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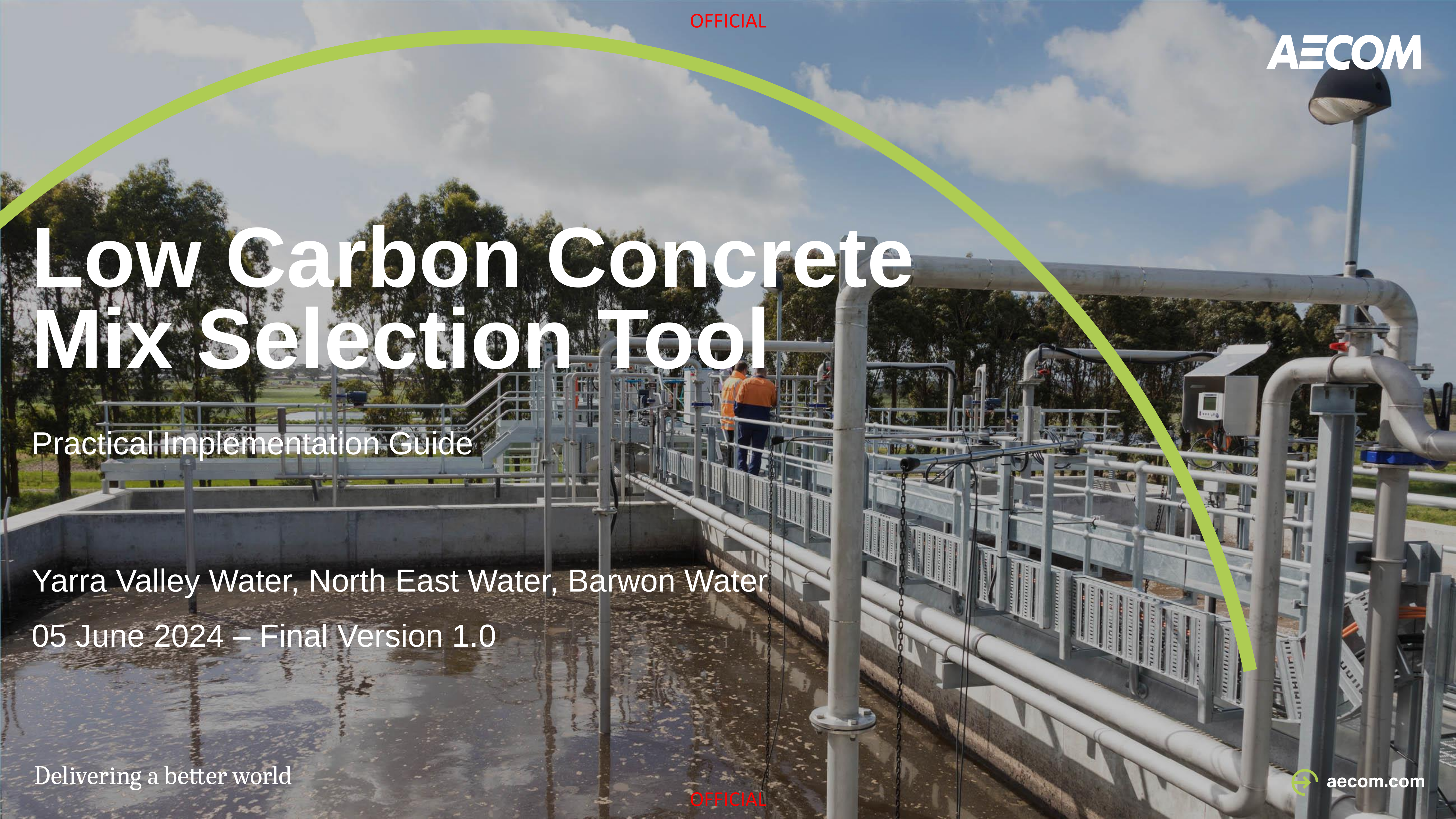

Low Carbon Concrete Mix Selection Tool

Practical Implementation Guide

Yarra Valley Water, North East Water, Barwon Water

05 June 2024 – Final Version 1.0

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Prepared for/by

Title	**Low Carbon Concrete - Mix Selection Tool - Practical Implementation Guide**
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Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
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Acknowledgment of Country

AECOM acknowledges the Traditional Custodians of country throughout Australia.

We pay our respects to both Elders past and present and to emerging community leaders. We recognise and celebrate the diversity of Aboriginal and Torres Strait Islander people and their ongoing cultures and connections to lands and waters.

