

# Memo

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**Datum**

25 januari 2018

**Aantal pagina's**

9

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DDV developments 2018-01-25

## DDV development

In the Hauraki report at Appendix L the user manual of the primary DDV developments have been described (Weeber et al., 2016). This user manual described an water quality mitigation tool tailored to the Waituna Lagoon and Hauraki catchment in which the effect of farm mitigations can be calculated. These mitigations are defined as a percentage reduction or a new areal load for a farm.

As an follow-up of the Hauraki study DairyNZ proceeded with developing a Financial Mitigation Tool (DairyNZ : Weeber, Neal and Burger, 2016) and acquiring the attenuation possibilities for the Waituna Lagoon catchment (Weeber and Burger, unpublished).

DairyNZ has expressed the following wishes concerning the DDV development:

- include the Financial Mitigation Tool in the DDV, enabling mitigations that are based on the farm system mitigation (FSM) and edge of field mitigation (EoFM) principles.
- include the optimisation scenarios in the DDV for presentation purposes.
- enable filtering selection of farms (specifically for Hauraki) based on classification categories (f.e. farmtype, farmsize, subcatchment, soiltype)

Deltares has been able to achieve the following developments:

- integration of the FMT in the DDV
- enabling a dataview for farm specific information
- improvement of DDV setup
- bug fixes

Currently FSM and the EoFM Constructed Wetland, N-filter and P-filter have been implemented for the Waituna Lagoon model. The complete integration of the optimisation scenarios, farm filtering and possibility to implement a self defined natural wetlands are perceived for a follow-up development.

## New features

<i>Topic</i>	<i>Development</i>
<i>User interface</i>	
Scenarios	<ul style="list-style-type: none"> <li>• Farm System Mitigation selection</li> <li>• Edge of Field Mitigation selection</li> <li>• Optimisation Mitigation selection</li> </ul>

User comfort	
User information	<ul style="list-style-type: none"> <li>• Number Farms selected</li> <li>• Farm information</li> </ul>
Developer comfort	<ul style="list-style-type: none"> <li>• Application config</li> </ul>
Aesthetics	
Bug fixes	<ul style="list-style-type: none"> <li>• Mitigations remain visible after deletion</li> </ul>
<i>Calculation core</i>	
Workflows	<ul style="list-style-type: none"> <li>• Separate Reduction, FMT and Optimisation workflow</li> </ul>
Preprocessing	<ul style="list-style-type: none"> <li>• Updated mitigation overview</li> </ul>
Postprocessing	<ul style="list-style-type: none"> <li>• JSON farmdata output</li> </ul>
Modules	<ul style="list-style-type: none"> <li>• FMT integrated</li> <li>• FMT upgraded for DDV</li> </ul>
Bug fixes	<ul style="list-style-type: none"> <li>• FMT EoFM costs calculation</li> </ul>

## User story

DairyNZ will hold stakeholder meetings to discuss potential mitigation plans with farmers. Each farmer knows for his own farm the potential on-farm-catchments that are available for edge of field mitigations, what he is willing to invest for farm mitigations and the mitigations that he prefers. For each mitigation, whether FSM or EoFM, the results show the effectiveness for TN and TP mitigation together with the loss in financial profit.

### *For Constructed wetlands*

A constructed wetland has a gliding scale of optimal implementation. Around 3% of the catchment is the most optimal application. However the farmer has to present to the DDV what part of his land flows towards a wetland (% Mitigated catchment area) and what part of that catchment can be converted into wetland (% of Wetland Area). Please note that NIWA (Tanner, Hughes and Sukias, 2013) has only assessed wetlands up to 10% of the catchment and therefore the tool will limit wetlands to this size. In the result the wetland size is in hectares.

### *For N filters and P Filters*

For N filters only one catchment size-effect relation is known for the Waituna Lagoon and therefore implemented. This relation is derived by DairyNZ/NIWA from EoFM test sites in Waituna ( McKergow et al., 2015; pers. comm. David Burger ). Therefore the size of the N filter is determined by catchment treated. In the results the filter size is expressed in m<sup>2</sup> (relatively small compare to wetlands).

