# Stormwater Victoria and Clearwater

# MUSIC Modelling Guideline 2024 – webinar 1 May 204

Melbourne Water have released a new version of their MUSIC Modelling Guidelines in 2024 with updates covering information gaps and advancements in both science and industry since the last edition.

This is a recording of a webinar on 1 May 2024, brought to you by Stormwater Victoria and Clearwater, to hear about the changes.

In the webinar, Melbourne Water and consultants E2Designlab share what has changed in this update and why, including a Q&A.

## Speakers

Speaker 1 – Julie Baumann – JB

Speaker 2 – Liv Blair-Holt – LB-H

Speaker 3 – Dale Browne – DB

Speaker 4 – Aaron Zanatta – AZ

**JB**

Thank you so much for attending this

Stormwater Victoria webinar

on the latest Melbourne Water MUSIC Modelling Guidelines.

Next slide please Liv.

Before we get too far, I want to stop and acknowledge the Wurundjeri People

of the Kulin nation, and I'm calling into this webinar from their traditional lands.

I pay my respects to their Elders, past, present and emerging

and I extend my respect to any Aboriginal and Torres Strait Islander

people joining us at the webinar today.

I would like to encourage you to acknowledge the

Traditional Owners of the land from which you're joining this webinar.

You can just type it into the chat function,

and it's a really nice way to bring us together a bit.

Next slide please Liv.

We're going to hear from some presenters

from Melbourne Water and E2Designlab.

The presentation is going to run about

40 minutes and there's a question and

answer session following the presentation.

Next slide please Liv.

'How do you ask your questions?' You might ask.

You will you ask them by typing

them into the chat.

Please include your name and affiliation,

just to make it feel a bit more collegial.

I'll go ahead and ask those questions to the presenters

following the presentation.

If you see a great question in the chat and

you want to make sure it gets answered,

please give that question a big thumbs up.

And just remember that the chat is

a public forum so please maintain

professional language.

Thank you so much.

I'm going to hand it over.

That's all from me. Thank you.

**LB-H**

All righty. Thank you, Julia.

Hi everyone. Thanks for joining us. I'm Liv Blair-Holt,

an Environmental Engineer with an

IWM background and

the Stormwater Adviser in the Flood Strategy

and Stormwater Policy team at Melbourne Water.

Our team's been the one leading the update for this.

I'm joined by Dr Dale Brown from E2Designlab.

Dale is an expert in the modelling and design

of WSUD systems with

an extensive experience across both

development and application of practical

applied models for stormwater

and waterway management.

We'll be joined at the Q&A at the end by a couple

of members from the Melbourne Water team.

So, as a virtual session I know

we'll spread across a lot of different

areas, and our operating area as

Melbourne Water is also across a lot of

country. So Melbourne Water respectfully

acknowledges the Bunurong, Gunaikurnai, Taungurung,

Wadawurrung and Wurundjeri Woi-wurrung peoples as the

Traditional Owners and Custodians of the

land and water on which we rely and operate.

We recognise and respect the

continued cultural and spiritual

connections that Aboriginal and

Torres Strait Islander peoples have with the land

and water they have cared for and

protected for thousands of generations.

Today, I'm on the lands of the Wadawurrung people

in Geelong and I'm sure

many of you are joining from other lands.

I'd like to personally pay my

respects to the Wadawurrung Elders past and present,

and to any people from other communities

who might be here with us today.

So, at Melbourne Water, we have a hand

in managing all parts of the water cycle,

from drinking water,

collecting and treating wastewater,

managing our flood and drainage systems, keeping

our waterways and catchments healthy.

Today, obviously we're focused on stormwater,

at that interface between our drainage

and our waterways.

Today we're going to discuss the

updated MUSIC Modelling Guideline.

I'll talk through a bit of the background,

introduce what's changing, and Dale will get into

some of the detail on the changes and their implications.

We'll give an overview of what's coming next

and then have some time for questions at the end.

Now, there might be some

questions that we can't answer today, so

we'll take them offline and make sure we

get the right answer and make sure it's shared with you.

Background: so the purpose of this document is to provide

guidance on modelling approaches and

input parameters for MUSIC models that

are submitted to us at Melbourne Water.

We receive a large number of these models every

year and this Guideline helps us

and practitioners to model and

achieve the stormwater treatment

objectives by supporting consistent, fair

and evidence-based approaches

to stormwater treatment concept design, by

ensuring that the modelling is specific

to our region's climate and geology

and by making that model development and

assessment smoother for everyone. So, the

2023 release updates the Guideline with

some information gaps and incorporates

recent advancements in both science and industry.

The update was developed with

peer review scientific research and

stakeholder engagement across

Melbourne's stormwater industry.

That process? So, this Guideline

has been updated a number of times

and the last one was in 2018.

In 2020 and 2021, we started the background

work for this, looking at the feedback over

the years, questions we keep getting,

what's changed in the industry and what the

science is telling us.

And we've decided to do this in two updates.

So this one's Release A, which is focused on

that refinement and clarification, making

the modelling that we're doing currently

better reflect what we know.

The next one that we'll work on is called Release B

and that will include more changes

supporting the shift to flow targets,

and many of you will have attended some

sessions on that with us in the past.

That'll be looking at how we understand

the infiltration, evaporation and harvesting in these models.

So, we had a draft document, new climate templates,

that was reviewed internally

and that climate data was

peer reviewed.

A couple of updates: so

the peer review team were happy,

then some broader review subject matter

experts at Melbourne Water:

the Urban Planning Development team,

the industry consultation and that included

feedback from Local Government,

consultants, suppliers and

the Urban Development Advisory Forum

that we had at the time.

So that feedback was received, we had some

follow-up interviews for further discussion,

some final Melbourne Water reviews

and now on to the launch.

So, there are some new things

from the 2018 version, some things that are updated,

some tweaks, some clarifications.

We've added some guidance

on modelling high-flow bypasses and overflows,

wetlands with multiple inlets

and some permeable paving.