Art by **Bianca Gardiner Dodd**

Table of Contents

Abbreviations

Term	Definition	Term	Definition
AS	**Australian Standard**	MRWA	Melbourne Retail Water Agencies
BW	Barwon Water	NEW	North East Water
CEC	Chemicals of Emerging Concern	OPC[1]	Ordinary Portland Cement
DEECA	Department of Energy, Environment and Climate Action	PFA	Pulverised Fuel Ash (i.e. Fly ash)
EPD	Environmental Product Declaration	RCA	Recycled Concrete Aggregate
GBCA	Green Building Council of Australia	SCM	Supplementary Cementitious Materials
GGBS	Ground Granulated Blast-furnace Slag	VPV	Volume of Permeable Voids
GHG	Greenhouse gas	VR	VicRoads
GP[1]	General Purpose cement (in Australia typically contains 92.5% Ordinary Portland Cement blended with 7.5% ground limestone)	WSAA	Water Services Association of Australia
IPCC	Intergovernmental Panel on Climate Change	YVW	Yarra Valley Water
MECLA	Materials and Embodied Carbon Leaders Alliance		

Note: 1 – for the purpose of simplicity wherever the term 'cement' is used it can be taken as referring to either GP cement or ordinary Portland cement as the carbon differential is minimal.

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Introduction

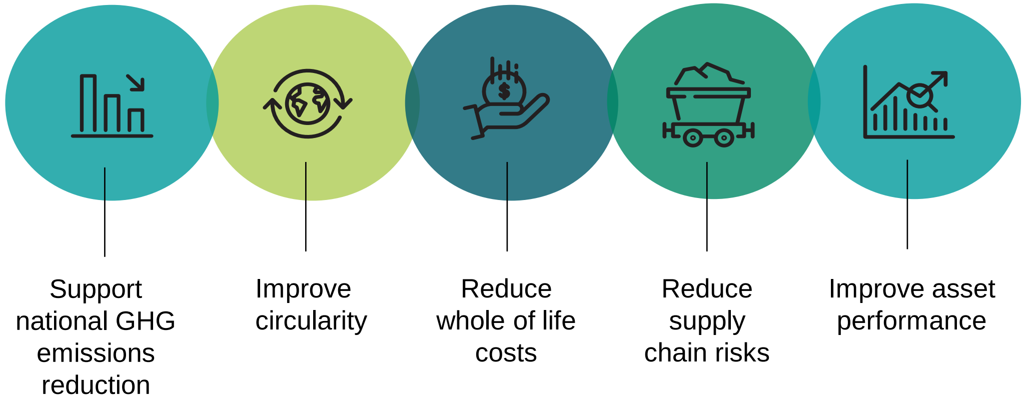
Introduction

AECOM has been engaged by Yarra Valley Water (YVW), North East Water (NEW) and Barwon Water (BW) to develop a **Low Carbon Concrete Mix Selection Tool** to collate one source of low carbon concrete mix information for YVW, NEW and BW to select concrete mixes for their projects.

This **Practical Implementation Guide** outlines how to effectively use the Tool to select low carbon concrete mixes and should be read in conjunction with the **Low Carbon Concrete Mix Selection Tool**.

Background

- As human-induced climate change worsens, it is imperative that strong and sustained action is taken to limit its future impacts (IPCC, 2022).
- The Victorian water sector has set world-leading targets to cut scope 1 and 2 emissions to achieve net zero by 2035 (DEECA, 2024), demonstrating leadership in reducing emissions faster than many other sectors.
- With changes to scope 3 emissions reporting requirements expected imminently, water corporations will need to understand, quantify and manage their scope 3 emissions in order to respond to the evolving regulatory and reporting environment, as well as stakeholder expectations.
- Given the significance of Ordinary Portland cement's (OPC) contribution to scope 3 emissions, estimated to be 8% globally, it is prudent that the water sector continues its leadership in emissions reduction and consider the benefits of adopting of low carbon concrete to:



