Delivering Optimisation in Practice:

Water Supply in Australia

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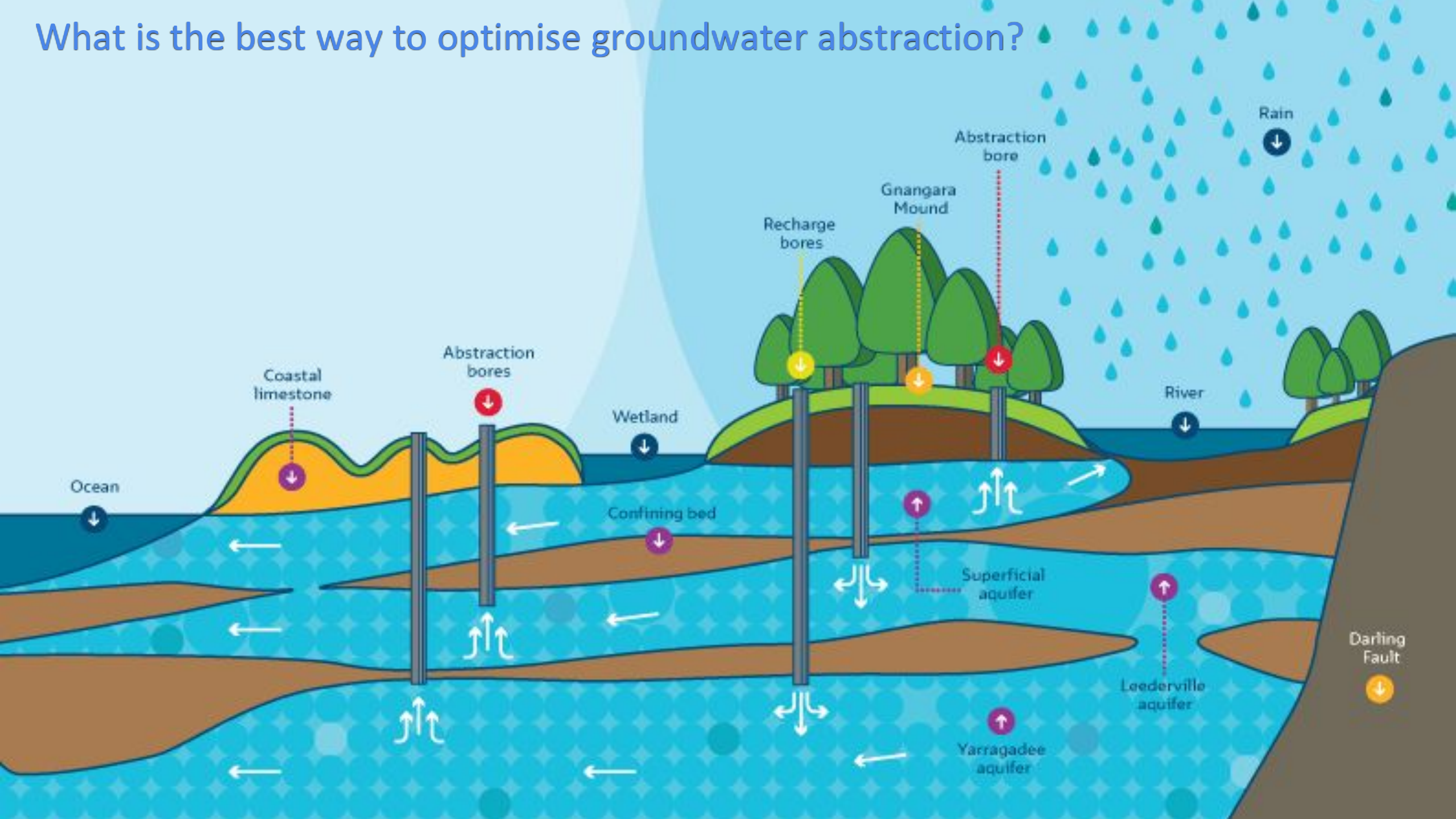
5 Tools for Delivering Optimisation

1. User Focussed Project
2. Process Mapping
3. Solution Architecture
4. Flexible Implementation
5. Measure Impact

What is the best way to optimise groundwater abstraction?



Problem Definition

Determine **which** (bore), **when** (to start) and for **how long** (to abstract) in order to meet demand and not violate maintenance and license constraints.