We've reviewed those rainfall templates

and updated them. We've had some updates

and clarifications on source nodes, on

modelling sediment ponds, on our outflow

and storage properties, hydraulic routing

and standalone sed ponds and then a

clarification on our stormwater treatment devices.

So, over to you, Dale.

**DB**

Right, thanks very much Liv, for the introduction

and welcome everyone to the webinar.

I see we've still got people coming in

but hopefully we've got most of you here now.

It's really good to see so many people coming.

It's fair to say these Guidelines

have been a long time coming, and

it's really good to see that we're at

this point where we can release them to the industry.

As you'd know, when you start out

setting up a stormwater model,

probably the first thing

you have to get your head around

and deal with is the rainfall,

so that was the first area we directed

our attention to and since the last

Guideline came out, there's been, I guess,

a bit of a step change in our thinking

and in the way we go about doing rainfall

and the main things that have

changed there is that we're now paying

a lot more attention to the quality of the

rainfall that we're using and

we're also looking a lot more closely at the

statistics of that rainfall.

So, what we did is we went back and we looked at all

of the regions across Melbourne,

and we have new tools now, and they're not new

anymore, they're probably 5 years old,

but we have tools that we've developed since

the last Guidelines, that allow us to

infill the rainfall looking at other stations in proximity,

that are closely

statistically correlated with those stations.

And what that means is that

we now have better quality data sets we can work with.

They're not purely data from

that station because we've infilled data

from other stations, but it's at least

still temporally correct. There's different ways of doing that.

We are then

able to make choices about what period

of rainfall do we use, which we've got a

broader selection to choose from because

we've got some better quality data.

But it has also allowed us to have a close

look at the regions we've got, and the

rainfall templates we're using, and think

about whether they're good enough and

they're still fit for purpose, or whether

we need to make some improvements.

Next slide thanks Liv.

So, there were two particular ones

that came to our attention. So, to be honest,

what we found is we did all our infilling

and we did all this fancy stuff,

and the reality is that actually

didn't change things very much.

Yes, we had slightly better rainfall data sets.

We had to make a decision at that point.

We could have brought out new template

for every one of the templates,

or we could just focus on the ones that were

critical and where it was actually

making a difference. And we chose that

latter approach, with the view that

we don't want to make change just

for the sake of making change,

just for a marginal improvement that's not actually

tangibly changing outcomes.

So, we're focused on these two regions where we

know we've got some problems and

we've improved those. But we did also consider

the other ones and it is possible to

update the others, but we don't see a

need at the moment.

Melbourne Airport, we're aware, it's brought to our attention, that there's actually a

four-month gap in the rainfall.

Now, in terms of that's actual impact on

treatment performance, it's not all that

much because things kind of average and

come out in the wash, but obviously if

you're doing stormwater harvesting and you're

looking at reliability, or if you're

trying to do an inundation frequency

pattern on a wetland, or if you're trying

to look at spells analysis for a bio-retention system,

gaps like that start to become a

bit problematic and so we've filled in

that data and we've brought in data from

some of the nearby stations and the

outcome of that is it doesn't actually

have a whole lot of impact on wetland

treatment system areas. They will change

a little, it says there that performance

will slightly improve. It does depend on

your circumstances, not everything,

some will go up, some will go down.

So, it will shift just slightly. You should see

some differences in your Melbourne Airport

models as a result of that.

But rest assured that we now have a

better template and it will be giving you

better results and it

means that when you're doing those

inundation frequency patterns,

you won't have those weird little bits

where everything's flat and the system dries out

completely for a couple of months

and you're wondering what's going on there.

Koo Wee Rup was another one, and this one's a bit of an odd one.

What we find is that as rainfall increases

across the range, generally, broadly speaking,

from west to east across Melbourne,

what we see is that rainfall increases

and the size of treatment assets,

wetlands, bio-retention, generally increases

as the rainfall increases. And we see that

consistently across all of the templates,

except for Koo Wee Rup.

And Koo Wee Rup is something of an outlier

and what we see is that the performance in Koo Wee Rup

is actually higher

than it is in the Melbourne Regional

template and it's actually higher than

the Melbourne Airport one as well.

So, it's something of an outlier

and it's looked a bit odd, and for that

reason we've spent some time and

attention on it.

Koo Wee Rup is right on the boundary of our area

and it probably wasn't the best choice of rainfall station.

Back then, we had to use what we had available.

What we've done now

is we've used Dandenong, which is still near

the coast, but at least it's a bit more

central and a bit further into the region.

And what we find is that

we're getting some more consistent

results coming out of that,

to what we would expect looking at the other stations.

So we think that's a better

representation of what's likely to occur

broadly across the region,

acknowledging that we do have large

regions and that there will be some

variations within those.

But, it's a good quality data set and

representative of what's happening

across our eastern region.

The second thing that came to our attention with

that is that we have some really big

regions that wrap right around Melbourne and

what's happening in the northwest

is not necessarily the same as what's

happening in the southeast.

So we ended up actually splitting this region and

introducing a second rainfall station to

cover those areas in the northwest.

It's called Bullengarook East, but it's

basically, think, Macedon, Gisborne, some of

those townships up around the Macedon Ranges

that it's covering.

And that gives us a better estimate of what is

likely to happen in those areas, which have

similar mean annual rainfalls to Dandenong or Koo Wee Rup,

but the rainfall patterns

in the mountains up there

are actually quite different. And what we see

is that we actually end up with, you know,

an increase in treatment system areas.

We have to work a bit harder to

get the treatment with those different rainfall patterns.

So that's, honestly, probably,

now just reflecting reality

a little better than it was before.

Next slide thanks Liv.

So, another thing we wanted to do was to really look closely at

the wetlands and how we're modelling wetlands.

These are pretty important for Melbourne Water,

because we've got a lot of wetland assets

and they're quite large and significant cost investments.