Introduction

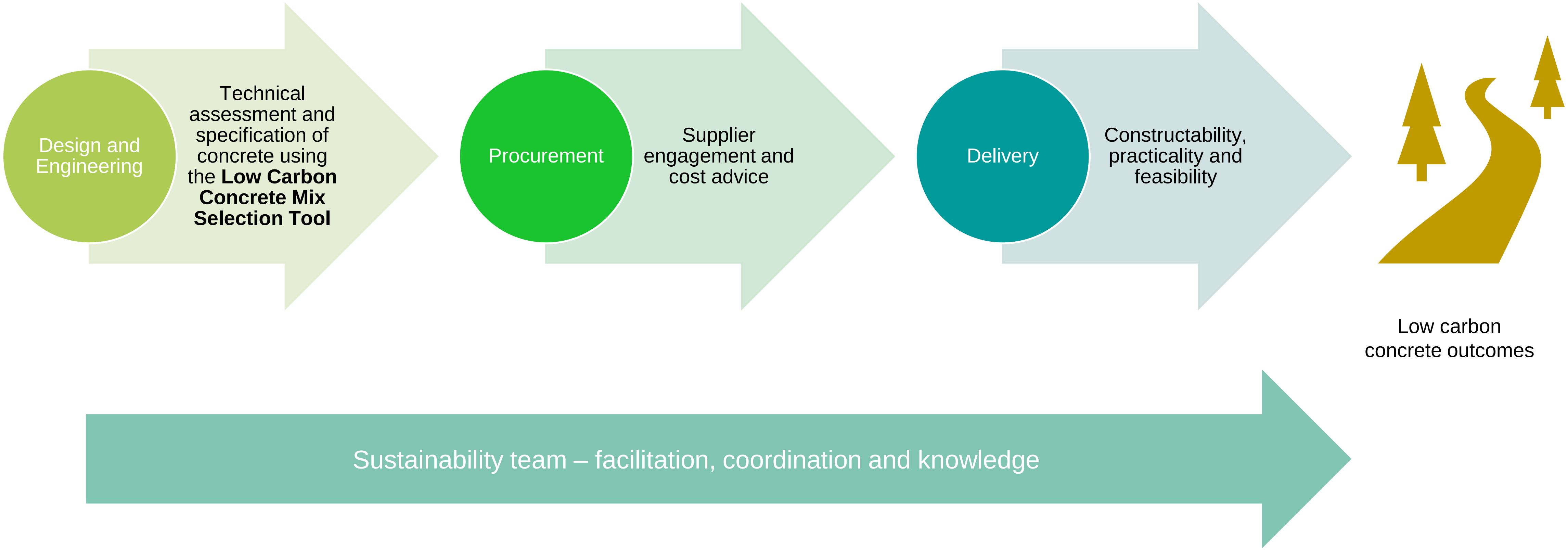
Purpose

- By creating one source of information to select low carbon concrete mixes for projects, the purpose of the **Low Carbon Concrete Mix Selection Tool** is to support YVW, NEW and BW's ambition to reduce scope 3 carbon emissions associated with concrete usage (herein referred to as concrete emissions) on their projects and in the broader supply chain.
- The **Tool is a starting point and a small, but key cog in the decarbonisation of infrastructure asset which will need to be refined by the individual water corporation** to be relevant to local suppliers and the types of assets constructed. The Tool will need to be modified by organisations to meet their specific and changing needs.
- The Tool is based on the minimisation of General Purpose (GP) cement in concrete mixes, but as more suppliers produce Environmental Product Declarations (EPD), the ability to transition to kgs of CO_2 per m^3 will provide a more useful measurement metric for concrete emissions.

Audience

- Experience and/or knowledge of concrete mixes is required by personnel operating the Tool. This skillset may come from personnel with materials engineering and/or sustainability backgrounds.
- The roles and responsibilities of the personnel required to operate/adapt the parameters in the Tool need to be determined beforehand by the individual water corporation.
- Collaboration between Designers and Engineers, Sustainability, Procurement and Delivery at a minimum is necessary to use the Tool to achieve the best outcomes, as illustrated on slide 9.

Multi-disciplinary approach to achieve low carbon concrete outcomes



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Tool overview

Tool overview

The Tool is focused on concrete elements and is aligned to the Melbourne Retail Water Agencies (MRWA) database and Water Services Association of Australia (WSAA) standards. The Tool allows for the collation of information on appropriate concrete mixes in one place and prompts the user to consider higher supplementary cementitious materials (SCM)% mixes for water utility assets.

