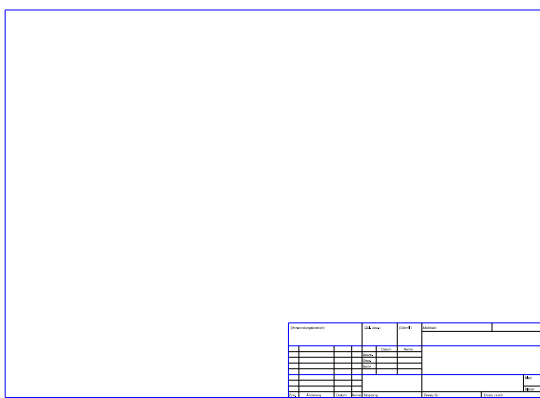
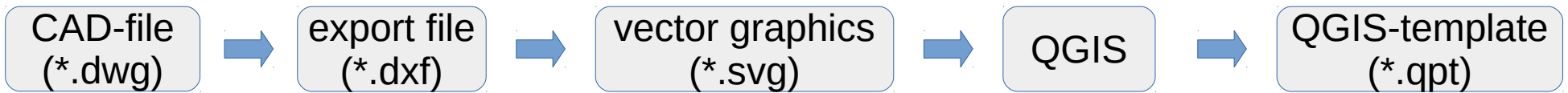


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Functionality

Functionality provided by QGIS:

2. Create Map Layout



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Design characteristics

GIS

1. QGIS



Databases

1. SpatiaLite
2. *PostGIS (not yet)*



Programming Language

1. Python



Forms

1. QT



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Design characteristics



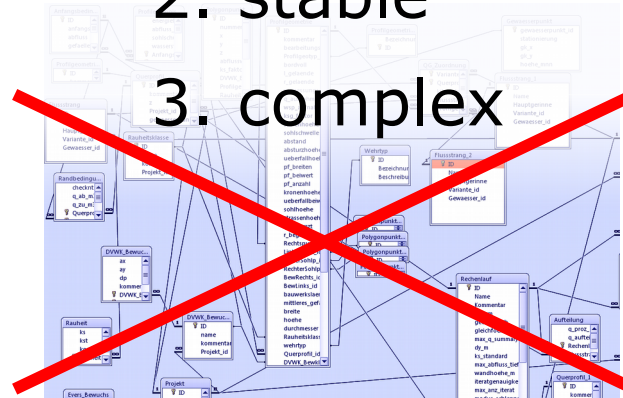
Operator of the
sewage system



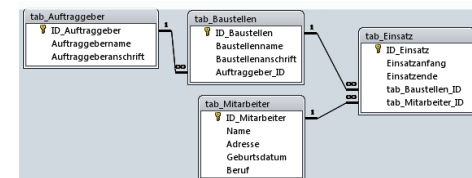
Consulting
office

Database
design

1. long-lasting
2. stable
3. complex

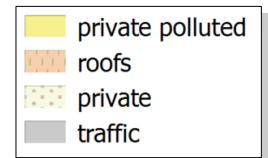
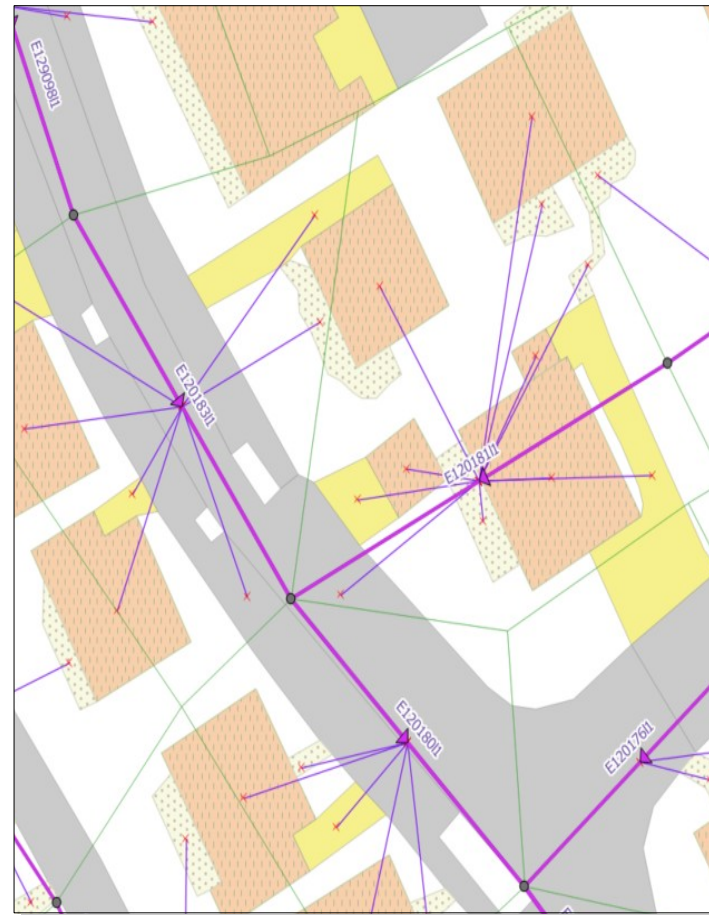


1. flexible
2. simple



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Example: Automatic linking of impervious areas



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Functionality



How does it work?  Spatial SQL!