One of the things that we noted

was that there's some

uncertainty and a lack of clarity

about when do you model

your sediment pond as an inlet pond in your wetland

that's essentially represented as

a single node with a sediment pond and

a wetland integrated together,

and when do you model it as a sediment pond

that's separate to the wetland upstream and

then it's draining down into the wetland.

Now, in MUSIC, when we model two nodes like this,

and we model them as two separate nodes,

essentially what we're saying to MUSIC is,

these two treatment systems are independent.

They do not influence each other,

and the water from the sediment pond is able to freely

drain from sediment pond out into the

outlet and then from there it will flow

into the next treatment device and

there's no backwater, there's no influence of the wetland.

Now, in practice, what happens

is that sediment ponds are often

located just upstream of a wetland and

there's often backwater from the wetland

extending into the sediment pond,

and the outlet from the wetland will

actually influence the hydrologic behaviour of the sediment pond.

Now, that's what the integrated inlet pond and sediment

and wetland within MUSIC is

intended to do in the wetland node.

It's actually got the sediment pond and the wetland

combined together into the one node.

So, what we decided is that we need to provide

a clear rationale for when to use each of these.

So, what we've said is that if you can show

that your sediment pond

is mostly hydraulically independent of the wetland,

then you can model it as separate.

We could have said

entirely hydraulically independent,

we felt that was perhaps

potentially too onerous and unreasonable,

so we've said if it's mostly independent

model it as separate,

but if they're mostly interlinked, and the flows from

the sediment pond are going to the wetland

and then it's backwatering and

they're interacting, then let's model it as a single system.

So, the guidance that we've put

is that if the difference in the

extended detention depths

is more than more than half of the

extended detention depth of the wetland,

then you can model them as independent,

otherwise, do the reverse essentially.

And I've got the, you can see there the, guidance.

Now, that will probably have some impacts.

No doubt some people will find

that when they go from using a

separated system to using a combined system,

what happens in MUSIC is that you

get more bypassing of that sediment pond.

You get a drop in treatment performance

because essentially the wetland is

inhibiting its ability to function effectively,

and so you may find

that you end up needing larger

treatment seds. On the flip side,

that's an opportunity for you to start

thinking about your design and say, well,

if we don't want it to be hydraulically dependent,

how can we design it to not be.

And that might mean you move that

sediment pond further upstream.

It might mean that you split it and model

two separate sediment ponds at different locations.

It might mean that you tweak

the levels that you are using so that you

can make them independent, or it might

mean that you accept in some cases that,

well, actually they were never

hydraulically independent and we really

should actually simply be modelling these

as a sediment pond and a wetland in one node anyway.

And that's fine.

Next slide thanks Liv.

In a similar vein to that, we're

seeing MUSIC has the secondary link functionality

is now well established and embedded,

but we're seeing sometimes

people have some difficulties in terms

of how to interpret the overflows and bypasses.

So, it's worth saying, in MUSIC,

you have high-flow bypass, low-flow bypass,

rear overflows and then you have

your outflow from your system.

The high-flow bypasses and low-flow are routed

entirely around that node and then

the weir overflow is actually routed through

the node, through that particular

treatment system and then is allowed to

spill over the weir relatively quickly

at the downstream end of it.

In a wetland, that functions a little bit

differently because those weir overflows

are actually coming from the sed pond at

the front end of it and spilling out from there,

and they're not passing through

the rest of the wetland to get that additional treatment.

Now, after the node,

all of those are combined back together.

So, you have low-flow bypass, outflow,

weir overflow and high-flow bypass

are all combined together into

the outflows that are reported from

MUSIC from that node.

Now, that is obvious, but it's also not obvious.

And what that means is sometimes

people have two treatment systems in series.

They've got a sediment pond

that's separate and then a wetland,

they've got a high flow bypass channel

that's routing flow all the way around those two assets.

To represent that in MUSIC,

we actually have to explicitly spell that

out for MUSIC and put a secondary link in

and say this high-flow bypass is not

only going around this node, but we're

going to use a secondary link and route

it around the downstream wetland and

then send it into a node somewhere further downstream.

And then in that secondary link,

we'll check the high-flow bypass option

to make sure

that it's sending those flows around it.

So that's just providing some

clarity for people on what MUSIC's doing

and what MUSIC's thinking.

So, there's some guidance on that,

and there's a few different diagrams

just to explain how to go about setting

those up and the thinking for how to model

what's actually happening in practice as

closely and accurately as you can.

Next slide thanks.

So hopefully that guidance will

will help people to have a clearer

picture and a clearer understanding of

what MUSIC is doing and what is

going on under the hood as it were.

On the one hand the purpose of

these Guidelines is just to set out Melbourne Water's

expectations, Melbourne Water's standards,

and what you need to do to submit -

what you need to put into a model that

you're submitting - to Melbourne Water.

On the other hand, we also wanted to be

providing some guidance and

some learning materials so that

new people coming into our industry can get

a better understanding of what's

actually happening, what the models are

doing and to be thinking, when

they're doing modelling, of how do I make

this mathematical model and

representation of a real system,

most closely represent the reality that's

occurring, accepting that it's a

mathematical model, it's imperfect and

we're not going to have everything.

But how do we make it represent it as closely as we can.

So we've also got some basic

guidance on routing.

And it's probably fair to say that universally,

in our industry, hardly anyone is using any

routing at all and that's probably

not the end of the world because if you

use routing, what you'll find is that

usually your results get better.

So, not using it is, in the majority of cases,

conservative, however sometimes that

can break down, or not quite be

entirely correct.

If you do want to use some routing,

the first thing I'd say is

that you need to apply it consistently

you can't just use routing on one link and

not on the other links. You need to do it

consistently throughout your model

wherever it makes sense to put it in.

Anything that's a constructed asset, be

it a, you know, a pipe, or a concrete channel,

you can get away with just using

what's called 'translation', that's

essentially saying this link has a

physical travel time and it takes 20 minutes

for water to get from one end of

this channel to the other. So, we're going

to put that into MUSIC and we're going

to say that's the travel time through this link.