It includes the following:

- Asset type and element
- Typical design life
- Typical concrete grades (MPa)
- Minimum and maximum cement content (kg/m^3)
- Exposure classification (e.g. as defined in AS 3600 (50-year design life), AS 3735 (80-year design life) or AS 5100.5 (100-year design life)
- Durability requirements (so assets meet the specified design life in the defined Exposure classification)
- SCM% currently available in the market
- Aggregate replacements available

ASSET TYPE	ELEMENT	DESIGN LIFE (YRS)	CONCRETE GRADE (MPa)	MINIMUM CEMENT CONTENT AS PER PROJECT SPECFICIATIONS, VR610 or WSAA (kg/m3) where relevant	WSAA, PROJECT OR ORGANISATION REQUIREMENTS / STANDARDS	UPPER LIMIT OF CEMENT (kg/m3)	EXPOSURE CONDITIONS (AS5100.5, AS3600, AS3735 or equivalent)	CONCRETE COVER (MM)	
								MINIMUM DURABILITY COVER (mm)	ADDITIONAL CONSTRUCTION COVER IF CAST AGAINST GROUND OR BLINDING/DPM (mm)
B	C	D	E	F	G	H	I	J	K
Asset type breakdown		Required design life of element	Strength grade	Concrete requirements to VicRoads, WSAA, organisation or equivalent		Max cement if required	Explore classification to Australian Standards or equivalent	Required cover to reinforcement	

SCM%	Coarse Aggregate (Y/N)			Fine Aggregate (Y/N)				Water (Y/N)	
	Virgin Aggregate	Crushed Concrete	Plastic Aggregate	Virgin Aggregate	Manufactured Sand	Glass Fines	Recycled washed Sand	Potable Water	Recycled Water
If setting a min. or approx. SCM value	Aggregates proposed and their % or amount							Water to be used	

Potential Suppliers and their products					Is it recyclable at the End-of-life?	Trial Opportunity? [Y/N]	Potential Concrete Mixes and Details	Curing and Workability (Required changes to	Recommended text for Drawing Notes	Carbon Footprint	
Hanson	Boral	Holcim	Other	Other						Carbon footprint outcome	EPDs
V	W	X	Y	Z	AA	AB	AC	AD	AE	(comment or value)	(link)
Potential mixes from suppliers that meet requirements.					Is there an opportunity to recycle the elements at end of life?	Is there an opportunity to do a mix trial on a new mix?	Mix and durability details, what's been used and what the options are.	Commentary on construction considerations.	Notes to add to drawings to ensure correct mixes placed.	Comment or vlaue of expected or final outcome carbon footprint.	Hyperlink to copy of EPD if aquired.

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Input parameters

Input parameters

The following parameters need to be adapted to each water corporation requirements:

- **Project specifications:** Input or review tool (**Concrete Element Summary tab** – refer to Figure 2) for project details such as type of structure (e.g., pipe, tank, pit, slab, foundation, bund, foot path), and exposure conditions (e.g., environmental factors).
- **Materials data:** Review tool for, or gather data on, available concrete mixes including supplementary cementitious materials (e.g., fly ash, ground granular blast furnace slag, silica fume), aggregates, and admixtures from suppliers. Input mix information from suppliers in the **Mix Details tab** – refer to Figure 3.
- **Sustainability requirements:** Understand project sustainability requirements and how that may be achieved with concrete reduction.