### *Farmers/consultant responsibility*

The Financial Mitigation Tool (FMT) is aware of the area of each farm, the available and suitable catchments and the mitigation relations (FSM and EoFM) for the Waituna Lagoon catchment. However, the available and suitable catchments derived in the attenuation project (Weeber & Burger, unpublished) are absent in the DDV. This gives the farmers/consultant freedom, being able to define themselves for their farm which areas are tile drained ( and therefore are suited for N- and P- filters) and the size of on-farm catchments.

The DDV only allows one FSM mitigation per farm. Currently, it is still possible to define multiple FSM in the viewer per farm. However, in the calculation core, only the first FSM implemented for the farm will be picked up.

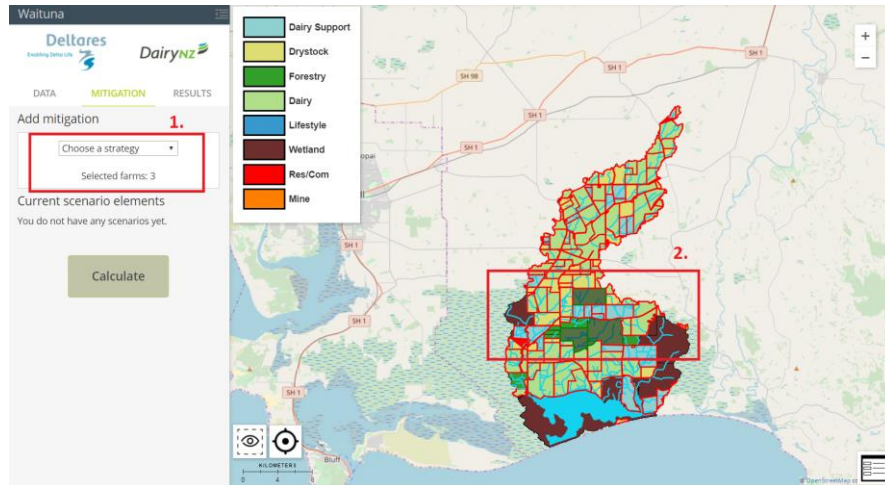
The DDV allows only one EoFM per on-farm catchment. It is the farms consultant/farmers responsibility to have these numbers readily available and to make sure that percentage of the on-farm catchments mitigated with an EoFM do not exceed 100%. The calculation core will check whether the mitigated on-farm catchment areas don't exceed a total of 100% and drop any mitigations applied to catchments that exceed this threshold. Dropping excessive mitigations is not communicated to the user before calculation, but will be visible in the data view per farm after calculation and the model results.

An limitation of the model is that each EoFM Type will be assigned to its own virtual on-farm catchment and only one EoFM can be assigned per on-farm-catchment. In reality, these are lumped catchments where it is feasible to implement this type of mitigation. As the mitigation is defined once per catchment the initial costs are underestimated (bringing out the material, design) compared to the reality where multiple mitigations need to be implemented. However, the scalable costs (maintenance, construction costs) that increase with the size of the EoFM are still realistic.

In the current DDV it is not possible to combine reduction, FSM and EoFM scenarios. If the user chooses to do so, an empty result will be returned after calculation.