That is, schedule the bores to be processed by a treatment plant throughout the year subject to:

- **Water quality** is under operational limits on 6 key chemical qualities
- **Maintenance** events at the treatment plant
- **License allocation** and **sensitivities** are accounted for, and
- **Practical** limitations are considered

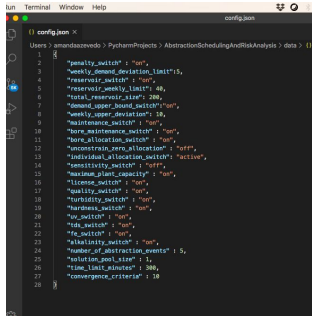
such that:

- the available water abstracted is **maximised**

User focussed project

- Engage the stakeholder throughout implementation
- Deliver partial results as a spike of the project
- Flexible implementation, possibility to add or remove components
  - e.g. Allow the user to easily activate or deactivate the constraints of the model depending on the scenario
- Allow exploration and visualisation of results of the model within the key KPIs related to the process

Agile delivery



Process mapping

Spike into business

Feature: Allow plant shutdown and maintenance

Feature: Add on/off constraints to improve flexibility

User focussed design

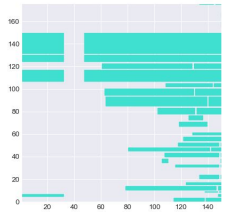
Base model: Proof of infeasibility

User acceptance testing

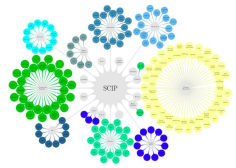
Feature: Allow some allocations to be infeasible