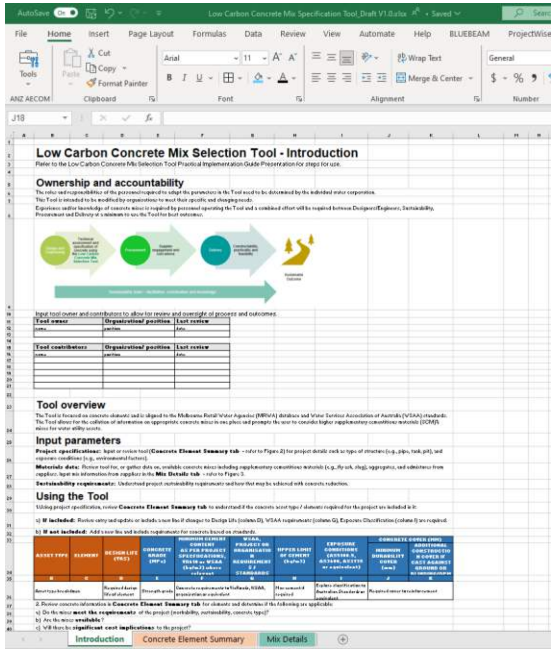

Figure 1: Introduction tab

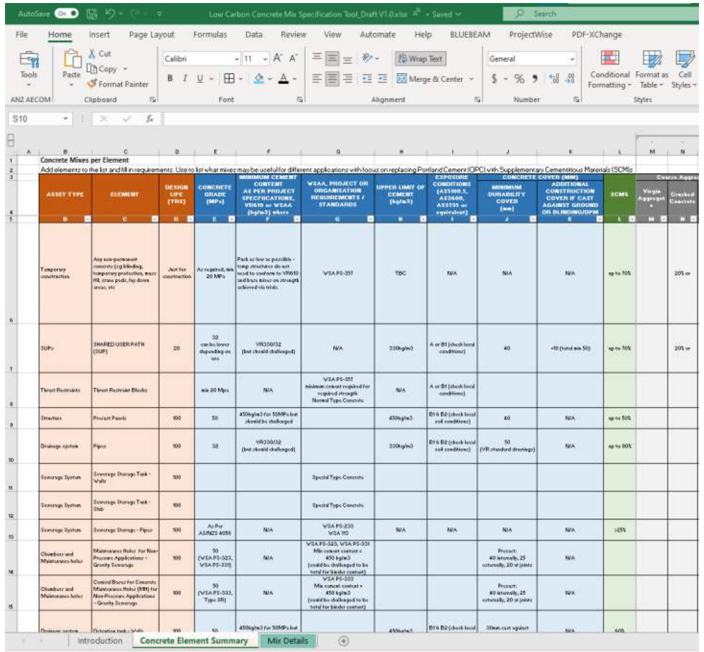

Figure 2: Concrete Element Summary tab

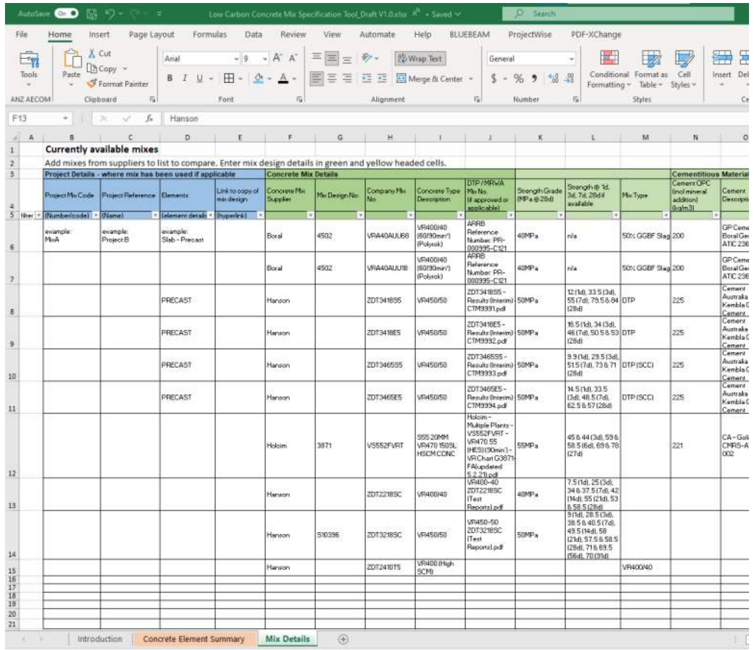

Figure 3: Mix Details tab

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Using the Tool

Using the Tool

1. Using project specification, review **Concrete Element Summary tab** to understand if the concrete asset type / elements required for the project are included in it:

   a) **If included:** Review entry and update or include a new line if changes to Design Life (column D), WSAA requirements (column G), Exposure Classification (column I) are required.

   b) **If not included:** Add a new line and include requirements for concrete based on standards.

ASSET TYPE	ELEMENT	DESIGN LIFE (YRS)	CONCRETE GRADE (MPa)	MINIMUM CEMENT CONTENT AS PER PROJECT SPECFIICATIONS, VR610 or WSAA (kg/m3) where relevant	WSAA, PROJECT OR ORGANISATION REQUIREMENTS / STANDARDS	UPPER LIMIT OF CEMENT (kg/m3)	EXPOSURE CONDITIONS (AS5100.5, AS3600, AS3735 or equivalent)	CONCRETE COVER (MM)	
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B	C	D	E	F	G	H	I	J	K

2. Review concrete information in **Concrete Element Summary tab** for elements and determine if the following are applicable:

   a) Do the mixes **meet the requirements** of the project (workability, sustainability, early age strength, concrete type)?

   b) Are the mixes **available**?

   c) Will there be **significant cost implications** to the project and how do these correlate to the cost of offsets? Refer to Scottish Water case study on slide 23.

3. Once the requirements of steps 1 & 2 are satisfied, move forward with design, procurement and construction following organisational processes.

