Webinar Q&A - Wednesday 30th April 2025
Whole of system simulation of catchment water quality treatment devices

#	Question	Answer
1	What would be the length of simulation?	Simulations can cover short duration (single event, hours) through to multi-month and even annual and multi-annual. You would want to consider the length of simulation in the design of the underlying hydraulic model to optimise the run times. Multiannual simulations have been undertaken in the past, for example: https://science.desi.qld.gov.au/__data/assets/pdf_file/0031/375763/qwmn-medli-SEQ-new-catchment-models.pdf
	It seems that the hydraulic simulation would be for limited period to reduce run time.	TUFLOW CATCH uses TUFLOW HPC for the catchment runoff component. The combination of GPU hardware simulation speed and TUFLOW HPC sub-grid sampling, and the linkage of surface and subsurface dynamics mean that we can accurately run multiple year simulations using todays technology. This has been done before - TUFLOW CATCH is designed to run for up to multiannual periods so that it can simulate environmental processes of a similar duration. Here's a useful example that discusses these things: https://www.tuflow.com/library/webinars/#oct2023_integrated_water_modelling Here is a report describing a multiannual execution of TUFLOW CATCH: https://science.desi.qld.gov.au/__data/assets/pdf_file/0031/375763/qwmn-medli-SEQ-new-catchment-models.pdf
2	What is the simulation time step in receiving waters (2D domain)?	It would typically be of the order of seconds. The timestep is computed dynamically and is such as to support solution of the equations of motion - i.e. solver for water velocity and depth (rather than using conceptual lumped models)
3	Which conceptual hydrology model is used?	TUFLOW CATCH uses TUFLOW HPC's direct rainfall hydrology. Here is a past webinar of ours that describes the modelling approach: https://www.tuflow.com/library/webinars/#feb2021_direct_rainfall TUFLOW CATCH does not use lumped or bucket hydrology models. It solves the surface and subsurface equations of motion on a grid cell by grid cell basis, with grids typically being in the order of metres or 10's of meters in size
4	You touched on this slightly, but have you compared the Catch results to other water quality modelling software (e.g. MUSIC). What are areas where Catch would perform better? Can you simulate design rainfall like in a hydraulic model?	Second question first: TUFLOW CATCH uses TUFLOW HPC for the catchment runoff component. It solves the equations of fluid motion directly, so does not make lumped assumptions with regard to hydrology. It predicts water velocity and depth on a grid cell by grid cell basis (typically metres or 10's of meters in dimension) and can be used, on a whole of catchment basis, to examine any type of rainfall event, design or otherwise. It can also be used to undertake multiannual simulations and this has done already, for example: https://science.desi.qld.gov.au/__data/assets/pdf_file/0031/375763/qwmn-medli-SEQ-new-catchment-models.pdf First question: TUFLOW CATCH predictions have indeed been directly compared with those of other catchment wide modelling platforms. The report URL above presents one such comparison and provides a detailed assessment of relative performance (especially with regard to hydraulic performance, although water quality pollutant export was also compared). It was found that TUFLOW CATCH was able to reproduce measured hydrographs with a high degree of accuracy, especially with regard to falling limbs, and that this reproduction was absent in the predictions of the lumped model. It was found that this ability to predict falling limbs correctly had a major impact on overall predictive capability of the catchment and receiving waterway models, right through to prediction of phytoplankton dynamics in the receiving waterway. More comparison work is ongoing. In terms of treatment - TUFLOW CATCH has been designed to interface with any other model predictions via the lookup table presented in the webinar. This means that, for example, if detailed modelling of pollutant removal has been undertaken in a different package for a particular wetland (or other device) then this performance/behaviour can be plugged into TUFLOW CATCH and used 'as is' to look at overall catchment wide impacts in the context of a model that explicitly simulates catchment hydraulics and pollutant export. This interfacing ability has been a deliberate design choice for TUFLOW CATCH and if other means of doing so are needed then we would be very happy to discuss how this might occur - our focus is user needs
6	What types of treatment process are used wetlands and bioretention systems etc.?	TUFLOW CATCH does not simulate a prescribed suite of 'treatment devices' as such. Rather, it allows the user to flexibly specify how a given treatment device behaves in terms of pollutant removal. This is therefore a more holistic and general approach to catchment wide water quality analysis and gives the user complete freedom to exercise their knowledge and experience in setting how devices perform, whether those devices be wetlands, swales, bioretention systems etc.