The other thing that you can

specify in MUSIC is the time of

concentration for the catchment.

MUSIC is not calculating that and it's not

explicitly representing that, so if you

have catchments that are different sizes,

and significantly different sizes,

you may want to represent that, you know,

the travel time in one catchment might be 10

minutes or 6 minutes, cos that's the time

step MUSIC is using, and then, in this

other catchment, you might say that it's

18 minutes or 24 minutes.

And what that means, is that that will start to split

the coincidence of peaks so instead of

MUSIC saying all of the water

instantaneously moved through the model

and went from these catchments to this

treatment to this treatment and

everything was instantaneous except for

what was happening inside the treatments,

what it will now start doing is actually

lagging some of those flows so

that they arrive at different times, and

that will mean that the peaks

experienced by the treatments will be a

little less extreme and that generally

you'll see some some better treatment

coming through. But it does become

important if, for example, you've got a

stormwater harvesting scheme, where you've got

a pipe diversion with a fixed flow rate

or you've got a pump with a fixed flow

rate pumping from a storage, pumping out

to another treatment system, or

pumping directly to reuse, that will then

influence the performance that you see on those.

And it will influence how much

water is going to which of those two pathways.

So, that's routing. So if you don't like it,

if it's too complex, feel free to not use it,

but in the interest of starting to

make our models more closely represent

reality, it is something that should be

on our radar and we should be considering,

particularly for larger catchments

and particularly for

stormwater harvesting schemes with

flow-rate sensitive diversions.

Just note on the secondary links,

that you can redirect flows where

you need to and we do this a lot for

stormwater harvesting schemes, where

we've got pumps, but you can also

redirect flows for catchments, so you can

send the surface and base flows to different locations.

We rarely think about it,

but the reality is that, at the

lot-scale, base flows probably are

never coming into our treatment systems,

they're probably just going underneath,

through the ground, and coming out in the

drainage system somewhere downstream.

But we routinely just model them with all

the flows going into them and we don't

really give that a second thought.

But if you want to do your modelling accurately,

you could start thinking about that.

Similarly, infiltration, reuse,

evapotranspiration, we can

can control those if we have a need to.

Next slide thanks Liv.

So another area where we find people

have lots of trouble, and lots of difficulties,

and look there's a few foibles in MUSIC itself that could

probably be set up, and I'm talking

MUSIC version 6.3 here, there's

probably a few things in the model that

that could be a bit easier to use.

One of the things that we see trips people up,

[speaker briefly muted]

you set the extended detention depth and

then you go into your custom stage

storage discharge and what that means is

that the custom stage storage discharge

overrides all user input, so you don't

need to think about your outlet pipe,

you don't need to think about your weir

because all that's overridden by what

you're feeding in. But the extended

detention depth that was specified in

that form before you went into the

custom stage storage discharge is

actually still important, and MUSIC is

expecting that you will provide it with

data for that custom stage storage

discharge curve for everything up to 2 metres,

plus that depth. So, say it's 0.35 metres, such

as the example here, then you need to

give it values all the way up to 2.35 metres in height.

Now, that's not stated anywhere,

it's not obvious, so it's in the Guidelines now.

So, if you're having trouble

and your MUSIC models are giving errors

after you put your custom stage storage

discharge in, have a look through

that guidance and hopefully that will help to clarify it.

Just to step back and say why are we even doing these,

the reason we do custom stage storage

discharge relationships, is that in MUSIC,

if we just put in the basic input parameters,

it's essentially assuming

that the wetland or pond that we're

modelling has vertical sides on it and

that there's a constant relationship

between that depth and that volume.

Now, we know that that's nowhere

near accurate for the vast majority of our assets,

and that if then try and look

at a wetland inundation frequency pattern,

or if we then try and look at

what is the residence time of that wetland,

we're not going to get very accurate

results just using those very

simplified assumptions.

So it's really important for those

particularly bigger assets and the wetlands, and the like,

that we're actually modelling the, you know,

an accurate stage storage discharge relationship.

Now, appreciate if you're

doing concept level you might not have that yet,

so you're simplifying, but at

functional and detailed design we should

have that bathymetry, we should be able to put

those details into the model so we're actually

representing what's happening in real life.

Next slide thanks Liv.

So, we've had a fair bit of focus

on the wetlands and we've really spent a

bit of time trying to just provide

clarifications, tightening things up a little,

sort of, maybe, possibly closing

some loopholes but also providing

clearer guidance and clarity so that

people are able to model more

consistently and with greater confidence.

It was mentioned before that

we're heading towards Release B and

Release B will introduce flow objectives

and how to model those and it will

introduce a number of additional

treatment types and classes that we're

not currently providing guidance for,

but we know are out there in the industry and being used.

We did manage to slip one in

to this set of Guidelines.

So we have permeable paving.

So we've provided

some recommendations for how to model a

permeable paving asset or system

using the media filtration node.

Now, that's not the only way of doing that,

but it's possibly the most common,

hopefully the most common.

We are making an assumption here that you have

a permeable paving asset that is, you know,

maybe being used for car parking or

or similar purposes, that you have

an asset that has underdrainage in it and

that the water will flow through

that system. Ideally it will infiltrate

to the subsoil if your subsoil supports it,

but then you may also have an underdrain

sitting in the base of the system, or

preferably not in the base, but a little

bit higher, so that water will

preferentially infiltrate.

But if necessary, water will also be carried

away by that underdrainage so that

we're not saturating the pavement,

we're not saturating roads adjacent

and we're not, you know,

saturating trees that are growing there.

So you'll have that underdrainage.

Next slide thanks Liv.

So, permeable paving, there's different types,

there's various guidelines and so forth out there, but it could be

porous concrete, could be porous asphalt,

could be the interlocking pavers and

then there's a few other weird and wonderfuls,

there's grass and gravel wave

and all sorts of things.