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Using the Tool

4. If the Tool **does not include** the relevant mix information relevant for the project:

   a) **Contact concrete suppliers** for additional mix information for project.

   b) **Add new mixes** to **Mix Details tab** to assess cement and/or carbon reduction and compare properties.

      i. Include information from concrete suppliers on mix specifications (Project Details ***columns B-E***; Concrete Mix Details ***columns F-M***; Cementitious Material ***columns N-Y***; Aggregates ***columns Z-AG***; Water to Cement ratio ***columns AH-AI***); Performance Test Results ***columns AS-BA***).

      ii. The Tool will calculate the **Cement Reduction %** from a GBCA baseline (***columns BB-BD***) once step i. is complete.

      iii. The Tool can be used to **compare mixes on performance properties** such as drying shrinkage, slump, VPV and admixtures used (***columns AS-BA and AJ-AR***). It can also compare **carbon footprint** information collected (***columns BE-BF***).

      iv. Record any **approval and compliance records** for mixes to specifications or authorities (***columns BG-BK)***.

5. Add any information collected and used into the **Concrete Element Summary tab** including:

   a) Mix details including aggregates, SCM% and admixtures.

   b) Availability, workability and process notes (from project team and contractors).

   c) Drawing notes used.

   d) Investigated trial mixes if relevant.

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Implementing the Tool

The **Low Carbon Concrete Mix Selection Tool** is only part of the process to reduce Ordinary Portland Cement (OPC) use.

For the benefits of the work to reduce OPC to be realised, concrete should be tracked through the design, procurement and construction process.

A process developed for a transport project and adapted for the water industry to decide on a concrete mix and navigate the approvals and compliance process is represented in the follow slides.

Key steps to set and deliver a carbon reduction of concrete on projects

1. Review the project's concrete asset elements including type i.e., insitu, precast, shotcrete to estimate the likely **GP cement reduction targets** (calculated against cement content defined by the Green Building Council of Australia (GBCA) for each concrete grade – refer to Slide 21):
    a. If a high percentage of the concrete will be cast insitu, set a GP minimum cement reduction target of around 40%.
    b. If it is mostly precast, set a GP minimum cement reduction target of around 30% as a good starting target.
2. Once the overall cement reduction target has been determined for the project, the simplest but key step is to add that target as a **minimum requirement in the concrete notes** on each tender drawing package.
3. The **Low Carbon Concrete Mix Selection Tool needs to be actively engaged with by the design team** (structural and durability people) to identify potential concrete mixes that both meet the technical specification requirements and ensure that the overall cement reduction target will be met. If there is a lack of suitable mixes currently available, the design team and project manager should **engage with the delivery partners/contractors and their concrete suppliers** to identify what low carbon mixes can be provided if project commitments are made.
4. Require that **delivery partners/contractors restrict the concrete mixes available for selection** on their ordering/purchasing platform for their site engineers/PMs to those that meet the cement reduction targets.
5. Require **delivery partners/contractors to provide weekly updates** from their accounts system of concrete invoices paid with mix code and quantity supplied to allow confirmation of concrete used throughout the project to be verified.

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An integrated, project wide approach to drive GP cement reduction

Planning phase

Review Organisation and Industry technical requirements and collate Project targets for:

- Performance including structural and minimum durability requirements
- Sustainability requirements including:
  - GHG emission reductions
  - % cement reduction
  - max % recycled materials content

Identify location of project with respect to nearest concrete suppliers / concrete batching plants, and recycled material suppliers where available.

Concept design

Review concept design to estimate concrete usage across project. Collate data required for cement use calculations including asset locations, type, elements, min structural & durability requirements, exposure classification, dimensions of elements.

Update design drawings notes and specifications to include sustainability cement reduction targets for insitu and precast elements.

Where concrete mixes have been specified, review using **Mix Design Tool** or similar.

Calculate GBCA carbon reduction baseline

First pass

Concrete mix review (Mix Design Tool)

Detailed design

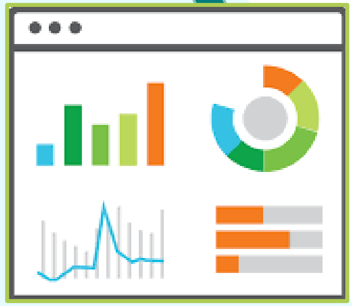
Refine design of concrete structure / element structural, durability & constructability requirements i.e., high early strength, self-compacting concrete, abrasion and chemical resistance.

Nominate low carbon concrete and recycled material content in design package report/s and drawing notes. Where a low carbon concrete mix has been assessed by the **Mix Design Tool** and meets performance and constructability requirements, include concrete mix ID/type on design documentation.