7	Just wondering if you can do sedimentation process using your tool	Yes. TUFLOW CATCH can estimate suspended sediment loads from the catchment. It can also deposit (and report on the depositing) of sediment within the catchment. This occurs where previously eroded sediment enters low flow areas and settles out (at a user specified rate). TUFLOW FV, which is linked for the receiving water modelling can discretely model the sediment erosion and deposition characteristics as well, using advanced techniques
8	Has Catch modelling results been tested against field data?	It has. The Queensland Water Modelling Network (QWMN) and Healthy Land and Water (HLW) commissioned a pilot study to test TUFLOW CATCH last year. Here is a link to the peer reviewed pilot study report: https://science.desi.qld.gov.au/__data/assets/pdf_file/0031/375763/qwmn-medli-SEQ-new-catchment-models.pdf

9	Does the water quality model consider build up and wash off processes and interevent times between events for pollutant loading prediction?	Yes it does. Build up rates are user specifiable and TUFLOW CATCH reports associated dry stores as a function of time for each computational cell. See the CATCH manual for details: https://docs.tuflow.com/catch/manual/2025.0/
10	Is this model can predict blockage on the urban pits and pipes?	TUFLOW can simulate user defined urban pits and pipes and associated blockages. You can specify how the blockage characteristics change for different event magnitudes. The software doesn't automatically predict the blockage values based on catchment runoff details (e.g. associated with sediment).
11	From a water quality perspective where we might be designing treatment trains for pollution management based around a % reduction in TN / TP, etc, is a "lumped" model inappropriate for evaluation of treatment strategies when we *can* be reasonably sure that our flows travel through our treatment train? Would an appropriately designed lumped model (e.g. including high / low flow cutoffs for better representation of treatment train hydraulics) with a reduced timestep (e.g. by using BoM 6 min pluvio data) in software such as MUSIC still provide results inferior to TUFLOW CATCH?	Every model has its advantages and limitations and so cross comparing is therefore often difficult. It is suggested that numerical models be selected that are capable of robustly answering the questions being asked. This is why we discussed lumped models, for example, having their place in very long term broadscale land use change impact assessments, and TUFLOW CATCH having a place in cases where high temporal and spatial resolution is required across catchment larger than a single treatment train
12	Could we have the data set for reference as a practice tutorial? Thankyou	There are tutorials on the TUFLOW wiki: https://wiki.tuflow.com/TUFLOW_CATCH_Tutorial_Introduction
13	It seems that the model can simulate only sediment load as a conservative pollutant. Does the model consider bed load and moving load of sediments, and suspension and deposition patterns?	TUFLOW CATCH allows for the simulation of dynamic erosion and settling of pollutants (not just sediment) in the catchment. This explained in the TUFLOW CATCH manual here: https://docs.tuflow.com/catch/manual/2025.0/ProcessDescriptions-1.html#ProcessDescriptionsSS-3 In the receiving waters, TUFLOW FV simulates a range of more advanced sediment processes and water quality processes. It can be used as a component in CATCH. See here for details: https://www.tuflow.com/products/modules/#sediment_transport
14	Are the pollutant liberation rates based on empirical equations or mechanistic models?	Mechanistic models - accumulation/wash off and erosion models are available. See the TUFLOW CATCH manual: https://docs.tuflow.com/catch/manual/2025.0/ProcessDescriptions-1.html#ProcessDescriptionsMats-3
15	What is the basis for the look up table – using the outputs from a water quality model?	Literature review
16	Is it possible to see the results as concentrations of pollutants? the environment generally reacts to concentrations of pollutants rather than % reductions of same.	Yes. TUFLOW CATCH outputs maps of concentrations in the surface and subsurface water flows
17	Thanks for showing the pollutant liberation experiment - very cool! Have additional experiments been done? It would seem to me that although a real-world experiment has been undertaken, applying pollutant load results to all roads in the TUFLOW Catch is still an averaged approach - similar to MUSIC. Thanks!	Michael is just presenting an example. You can parametrise the pollutant load details to whatever resolution you desire. If you wish to characterise the roads with 100 (or more) different load rates accounting for different road characteristics, you can.
	How do you account for build up and wash off characteristics?	The user specifies build up rates and a time of concentration for wash off for each pollutant and each land use/area individually
18	Can the model also deal with dissolved pollutants other than undissolved pollutants that stuck with sediments and sediment concentration?	Yes, dissolved pollutants can be modelled. They are advected and dispersed with the flow and can be in the surface or subsurface water. The Advection and Dispersion (AD) module is coupled with the TUFLOW HPC hydraulics engine and TUFLOW CATCH module for that purpose.
19	Road sediment pollutant load will vary due to a number of parameters (eg. road age and degradation rate of road, vehicle usage, road materials and constituents, times since last rainfall and intensity of that rainfall, pot holes, any developments in the area eg. muddy tyres, seasonality, etc). It's not static even on the same road.	Noted
20	Is there any continuous field studies to assess the change in concentration and composition of pollutant compared to 2003?	Not as far as I am aware
21	The natural treatment of pollutants depends on their resting or travel time within the system. Does the CATCH model account for resting time attributes in its analysis?	Yes, the pollutants are transported in the hydrodynamic field (TUFLOW HPC and /or FV) so will experience any travel time and residence times that the hydraulics show.