So this will

provide you some guidance on modelling

these various different types of

permeable pavement and it's probably

fair to say there hasn't been a lot of

uptake of this in Australia compared to overseas

and hopefully providing this

guidance will will help to facilitate

and enable some of that.

At the same time, we appreciate that it's a lot easier to

do a small raingarden than trying to do

a very large expansive permeable paving.

There's maintenance implications and all that,

but it is a good solution,

and application for certain circumstances.

Now, MUSIC does have a few limitations.

We're using the media filtration node,

which is originally set up

based on a set of data that was

focused mostly on sand filters and proprietary filters.

And that work was

done by Hugh Duncan maybe about 20 years ago now.

That data set did include a

number of gravel filters that more

closely represent what's going on in a

permeable pavement in terms of the

gravel aggregate that's sitting

underneath it and the likely performance.

So, it's an adequate and good enough

representation for now of the

stormwater quality treatment performance,

but it is dated and it's by no means perfect

and that's an area that we have on our radar for future improvements.

MUSIC doesn't represent evapotranspiration in the media filtration node

and we know that some of

these pavements will be doing a bit of evapotranspiration.

It's probably

conservative to leave it out.

And we're not representing clogging and we know

that these assets will clog up over time.

We've done a bit of work on those and

what we are saying is that you need to

use a conservative saturated hydraulic conductivity.

The manufacturer

will say we can infiltrate water through

the system, it's got an infiltration rate

of 4,000 millimetres, an hour. And it will.

For the first week that it's in place.

But that will decline, and the evidence

we have from the work we've done to date

suggests that it will decline

exponentially - it will drop off quite

rapidly as sediment starts to accumulate

and build up in that pavement.

That said, it will retain a

reasonable hydraulic conductivity for

quite a long period of time and we've

tested systems that are five, six years

old that are actually still working

quite, perfectly, well, they're not

hitting 4,000 millimetres an hour, but they don't need to.

If they're doing 50 millimetres an hour,

that's enough for, you know,

any rainfall that we're interested in for

water quality and for stormwater treatment,

and it'll even do a pretty decent job

of managing, you know, even a

one in 10-year flood event, so it's still pretty good.

The guidance we're giving is

conductivities, please set it to

somewhere in the range of 100 to 200 mm/h

recognizing that that's a lot less

than what's theoretically possible, but

also balancing that clogging risk.

We would note we did consider

using the infiltration node and for

systems with no underdrainage we would

potentially still revert to using that.

One of the limitations is it has

nothing in it to do with the media

or later treatment performance, so

it's really just representing that void

as a pond essentially,

as a storage with a porosity that's limiting it.

Now, MUSIC isn't the only thing

that's out there in terms of

tools for modelling stormwater and it

isn't the only one that you should

necessarily be thinking of so I would

just draw to your attention if you're

modelling permeable pavement that there

are other tools and that they can

provide some guidance on the structural inputs.

I'd probably use MUSIC for water quality,

but for structural, be aware

that there's some other considerations.

So I would say have a look at DesignPave,

but not only do that, but talk to

your proprietary manufacturers because

they have a really good knowledge of

what's going on, and talk to your

client about what are their common

design practices because you might find that

what you're getting out of MUSIC or

what you're getting out of DesignPave

doesn't always align with what's

actually happening in practice and you

might need to make some adjustments or

tweaks to either your modelling or your design,

to get a good solution.

Sorry, we're departing a bit

from pure MUSIC guidelines here.

Next slide thanks Liv.

Okay, now there's a couple of other things

that we've got in the Guidelines.

And this is really intended

as a bit of a clarification,

but, there's been some concerns

raised that standalone

sediment ponds are getting used

occasionally and usually the use cases

for these will be where you've got a

development, you've got 80 or 90% of

it going to your main treatment train

that's going to your sediment pond and

your wetland as per usual, but you've got

a little bit over on the side that is

draining off to its own little area, and

you can't get it back into the main drainage

pathway, or going to a

different catchment, going the opposite

direction entirely, and maybe you don't

have the space to actually get full

treatment train in place because, you

know, maybe there wasn't consideration

in the early stages of planning and

design of that land to say, well, where

are we putting our water sensitive urban design assets?

And we need to be setting aside these spaces.

There might not have been

that thinking, and physically and

practically sometimes the landform

simply doesn't allow for it. So what we

see is sometimes we're getting these

standalone sediment ponds where you've

just got a sediment pond where we say,

look, can't do everything, but at the

minimum let's get sediment treatment in,

because you're chasing a high target for

sediment - it's 80%. If you miss 10% of

your catchment, that means the rest of

your catchment you've got to do 90%,

and then diminishing returns kicks in,

and getting that extra 10%, you know, you

end up with a huge increase in your,

in what you have to do to get that sediment

out because you've got that other

catchment you're missing.

So it's better often in those cases to put that

sediment pond on that additional catchment.

That said, what we're seeing

is that some people are taking advantage

of that opportunity, and maybe

sizing those sediment ponds a little

larger than is really necessary for

coarse sediment removal and really necessary

to meet, you know, the guidance,

which is providing guidance on

appropriate sizing for sediment basins to

remove that coarse sediment.

There's been some more work done and research done

on nutrient removal in ponds, sediment ponds,

and wetlands, and that's really

firming up the long-held views that

vegetation is really important for

nutrient removal, that, yes, the ponds are

great for providing sediment settling,

there will be a certain amount of

settling of particulates in these systems,

but we really need vegetation to

be actively taking up those nutrients,

doing something with them, removing,

binding them up, taking them out, you know,

allowing it to return to the atmosphere,

binding it into the soil.

We need plants in these systems for

that to happen and we're seeing a really

significant difference in the performance

for nitrogen of systems with

vegetation versus those with no vegetation, or not very much.

What we're saying is for these systems we really

shouldn't be assuming that there's

nitrogen removal and, look, by extension,

we could be suggesting that we should be

assuming relatively little nitrogen

removal in any of the sediment ponds.