1. Create new table from areas
2. Create buffer
3. Find nearest catchment intersecting with buffer
4. Create line

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Functionality

SQL statement included in the Python code:

```
WITH tlink AS
(
  SELECT f1.pk AS pk,
  Distance(ha1.geom,f1.geom) AS dist,
  ha1.geom AS geoha1, f1.geom AS geof1
  FROM
    haltungen AS ha1
  INNER JOIN
    linkf1 AS f1
  ON MbrOverlaps(ha1.geom,f1.gbuf)
  WHERE f1.glink IS NULL)
UPDATE linkf1 SET glink =
(
  SELECT MakeLine(PointOnSurface(t1.geof1),Centroid(t1.geoha1))
  FROM tlink AS t1
  INNER JOIN
    (
      SELECT pk, Min(dist) AS dmin
      FROM tlink GROUP BY pk) AS t2
  ON t1.pk=t2.pk AND t1.dist <= t2.dmin + 0.000001
  WHERE linkf1.pk = t1.pk)
WHERE linkf1.glink IS NULL;
```

list of all distances
between areas and
pipes

**line
creation...**

... only to the
nearest pipe

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Functionality

Spatial SQL ...

1. Replaces a bunch of Python code
2. Benefits from indexing
3. Requires a powerful database
4. Requires multiple geometry columns

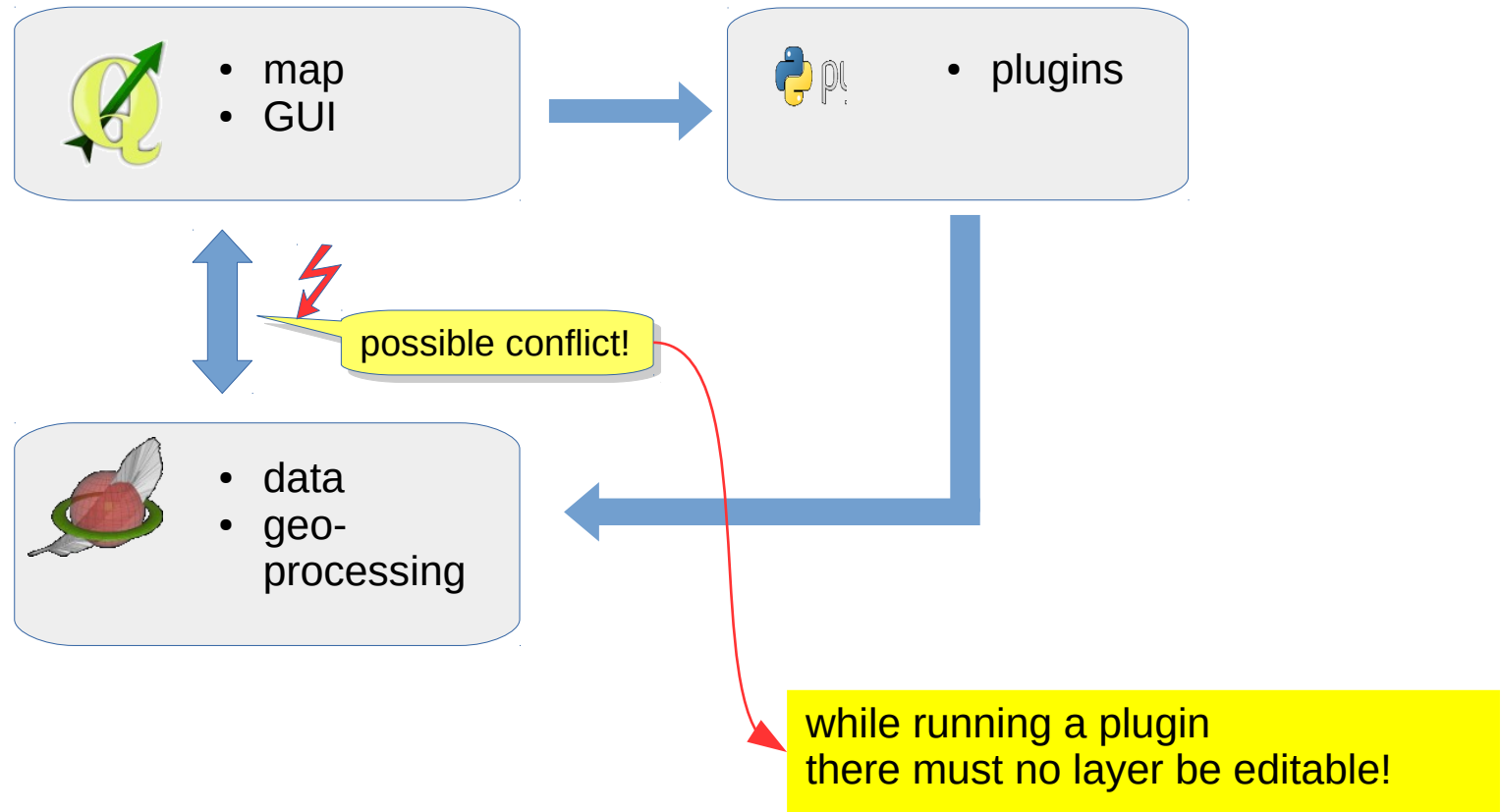
Doesn't with
GeoPackage!

Does it really?

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Functionality

QGIS and Spatialite-DB



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Experiences



There was a lot to learn besides creating the QGIS plugins:

- adapting a template project file to a new database
→ modification of XML files with a python xml parser
- Awesome QT editor for designing forms
- Writing documentation with Sphinx → automatically using comment lines in the Python code
- Handle the powerful logging/error-report mechanism

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Conclusion

What will be next?

The QKan project is still in progress:

- Adaption to additional hydraulic simulation software packages
- More data handling plugins
- More result analysis plugins

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Thank you!