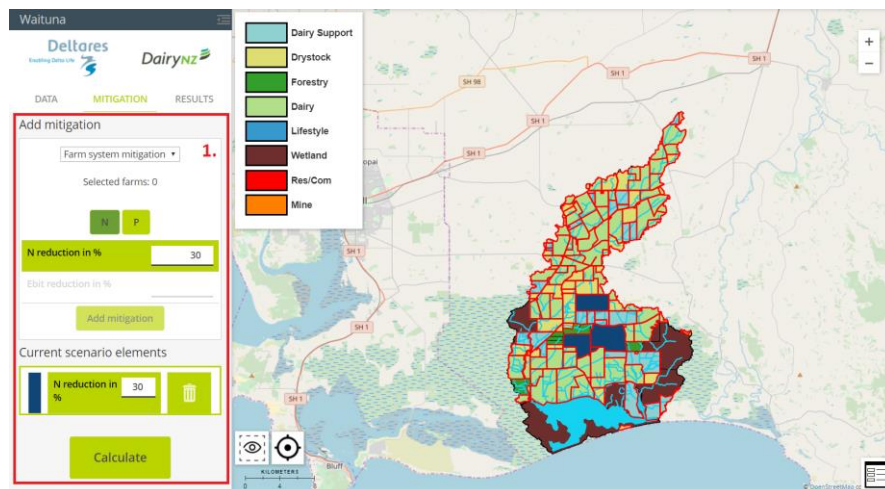
## New Features front end

The new features in the front end have mainly focussed on the Waituna Lagoon Catchment, as for this catchment the required FSM and EoFM information is available.

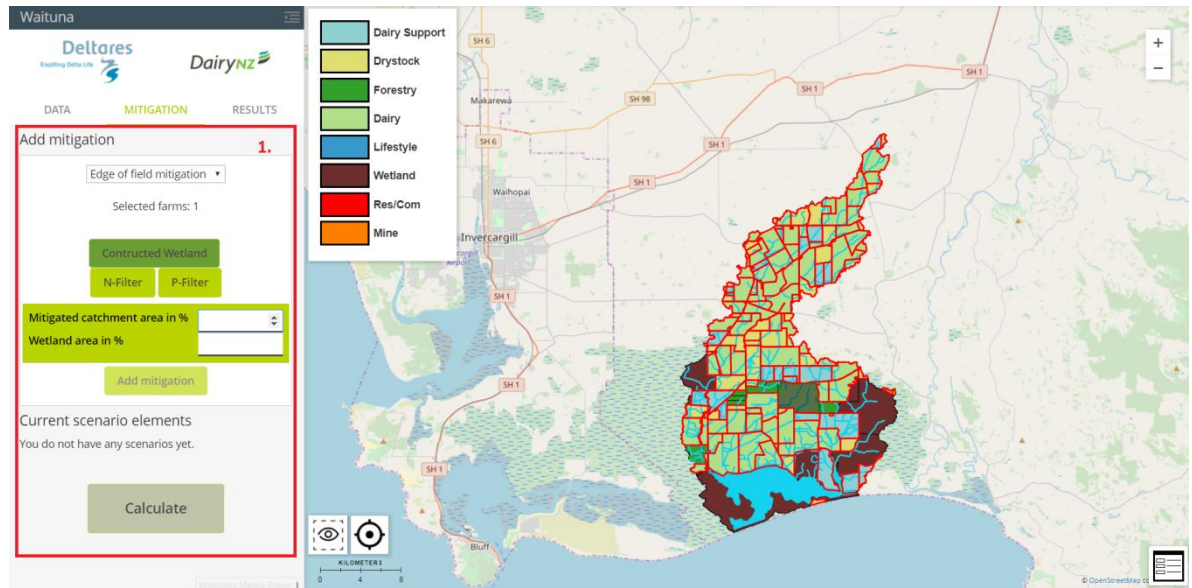


Nr.1 Now it is feasible to select 3 mitigation scenarios, namely “Farm Nutrient Reduction” (old development), “Farm System Mitigation” and “Edge of Field Mitigation”. These scenarios can not be combined (will result in empty output of calculation).