As a compromise, what we're saying

is that if you've got

sediment ponds upstream of wetlands you

can still assume that they're effective

for nitrogen because that will just

offset what the wetland's doing, but where

we've got the standalone systems,

what we're saying is, now, please

set the k value to zero, which is essentially

saying let's assume no nitrogen treatment in these systems.

You know, what's the right answer? At probably 5 or 10

or something. It's not 300

but it'll be somewhere in between.

To be conservative at the moment we're saying

set that to zero. We understand and

appreciate that is going to have some

impacts in terms of how these systems

are designed and what may get rolled

out in the field, so we will have some

further discussions around that just to

understand how that's

playing out in industry and whether we

need to make any tweaks to that in future.

Next slide.

I think that's me, so I'll hand back to you to continue on.

Thank you.

**LB-H**

Sorry, just struggling to come off mute there.

So, the proprietary products.

So this was in response to

some industry requests just clearer

guidance on our approach to the

proprietary treatment products.

We do acknowledge that they play an important

role in a lot of places as part of

the solution for stormwater management,

but they may not be a replacement of

nature-based solutions in our

Development Services Scheme. And, you know,

where we're not the decision maker,

that's up to the other decision makers.

We do support a national approach for

proprietary stormwater treatment validation.

I think that covers it.

So, to wrap up, in summary,

So, the cut-off for submitting

new models following the old Guidelines

is going to be the end of this

financial year, so June 30th, 2024.

Those new rainfall templates will apply.

Dale's been through

the sediment ponds and wetlands and

the nitrogen removal, and those

proprietary products, manufactured devices.

What's coming next? So we're going to

continue the transition to these updated Guidelines,

and retire that old one at the end of June,

and after that we'll have an update

to the Practitioner's Note to make sure

that the numbers for those rainfall

templates are in line, because that

refers to the rainfall templates.

The MUSIC Auditor's getting updated as well

to match those new templates.

Those old documents are still up

on the website for reference, and they will

get removed eventually,

so if you want to archive them, please do.

We are also working

on the Emerging Assets documents.

Many of you will remember from previous

Stormwater Vic sessions that that's bringing

together information on assets that are

focused on stormwater harvesting and infiltration

and, when we release that,

we'll have another update to the MUSIC modelling Guideline,

which will integrate those assets.

And that's time for questions. So, yeah.

I do want to preface this, as I said

earlier, there might be some things that

come up that we can't answer today,

and also maybe you'll think of other questions

outside of the session as you're

getting used to following the new Guidelines.

So, for any of those,

we'll follow up, if you send them through to

the enquiries@melbournewater.com.au email address.

And I think it's back to Julia.

**JB**

Hello everyone.

There's a lot of great questions coming through.

Bear with me. Any ones that we miss in this live

session I will send through to the team

at Melbourne Water to answer offline.

We've had some good answers also in the chat,

so if you've asked a question,

feel free to flick through, there's been some

really good peer answers.

Really quickly, just start with some questions

just generally about the Guidelines.

Anne - asks: is it still correct to refer

to the Urban Stormwater Best Practice

Environmental Management Guidelines

Stormwater Victoria, Stormwater

Committee 1999?

**DB**

So, if no one else wants to take that I

think the answer to that one is: Yes.

We are still using BPEM. Obviously, the

EPA Guidance has changed and so

the references to all the EPA Acts have changed,

but they are still pointing back

to the CSIRO guidelines and BPEM at present.

We'd love to see that updated

at some point, but that's an even bigger

task than doing these Guidelines. So, yeah.

**JB**

Sounds good, I'm going to switch

over to some questions about rainfall generally speaking.

Jessica - asks:

How was the data infilled from the nearby

stations for Melbourne Airport?

Was it just a direct infill for the missing dates?

Or was it a bigger job?

**DB**

Yeah, so, with the infilling,

we are doing what you've said,

is that we're looking at the other stations

in proximity, and we're infilling.

So, we're only infilling where there's actually missing data.

If, you know, if the BOM

says it's zero rainfall, we take

their word for it that it's zero rainfall on that day.

So, we're only taking the dates

where the BOM has tagged it as being

missing, or accumulated data and says

we don't actually have good data for these periods.

And what we're then doing, is

we're looking at the stations

in the vicinity of that station, we're

identifying which one has the highest

statistical correlation so it's the

closest in terms of those two

stations having similar data, which isn't

necessarily the closest station because

if you're, you know, if you're in the

hills, what you can see is that the

rainfall can change very quickly in a

short space. Sometimes the best

station to use is not the closest, but

we're generally adopting the, you know,

the best, most representative station,

we're taking data from that. It then

goes to if there's no data there, it then

goes to the next station, and then the

next station, and we allow it to do

a range of different stations and bring in that data.

So the idea is that using

the best available data for that

particular point in time to infill.

Now, because of that particular process, it

means that there are still gaps in the data,

because sometimes there is no data

available and we haven't infilled everything.

But they're much much much less than

they were, and we're then reviewing

the quality to make sure that we've

actually got good quality data sets afterwards.

But it also means that

we're confident that that data is

somewhat grounded in reality - we're not

just stochastically making it up, which is

not to say that isn't a valid and alternate approach.

Realistically, I think,

in the next set of Guidelines we bring out,

there's probably going to be a

step change in rainfall and we'll probably be

using longer templates we'll probably be

using multiple templates not just one

and you'll probably have both current templates

and future climate change projections.

But that is going to take a bit of work.

So it's probably going to be

not the next set of guidelines, it'll be

the one after in three years' time or

something like that.

**JB**

Got a follow-up couple more

great rainfall questions coming from

Niels - , and, probably Dale

you've touched on it, but Niels asks:

has Melbourne Water, and I suspect you too,

investigated the viability of using

synthetic six-minute data, to remove

any errors related to physical rain

gauges in real life?

**DB**

Yep, we have.

And we've tried generating some

synthetic data there's a couple of

different approaches out there for doing

that, we've looked at using

the GCMs, or the Global Climate Models, and,

to be fair, I should say we haven't

looked at it actually other people have done that work.