Procurement / Delivery / Quality

Procurement / Quality to work with Design and Delivery to manage reviewed / approved/ used compliant low carbon concrete mixes and upload to **Master Concrete Mix Database.**

Early engagement of concrete suppliers to gain understanding of low carbon concrete mix availability and Project concrete mix approval requirements wrt low carbon concrete options and recycled material content



Cement Reduction & Embodied Carbon Reduction Tracking Dashboard

Is concrete mix compliant?

NO → **Request new mix from Supplier**

YES → **Concrete mix approved and available to order once entered into the procurement system**

Site trials and testing may be considered

Concrete mix reviewed for Project targets for structural, durability and constructability requirements as well as compliance with Project cement reduction and recycled material requirements, and WSAA / Organisation performance requirements.

Key steps to set and deliver a carbon reduction of concrete on projects

6. Project team to maintain a **'live' dashboard of concrete used and overall cement reduction achieved** and display that as an average so the project team can have confidence that the target will be met. This will allow decisions to be made with confidence to accept a mix that doesn't meet the target as long as it doesn't shift the overall project average below that key mark (see example of a project dashboard on next slide). Noting that the delivery partners/contractor will need to raise a Request for Information (RFI) if they intend to/have used/order a mix that doesn't meet the project minimum target – hence the importance of having that requirement on the drawings.

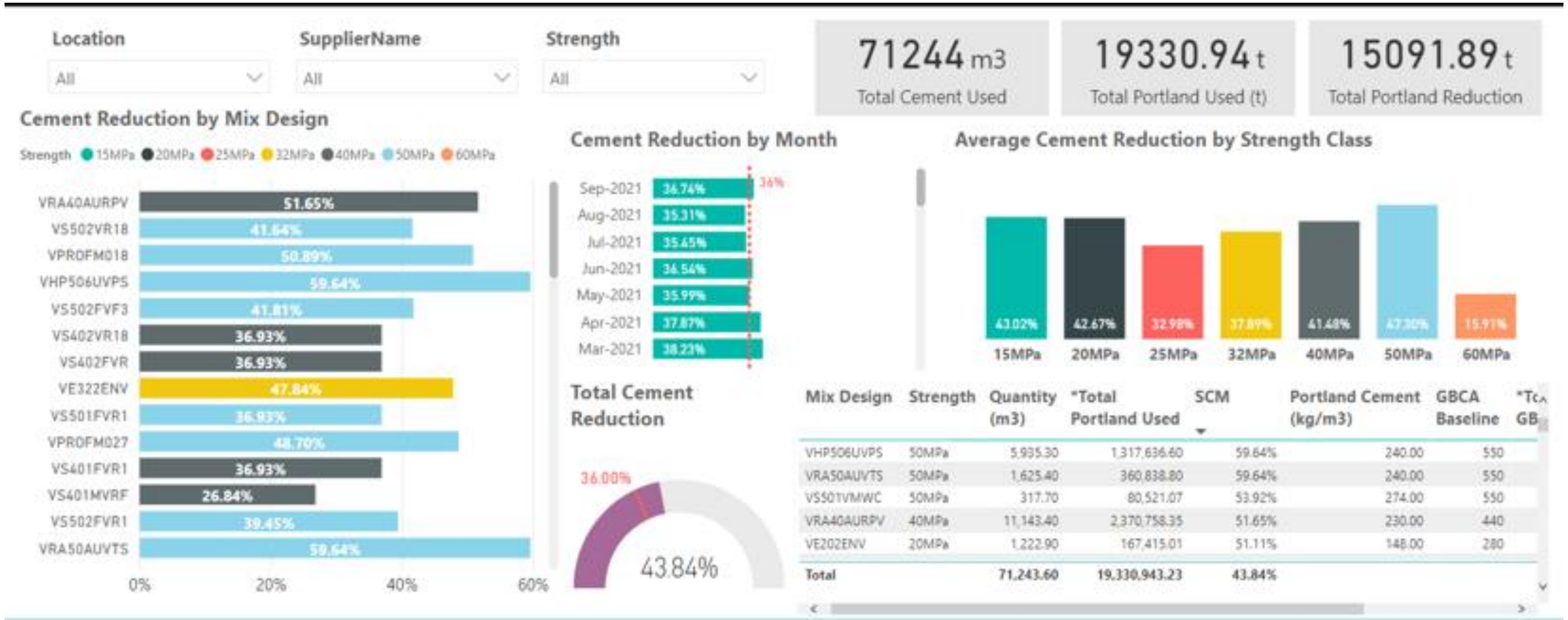


Figure 4: Concrete mix data tracking and project cement reduction monitoring

Sample calculation of cement reduction using GBCA concrete mix baseline

Base Reference Mixes

The GBCA cement content listed in Table 1 below are generally used as the base/reference mixes across a range of compressive strengths and assume that the entire cement content stated comprises OPC. i.e. it does not include any Supplementary Cementitious Materials or the inert mineral content that is in typically in Australian GP and GB cements.