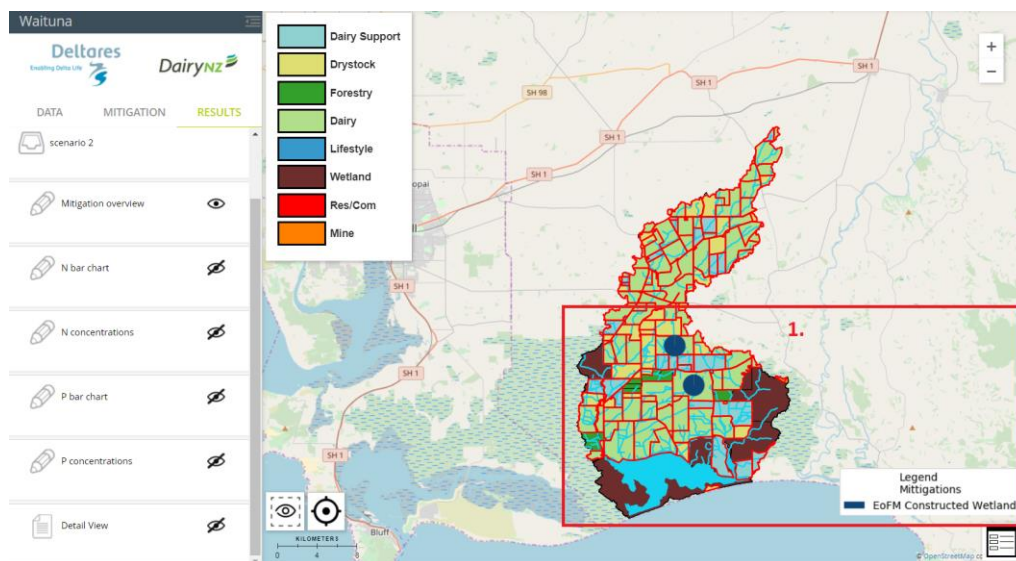
Nr.2 Based on the farms selected in the view, the number of “Selected farms” at Nr.1 will update.



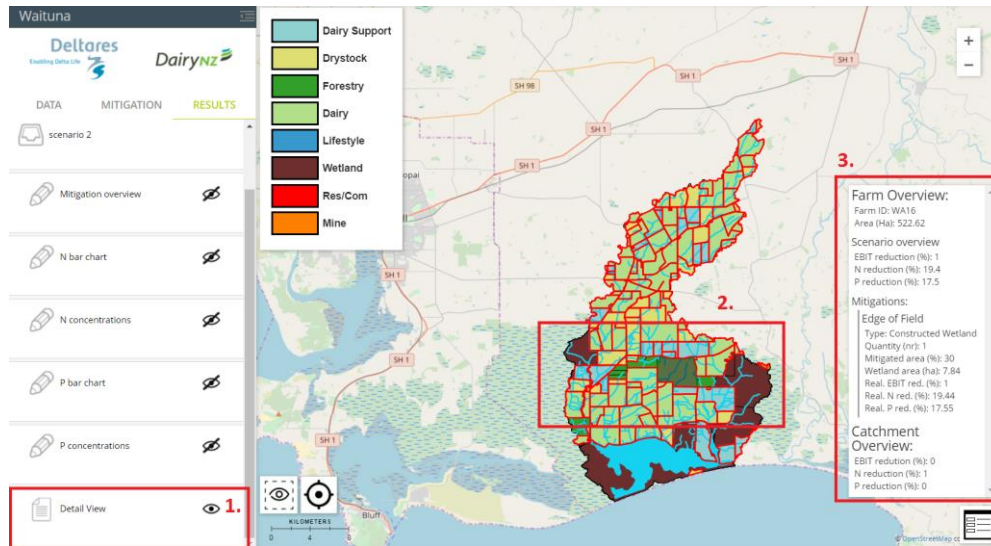
Nr.1 When the “Farm System Mitigation” scenario is selected and farms are selected, the user can implement an FSM mitigation either focussed on nitrogen or phosphorus reduction and its severity determined by a reduction percentage or allowed earnings reduction (EBIT). By adding the mitigation it can be taken up in the calculation. These mitigations are implied on the whole farm.



Nr.1 When the “Edge of Field Mitigation” scenario is selected and farms are selected, the user can implement any of the available EoFM mitigations (Constructed Wetland, N-filter, P-filter). For these mitigations the effect of reduction and costs are determined by the mitigated catchment (as % of whole farm) and the size of the mitigation (as % of treated catchment). For the N-filter and P-filter fixed mitigation sizes as relation to catchment size are used. Each mitigation will receive its own catchment and only one of each can be implemented (when the wish is to implement multiple of the same type of EoFM the catchment need to be expanded, this however only includes initial costs once). Note that a maximum of 100% can be allocated by farm with the treatment catchment.