There's been a review of that data

and we were very hopeful that that would say

we could make use of that.

It actually, it said, it was

fairly confident in the daily data that

was coming out, but it raised some

questions about the sub-daily and

particularly, you know, the hourly and six-minute data.

There's some limitations

there, there's some really good data sets

but they're only available at 30-minute

not six-minute. Six-minute data that's available,

there are some limitations

in terms of trying to predict and

generate that data. You really

need to go back and really closely look

at whether you're representing

the statistics, the patterns of the

actual historical rainfall. Whether

you're capturing the peaks and

whether you're getting that balance of

all those things and we may find

that we actually have to use different

data sets, you know, some that are

suitable for stormwater quality,

but maybe aren't quite getting the peaks,

and then other ones that are suitable for

say flood modelling, where those peaks are

really critical but maybe, you know,

the intervening dry periods aren't quite

as good on that sort of thing.

To be honest, I expect, as I foreshadowed, that

in the next round we quite possibly will

be moving to using stochastic data or

using a blend of historical and stochastic data.

**JB**

Brilliant.

As a follow up, I've got a couple of questions

related to how the rainfall templates

do or do not include

the impacts of climate change and how

practitioners might be able to adjust them

to allow for climate change. Do you

have any thoughts on that Dale?

**DB**

Firstly, they do not. They are based on

what is the long-term statistical

historical average using as much data as

we have available, for as many stations

region, so that we're making full use of the data.

What we will probably be doing in the

next round is that we will be saying we

are only going to use the last 40 or 50 years of data,

accepting that there has

already been significant climate change

that has occurred and we are already

seeing trends and shifts in the rainfall

and that will better reflect what's

happening now, but also balance making

sure we've got a decent amount of data.

We've just had 15 years of

millennium drought and then we've had 10 years

of above-average rainfall.

If we use anything in the last 25 years, it's

not going to represent any reality of

what is likely to happen in the future.

So, we need to be careful in what we're

picking up and what we're using.

We need to make sure that we've got a

long enough period that we're representing that.

Future climate change projections,

wonderful. We've built some templates for that,

we've got templates for a

future dry case, we've got templates for

a future wet case, we've got templates

for something in between. What we find is

that the most conservative templates for

stormwater quality are either the current ones,

or the ones that predict a

wet, low-increase-in-temperature future

where there's not too much change.

That's not surprising, because that's

saying that the rainfall is not dropping off too much.

The hot, dry futures will

have a big impact on stormwater harvesting

and we'll see that drop off.

That said, the worst case we've seen is about a

10% decrease in yield. But, what we see

with those templates, is that you get

better performance out of your assets,

and they're actually non-conservative.

If we think about it that we should be

considering both or multiple cases, then

the one that will actually be driving

our sizing will either be the current one,

or the wet, not-so-hot future.

Which is still a possible and

valid possible future that will be driving

our sizing if we start doing that.

So, we've come back to, we might as well just

continue using what we've got now.

Thank you.

**JB**

Thanks so much, Dale, for the detailed answer.

We have many, many,

really technical questions on

modelling assets in MUSIC

and I'm going to hopefully get through

a couple of these, but it's going to be an

in-depth answer and I'm going to ask you

all to please come back to us and

to look for a better answer via written response,

because we're not

going to get through all of them in 15 minutes.

So, Dale, I'm just going to start with some questions

around sediment ponds, because that was a big part of your presentation.

Guyani asks: can you please clarify how to model wetlands

with multiple sediment pond inflows,

particularly if they're not hydraulically independent

like your handy figure in the presentation?

**DB**

Yeah, okay, yes, we have

provided some guidance around

these multiple sediment pond inflows.

Where they are hydraulically independent

it's a little more straightforward,

because you can model that as a separate

system and then you can split that

system to represent the different

inflows coming in. So, you can

proportionately say, 40% of the inflows

coming off this flow path and will size

the sediment pond accordingly. This one

60% will size it accordingly.

Where it's hydraulically interconnected,

then we really do need to have it coming

into just that single node, and

representing that as a single system.

In those cases, then, there are some

limitations of what we can do, so we are

modelling it as all coming into one.

We have given some fairly detailed

guidance on that in the Guidelines.

I didn't cover it today, just in the

interest of not being able to get

through everything we've got.

That said, please have a look through those,

see if it makes sense to you,

if you've got any questions or you're still not clear,

come back and let's talk.

We need to make sure this is clear

for everyone, and we've all got good

pathways forward.

Also, you know, I have some good ideas and

I have some experience modelling, but I'm not

the be all and end all. There's lots of smart

people out in industry. So, if, together, we

come up with a better way of presenting this,

or even a better way of doing this,

then let's work through that and

work out what that looks like,

and then we can look at bringing that in when

we do Release B, which hopefully is not too far away.

We can look at making some tweaks to these Guidelines.

So, we're probably in a unique position that

the next update of the Guideline isn't years away.

**JB**

Excellent. Just being wary of the time,

I've got a question from Hamid, and he asks:

for the single wetland node, how do you

model the stage storage discharge relationship

for the sediment pond proportion?

Just because it does get a bit tricky in that design stage.

Do you have any great advice on that, Dale?

**DB**

Yeah, I understand.

Look, it's, you've really got

to look at how the system's working and

how it's connected.

What I would probably come back to is that,

if it really is not hydraulically independent,

then, the wetland outlet and

the control structures on the wetland

are going to be driving a

lot of what's happening in the sed pond.

So, what you would probably come back to

is representing that as one system

and modelling all of your storage

as one connected, cohesive system,

regardless of whether that storage is

sitting in your wetland or your sed pond,

you'd model that all as one system in

terms of setting up your state storage

discharge curve for your wetland.

So, you just be putting in one setup.

Now, that does mean that you lose the intricacies

and the detail of exactly what's going on

in terms of those connections between

the sed pond and the wetland, if you've

got pipes that are restricting flows and

limiting things, you're then not fully

representing all the detail of exactly what's going on there.