Solution architecture

Test different solvers

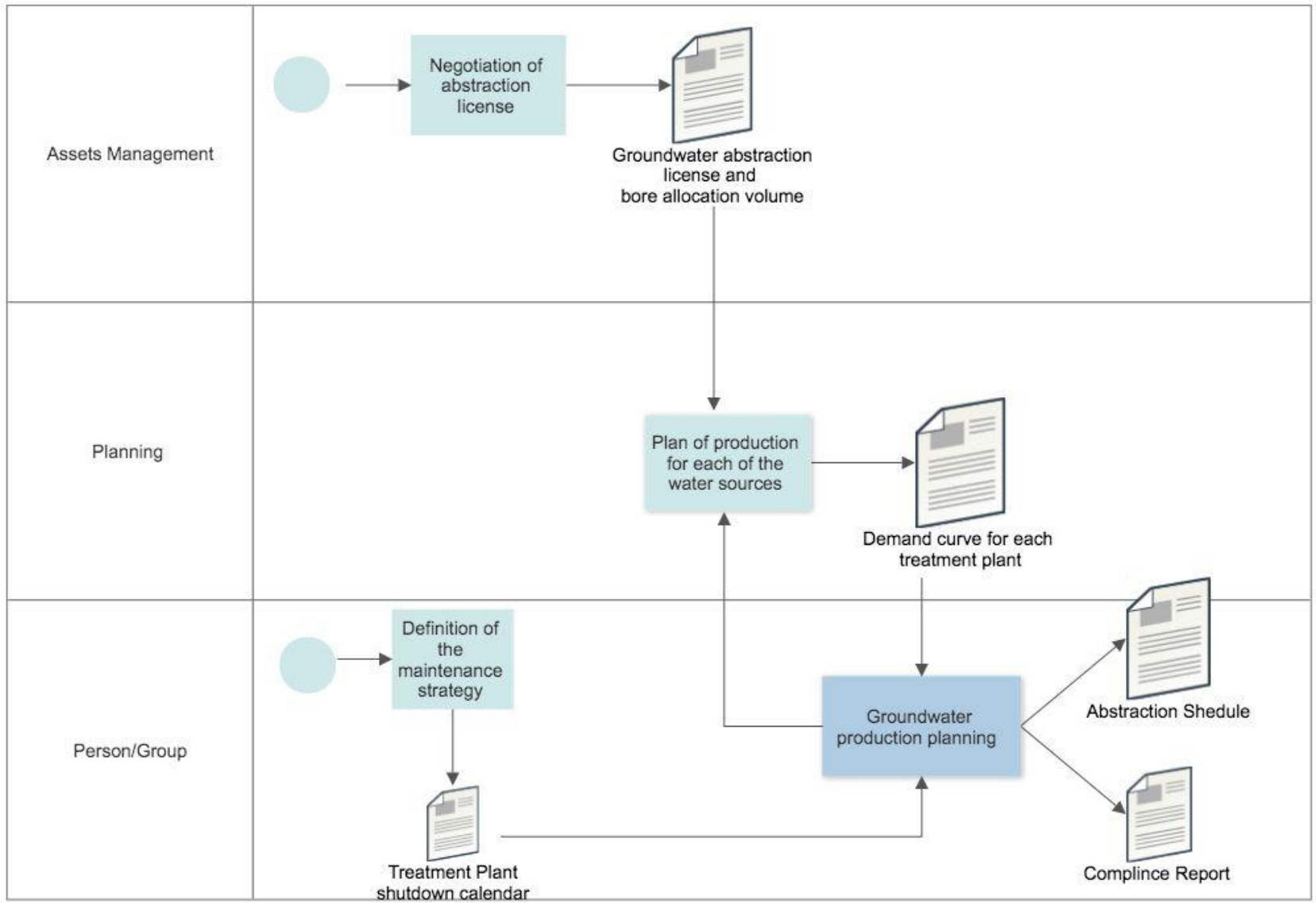


GUROBI OPTIMIZATION



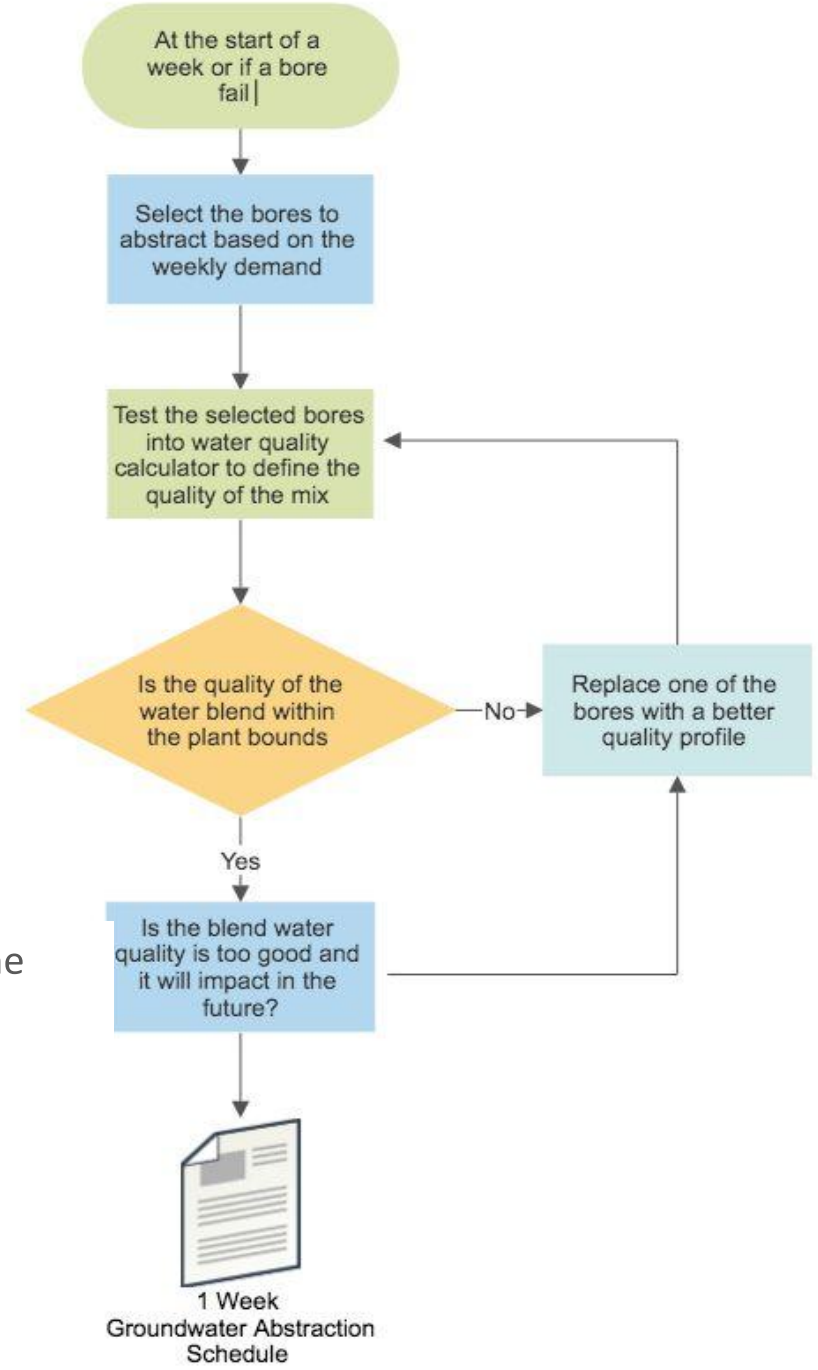
Process Mapping

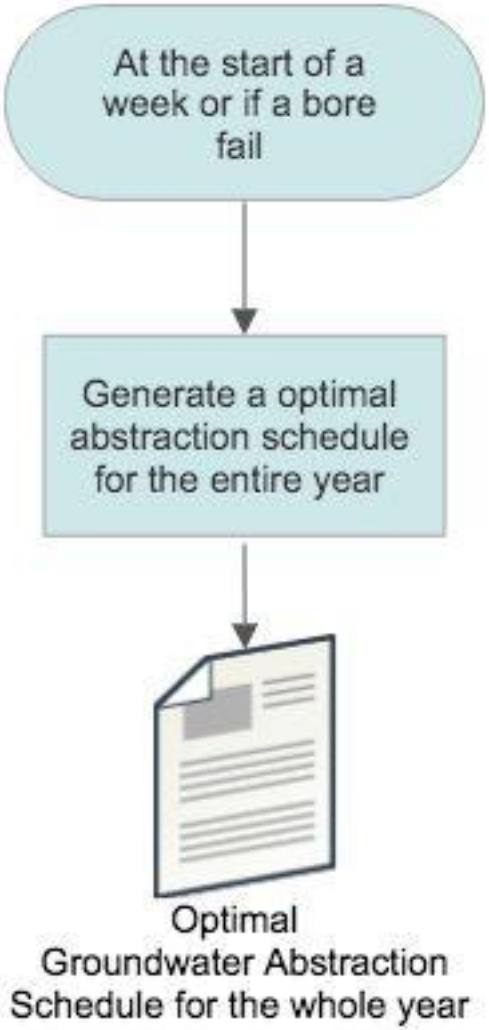
- a process map captures the steps taken to complete a task or process
- it captures inputs and outputs, e.g. triggers for events and documents
- it is similar to an algorithm, but there are formal ‘flow chart’ like components
- the user should approve the map
- The act of developing a process map is helpful in understanding the problem and showing the stakeholder you understand the problem.


Assets Management
Negotiation of abstraction license
Groundwater abstraction license and bore allocation volume
Planning
Plan of production for each of the water sources
Demand curve for each treatment plant
Person/Group
Definition of the maintenance strategy
Groundwater production planning
Abstraction Shedule
Treatment Plant shutdown calendar
Complince Report

219 bores
6 treatment plant
30 abstraction licenses
6 quality parameters

Current quality versus the bores not scheduled.





Process Mapping - Our Principles

- Reduce steps abstraction of scheduling process
- Entire replace the manual process with automated solution
- Embed the water quality into the model as a blend component
- Implement a flexible tool that captures the changes in the system