Nr.1 Mitigations that have been implemented will be shown in the results in the mitigation overview. This excludes faulty mitigations (e.g. more than 100% catchment allocation, combination of multiple FSM per farm).



**Nr.1** With this eye icon the detail view can be switched on in the results. By default the detail view is switched off. For a good overview of the detail view the other results need to be switched off to prevent overlap with legends.

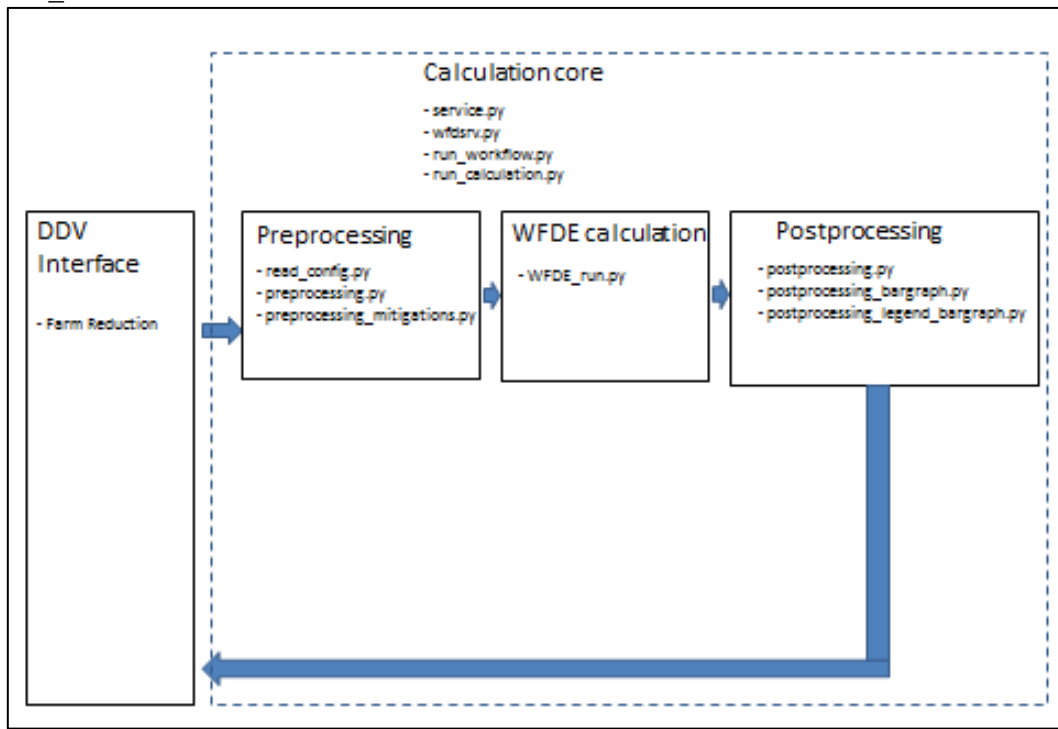
**Nr.2** When no farms are selected or multiple farms the detail view shows the catchment wide result. With the "Reduction mitigation" mitigation scenario this includes N and P reduced. With the "Farm System Mitigation" and "Edge of Field Mitigation" mitigation scenarios this includes loss of operating profit due to mitigations (EBIT reduced).

**Nr.3** When one farm is selected specific information for this farm is shown. This includes farm area in hectares, loss of operating profit, reduction of N and P and mitigations specific information.