That's a trade-off we have to make.

Look, the other way of doing it,

is to look at whether you can get,

you know, enough separation between the two.

You might tweak your extended detention levels,

you might tweak exactly where your sed pond's sitting, or

the level so that you can get it

independent and then you can more

accurately represent what's happening

with those, you know,

structures, pipes and weirs and whatever,

connecting the two systems.

Look, we're working within the limitations of an

existing model. In the future,

maybe we can improve what's actually

going on so we can represent that more accurately.

**JB**

Thanks so much, Dale.

One more technical

modelling question, just while we've

got you on the line, Niels - asked:

on stage-storage discharge curves: is it

fair to say we should only really use

the generic orifice diameter, or

parameters, early on in the design process

to guide what's necessary, to

achieve that 72-hour detention time and

then move to a custom stage-storage approach,

as soon as you have any real design information?

**DB**

Yeah, Niels, in an ideal world,

yes, we should be doing that as

much as we can.

In practical terms, it's a lot more effort to set that up

than it is to just use the conceptual modelling,

so, there is a time and place to

do that high-level modelling where you're

doing a lot of change to the design and

the systems and there's a lot of flux.

Or, you know, if you're just doing high-level

prioritisation of assets and

you're trying to model 20 different wetlands,

you're probably not going to have

that data and it's going to be too

much work to keep changing that.

But certainly, once you get into a

functional or a detailed design and

you've got that data, absolutely we need

to be putting it into our systems.

But it is that balance of effort versus accuracy.

We do need to have that in mind,

we can't just make everyone do it all the time.

Thank you.

**JB**

I've got a couple of questions.

We're just kind of heading towards the wrap-up stage.

I got a couple of questions, one from Niels - and

one from Patty -, around how the

performance of an asset changes over time.

Patty asks: how does the MUSIC model,

how does it assess the asset life-cycle performance?

And Niels asks a very similar question:

how do you take into consideration

the degradation of those assets over time?

**DB**

Yeah, great question. I was talking to someone in

asset management yesterday, actually, and

we're talking about, with WSUD assets,

they're a little bit unique. They're not like

roads or other assets which degrade

with a fairly, not linear, but a fairly

predictable profile over time.

A sediment pond accumulates sediment and

its effectiveness can degrade over time

as it fills up with sediment and maybe

it isn't able to trap as much and

capture it as effectively. The same can

happen with wetlands, and even bioretention

and permeable pavement,

that's why we have those requirements about

being conservative about the hydraulic conductivities.

And that's trying to get an approximation

of what is its behaviour

over a period of time, with maybe a good

starting point and then a lower,

lower ending, point.

That said, what

we're also seeing is that wetlands

mature over time and the plants establish and

they grow and they get bigger,

trees grow and they get much larger if

we're doing passively irrigated street trees,

raingarden media gets more established,

and what we're seeing is some of the

evidence is actually suggesting that our

WSUD assets can get better with time and,

as those assets mature, they can actually

become more effective at doing their job,

because they've got better vegetation,

they've got more root systems established,

more canopy cover.

And, so, the value and the benefits of these

assets can decrease due to some factors,

but it can also increase due to other factors.

MUSIC is assuming

everything is static, and it's a single

point in time, and we're really trying to

do an average approximation across that

20- or 30-year life cycle.

Asset management people are starting to talk about,

how can we start capturing those,

both declines and increases in condition,

and capture that we're not yet there

with MUSIC in terms of capturing it.

That said, there are clogging models out there.

I did it for my PhD and Nilmini Siriwardene did her

entire PhD on modelling clogging of infiltration systems.

And permeable pavements are the same.

There is science out there that could be built

into the models, it just hasn't happened yet.

**JB**

Excellent, I've got a couple of questions,

this is probably for the Melbourne Water team.

Inoka asks: was there any consideration to the Melbourne Water

Healthy Waterways Strategy requirements

in updating these MUSIC Guidelines?

**LB-H**

I'll jump in for that one.

So, the flow targets and stuff is going to come through in Release B.

So, not in this one so much, but stay tuned.

**JB**

Thanks, Liv.

I've got another one probably for you.

And this one comes from Tess, and she asks:

would you like us to put our feedback somewhere

publicly for Release A?

Are you interested in industry feedback on Release A?

And if so, where's the right place to put?

**LB-H**

We haven't got anything set up at the moment,

but I will look at what we can do.

**JB**

And there's a few questions in there, as well, with a

lot of technical ones that

we haven't been able to get into.

So, we will keep in touch with the industry,

and make sure that we can support the transition.

That support of the transition is probably

where I wanted to end things and wrap it up.

There was a great question from Val in the chat,

saying that a lot of this modelling is

fairly technical MUSIC modelling, and

will there be some training courses and

will there be some support in the industry?

Because this is leveling up our, what we usually do.

**AZ**

Hello Val, it's Aaron Zanatta,

Manager Stormwater Policy and Flood Strategy.

We'll take that question on notice, Val.

Really good point, and we'll have a look

and see what we can do

and get back to the group.

Definitely want to see if we can help in any way.

Not sure what that'll look like.

So, I'll take that one on notice.

**JB**

Brilliant. Thank you all so much for coming.

There are way more questions

than we can get through with Dale and Liv

and the team from Melbourne Water today.

Liv, if you could pop that last slide up,

I'm going to wrap things up,

and we're going to call it a day.

Thank you so much for coming to this technical webinar.

Please give Stormwater Victoria two minutes of your time

and complete the exit survey,

just to let us help bring you better technical content in the future.

If you enjoyed this presentation, please consider

becoming a member of Stormwater Victoria.

We do great events like this all the time.

And if you got really excited to learn new things

and chat to experts,

consider attending the Stormwater Victoria conference.

It's in San Remo at the beginning of June and

information about registration is

available on the web.

Thank you all so much for joining us.

Thank you for your fabulous questions.

Thank you for your patience with our technical difficulties.

Have a wonderful day.