22	Do we need eWater MUSIC any more?	Yes. I believe MUSIC will still be used by industry. MUSIC and TUFLOW CATCH will actually be complimentary in some regards for the specification of the intervention inputs. It is suggested that numerical models be selected that are capable of robustly answering the questions being asked. This is why we discussed lumped models, for example, having their place in very long term broadscale land use change impact assessments, and TUFLOW CATCH having a place in cases where high temporal and spatial resolution is required across catchment larger than a single treatment train
23	Is there the capability to simulate different kinds of pollutants (e.g. TN / TP / GPs) along with custom curves for pollutant load by land use (e.g. a natural environment will have a very different TN concentration in runoff vs a farm)	Yes. Any pollutants can be simulated if their pollutant generation properties can be specified, and these specifications can be varied on a spatial basis (i.e. Roads deliver different pollutants at different rates to grassed ovals etc)
24	Do the treatment device set-ups in Tuflow Catch allow for high-flow bypass of flows around the treatment device?	Yes. TUFLOW HPC / FV, which make of the engines within the TUFLOW CATCH framework, can simulate these directly
25	Are there standard "liberation rates" of different pollutants that have been developed for different land uses within the catchment?	Some are presented in the TUFLOW CATCH manual: https://docs.tuflow.com/catch/manual/2025.0/SimulationConstruction-1.html#tab:tab-PollAccRates
26	Pollutant load is generating using daily time step and hydraulic runs are smaller time step? Pollutant load transport along the waterway may be distorted due to different time steps.	no, the pollutant load is generated using the same timestep as the rainfall inputs, which is typically 6 minutes. 6 minutes is at a fine enough resolution that the behaviours are not distorted.
27	Can the buildup of sediment and pollutants in treatment devices be tracked to help asset managers (ie, Councils) plan maintenance of their treatment trains?	Yes, and that is a great example of using the simulation models to support operational practices. Given the inherent uncertainty is the actual build up of sediments and pollutants in the treatment devices, the models can be used for a range of like weather conditions over a given period of time to understand the range and timing of buildup.

28	Could we factor in air pollution contribution separately in this type of modelling ?	We could add a background pollutant concentration to rainfall in TUFLOW CATCH if required
29	Can TUFLOW CATCH model gross pollutant liberation? Can TUFLOW CATCH simulate a gross pollutant trap as a 'device' rather than a wetland/bio?	Gross pollutants are probably best simulated as particles rather than dissolved constituents. TUFLOW CATCH cannot do this yet, although the receiving water component TUFLOW FV can
30	TUFLOW establishes part of the 'exposure assessment' in the risk assessment framework. A significant complexity with determining the type and extent of WSUD intervention required is establishing ecologically-relevant (ecotoxicological) threshold intervention levels (remediation criteria) for sediments, nutrients and pollutants (individually and cumulative). This is the 'toxicity assessment' side of the risk assessment framework. It's vital to understand ecotoxicity to assess risk and therefore WSUD intervention. This is very complex for nutrients (e.g. N, P) but also sediments. For example, how much sediment load and nitrogen concentration poses an unacceptable risk to the receiving aquatic ecosystem. Nutrients don't have a direct ecotoxicological effect (except at unrealistically high concentrations) but they can have a long term advere effect via the secondary effects on algae blooms. There are published water quality guidelines for some road run-off chemicals but sediments and nutrients are complex.	Noted
31	How do the water quality modelling results of TUFLOW CATCH compare to those of EPASWMM and eWater MUSIC?	At a granular intervention level, treatment efficiencies from other models can be plugged into TUFLOW CATCH via the removal lookup tables. System comparisons against other water quality packages in ongoing. A comparison against one such commonly used lumped hydrology water quality modelling software is included in the following peer reviewed study: https://science.desi.qld.gov.au/__data/assets/pdf_file/0031/375763/qwmn-medli-SEQ-new-catchment-models.pdf
32	1. Is it possible to assess pollutant removal efficiency for nitrogen, phosphorus, and gross pollutants? 2. How can this be linked to and integrated with the sizing of treatment assets in MUSIC? 3. what duration events and multi events should be run to assess performance of an asset? Thank you!	1. Yes. Pollutant removal is specified per treatment device and per pollutant. This could include gross pollutants if they were simulated as dissolved quantities 2. TUFLOW CATCH allows users to specify removal performance and then assess performance within detailed hydraulic regimes (and in a spatially and temporally resolved manner). If other software has been used to develop these lookup tables then they can be easily integrated into TUFLOW CATCH as such - this was a deliberate design intention of TUFLOW CATCH. 3. It depends, but we suggest multiannual simulations to allow assessment of seasonality
33	Am I understanding correctly that TUFLOW Catch is doing only what you tell it to do? You said, you made up numbers for the simulation. In practice I would have to use numbers (removal rates) that are evidence based. Also, what about dissolved pollutants, e.g. Nitrogen?	The removal numbers are user specified, and it is intended that these come from user experience and knowledge, or literature or data. TUFLOW CATCH is not proposing to develop these removal relationships: it allows them to be seamlessly applied in a whole of catchment setting under a range of explicitly simulated hydraulic and pollutant conditions - primarily o then assess how the cumulative dynamic performance (without lumping) impacts downstream receiving waterways. Any pollutants can be simulated (included N) - sediments was just as example
34	What types of treatment devices can be included in the model?	TUFLOW CATCH does not simulate a prescribed suite of 'treatment devices' as such. Rather, it allows the user to flexibly specify how a given treatment device behaves in terms of pollutant removal. This is therefore a more holistic and general approach to catchment wide water quality analysis and gives the user complete freedom to exercise their knowledge and experience in setting how devices perform, whether those devices be wetlands, swales, bioretention systems etc.