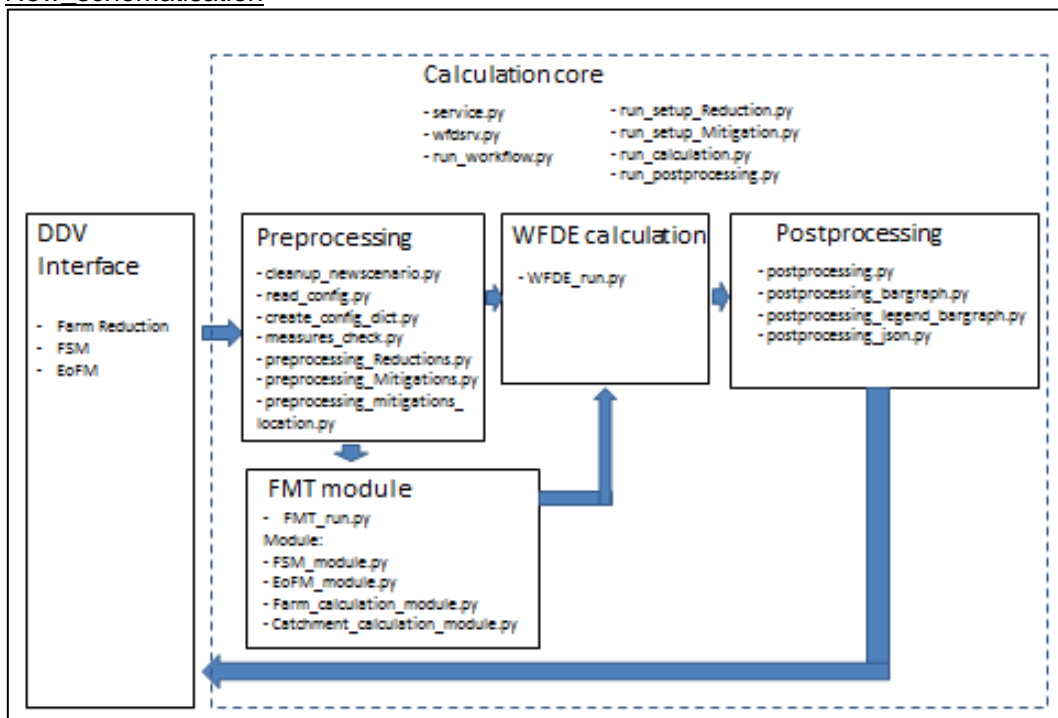
## Back end changes

The back end has changed significantly to enable the FMT scenarios and to enable new features. Each of the mitigation scenarios now has its own workflow in run\_workflow.py.

### Old\_schematisation



### New\_schematisation



## Features to be developed

<i>Topic</i>	<i>Development</i>
<i>User interface</i>	
Scenarios	
User comfort	<ul style="list-style-type: none"> <li>Filtering selection (mostly for Hauraki)</li> </ul>
User information	
Developer comfort	
Aesthetics	
Bug fixes	
<i>Calculation core</i>	
Workflows	<ul style="list-style-type: none"> <li>Optimisation workflow</li> </ul>
Preprocessing	
Postprocessing	
Modules	<ul style="list-style-type: none"> <li>Integrate optimisation results</li> <li>Incorporate Natural Wetland in FMT</li> </ul>
Bug fixes	



## Literature

McKergow, L., C.C. Tanner, E. Baddock, P. Pattinson, D. Burger, J. Scandrett, 2015. The 'Nitrate Catcher' : Design and installation of a bioreactor to monitor nitrate-N removal from drainage water. NIWA report HAM2015-044, prepared for Environment Southland and DairyNZ.

Tanner, C.C., A. Hughes, J. Sukias, 2013. Assessment of potential constructed wetland sites within the Waituna Catchment. NIWA report HAM2013-071, prepared for Environment Southland and DairyNZ.

Weeber, M.P., J. van den Roovaart, E. Meijers, N. Goorden, D. Tollenaar, D. Burger, 2016. Development of a Water Quality Modelling Framework for the Hauraki Plains Catchment. Deltares report 1210754-000-ZWS-0006, prepared for DairyNZ.

Weeber, M.P., M. Neal, D. Burger, 2016. Development of a financial mitigation tool for the Waituna Catchment model. DairyNZ

Weeber, M.P., D. Burger, unpublished. Cost, effectiveness and feasibility of edge of field mitigations for reducing the nitrogen and phosphorus load from farms in the Waituna Lagoon Catchment, New Zealand. DairyNZ