Automating and combining processes

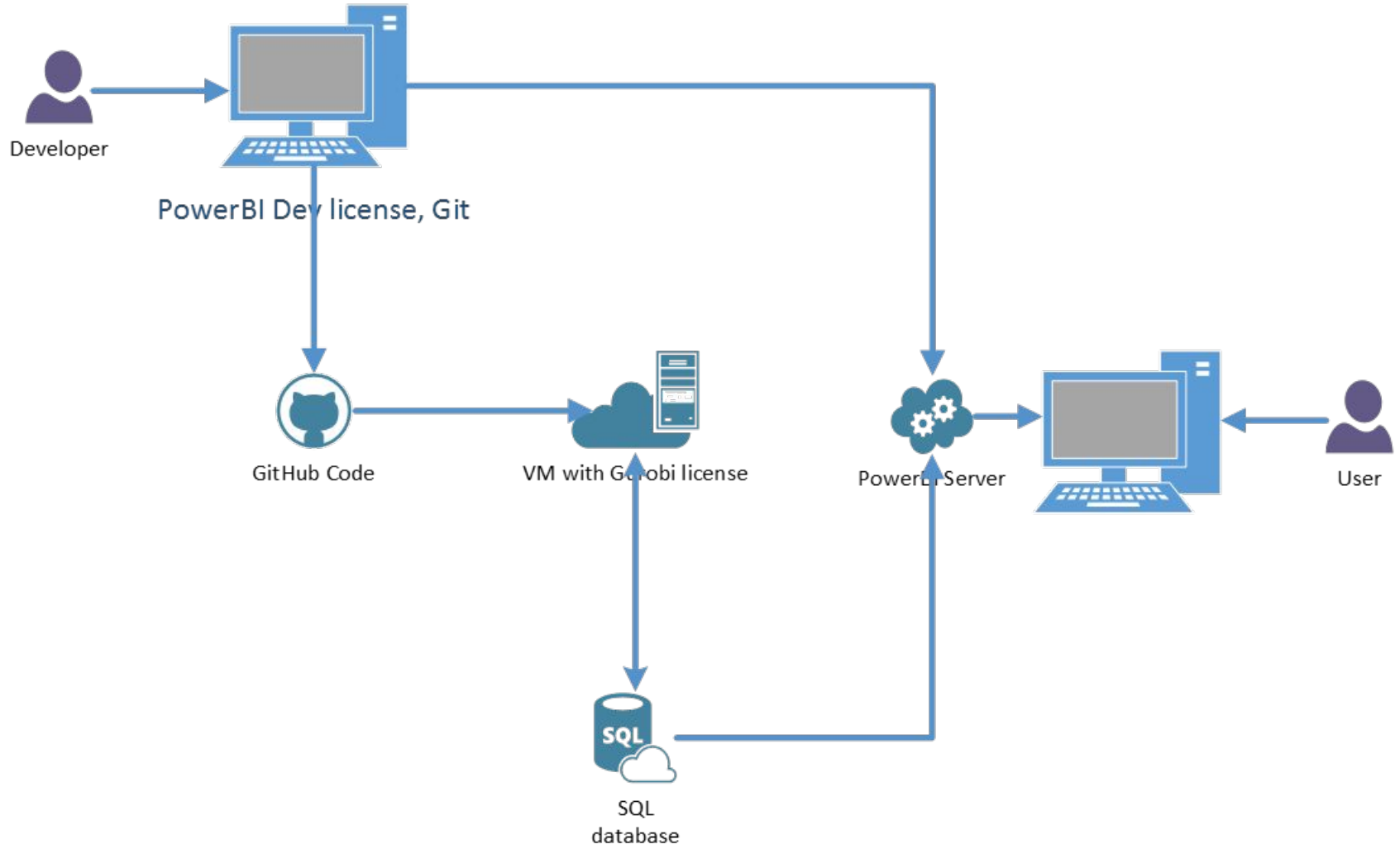
Have a clear vision of with values the project should delivery, in our case was:

- Reduce the number of steps of the bores plan and schedule
- Incorporate the water quantity with the schedule
- Visibility of the schedule of the whole plan horizon, instead of individual weeks
- Allow the user to decide how restrict or flexible the model is
- Possibility to reschedule the production from any point in time - key feature due to bore failure
- added soft constraint to mimic the dynamic of the process
- allow the user to choose which quality constraints are important for each situation.

Solution Architecture

- The solution architecture is the design to deliver the solution in the context of the technology stack available
- You should consider:
  - where the data will come from
  - where the model, solver and algorithm will run
  - how the results will be stored
  - how the results will be ingested into a report or visualisation

Solution Architecture



Flexible Implementation

- Write a wrapper to interact with the solver/s
- Object oriented code implementation

  <insert examples>
- Use switches for indicator constraints to provide flexibility to the user
- Implement each constraint, variable in its own ‘method’ to allow for different versions of the model, controlled by switches

Project value

Direct value

- Identify direct savings in $$ terms.

Indirect value

- The cost of not having this solution, or the cost of going with other solutions.

Value not measured by $

- Risk
- Mental health of users
- Opening up capacity for users to focus on more important tasks

Opportunities

- New insights from the results
- Other ways the algorithm can be used in similar contexts
- New questions that can now be asked

Project value

Direct value

- Reducing variable costs associated with water treatment
- Reducing pumping costs associated with solution

Indirect value

- Reducing cost of making up production with desalinated water

Value not measure by $

- Reducing work hours spent on scheduling
- Reducing **risk** associated with non-compliance, **achieving** the production **target** and water quality **standards**.

Opportunities

- Expand the model to optimize the water production profile for all sources of water
- Use the model to simulate the impact of a bore in the borefiel and indicate which volume and quality is needed in the future

Thank you!

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