35	Thanks Michael on the beautiful presentation. Can you shine some light on potential ways to calibrate the pollutant liberation rate for different catchments where there are limited observations.	Pleasure. Limited observations is a challenge indeed! I can only suggest that literature be reviewed, in a similar way as we undertook in our original TUFLOW CATCH report here: https://science.desi.qld.gov.au/__data/assets/pdf_file/0031/375763/qwmn-medli-SEQ-new-catchment-models.pdf
36	So, Treatment Efficiency will change for short and long duration rainfall. How do you tackle it?	It is expected that short duration rainfall will have higher device inflow rates, and longer duration lower flow rates. The lookup tables for treatment has been designed with this in mind
37	Are TP & TN can be compared along with others	Yes. Any pollutants can be simulated if their pollutant generation properties can be specified, and these specifications can be varied on a spatial basis (i.e. roads deliver different pollutants at different rates to grassed ovals etc)
38	Is the TUFLOW model app available and how can one access it ?	It is. It can accessed through https://www.tuflow.com/downloads/ Demonstration modes can be run prior to purchasing a license to see if it's a fit for your needs ~~for free~~. Supporting documentation is here: https://docs.tuflow.com/catch/manual/2025.0/
39	Does TUFLOW Catch factor in sediment relocated downstream in the hydraulics?	Yes. TUFLOW CATCH can estimate suspended sediment loads from the catchment. It can also deposit (and report on the depositing) of sediment within the catchment. This occurs where previously eroded sediment enters low flow areas and settles out (at a user specified rate). TUFLOW FV, which is linked for the receiving water modelling can discretely model the sediment erosion and deposition characteristics as well, using advanced techniques

40	Would it be fair to say that TUFLOW Catch is better suited to Detailed Design/As-built assessment of treatment systems; whereas MUSIC is more targeted towards conceptual design?	Every model has its advantages and limitations and so cross comparing is therefore often difficult. It is suggested that numerical models be selected that are capable of robustly answering the questions being asked. This is why we discussed lumped models, for example, having their place in very long term broadscale land use change impact assessments, and TUFLOW CATCH having a place in cases where high temporal and spatial resolution is required across catchment larger than a single treatment train
41	At-source treatment would be hard to simulate with the coarse grid resolution?	We typically use 5-20m grid cells size with Subgrid Sampling turned on, and this is ample for resolving the necessary hydraulic and pollutant export features
42	Does TUFLOW Catch integrate with BGC models with reactions for ecodynamic modelling?	Yes. TUFLOW CATCH seamlessly integrates with the downstream 3D receiving water model TUFLOW FV. This means that TUFLOW CATCH can simulated pollutant export and catchment transport, then deliver predicted flows and loads to automatically written boundary condition files for TUFLOW. TUFLOW FV then uses it fully dynamic water quality BGC model to simulate transformation from oxygen up to phytoplankton dynamics. This is explained in more detail in the TUFLOW CATCH manual here: https://docs.tuflow.com/catch/manual/2025.0/Overview-1.html#Overview-1 and https://docs.tuflow.com/catch/manual/2025.0/Architecture-1.html#Architecture-1
43	Can this be extended to quantify the benefit of healthy soils and infiltration. I.e. what is the benefit of shifting land use towards conditions that reduce overland flow and promote subsurface flow?	Yes, TUFLOW CATCH simulates both surface and subsurface flows (and surface land use/perviousness) so these sorts of scenarios are possible. TUFLOW CATCH also reports groundwater efflux and surface water efflux at bottom of catchment and these flows and pollutant loads can be compared under different land use/infiltration scenarios
44	Are there examples in using TUFLOW Catch in the development of sediment and erosion control plans? It would seem that the capability is there to develop detailed plans, but requires some industry acceptance.	Not specifically for SECP but this is an excellent application for TUFLOW CATCH.