Table 1: GBCA Cement Contents in Base/Reference Mixes

Grade (MPa)	Cement Content (kg/m^3)
20	280
25	310
32	360
40	440
50	550
55	550
60	550
65	550
80	610

For each concrete mix the OPC reduction will be calculated by taking the weight per m^3 of the GP or GB cement component and removing the added minor content – the concrete supplier to confirm what that mineral content is in their designated mixes.

Then subtract that figure from the GBCA cement content for the grade of concrete and divide by the same GBCA figure to get the reduction and convert to a percentage.

As an example – if a 40 MPa concrete is required, and the structure/element is in a B1 exposure classification then accepting that to align with B80 (i.e., TfNSW concrete specification*), the mix must have a minimum of 240 kg/m^3 of GP cement and 80 kg/m^3 of fly ash is added to achieve the total minimum binder content of 320 kg/m^3 then such a mix would achieve a cement reduction of ~45% if all the GP was OPC:

GBCA cement content 440 kg/m^3 → (440-240) / 440 → 200/440 =0.455 → 45.5%

If the GP cement contains 7 % inert mineral, then the OPC content of that 240 kg/m^3 is 223 kg/m^3 and therefore the full OPC reduction for that mix is 49.3%.

*Note requirements for minimum cement or total cementitious content vary slightly state to state, though in Victoria DTP Section 610 Structural Concrete is in line with requirements of AS 5100.5.

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Case Studies

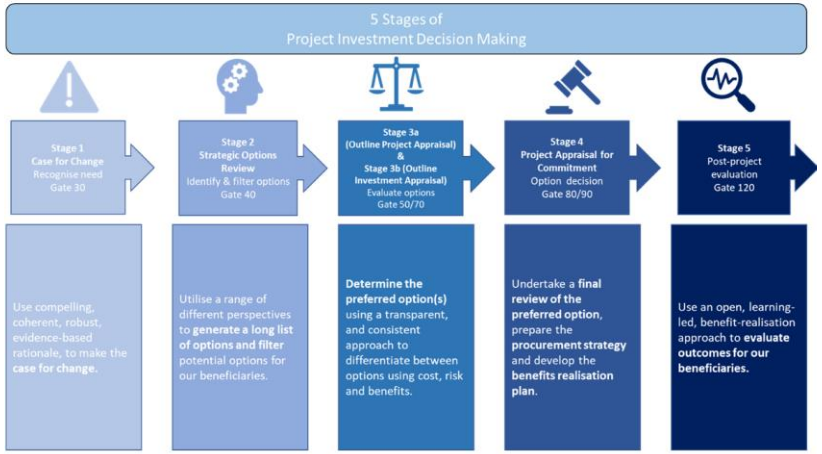
1. Scottish Water – Project Investment Appraisal Framework
2. Scottish Water – Designing out Concrete
3. Biochar: the circular economy opportunity for the water sector
4. Geopolymer trial on retaining walls in transport sector
5. Recycled concrete aggregate proving field trials in transport sector

Scottish Water – Project Investment Appraisal Framework

Scottish Water are aspiring to be a leading organisation, recognised for excellence in how they appraise project investment for the benefit of customers, communities and the environment. Within Scottish Water's **Project Investment Appraisal Framework**, there is a **decarbonisation cost-benefit analysis tool** which compares the upfront cost of investing in reducing the cost of the carbon during the capital project versus the future cost to the business of purchasing carbon offsets. This allows them to plan, manage and prioritise challenges and ensure customers' money is invested in a way that maximises long-term value.

Project Investment Appraisal is the process of assessing the costs (including carbon), benefits (social, economic and environmental) and risks of alternative ways to meet objectives, whether that be Scottish Water objectives or wider objectives. The tools allows for several factors to be considered, including:

- Initial investment costs
- Long-term savings
- Market and financial risks and benefits (government incentives and subsidies)
- Energy price volatility
- Fluctuations in offset costs
- Regulatory risks
- Environmental impacts
- Customer expectations



The tool has been used to justify to the regulator customer price increases being passed on to customers now as the cost of construction does increase when low carbon materials are used, but with the pay-off that future fees and charges will not escalate at a greater rate because of future offset costs to achieve net zero emissions by 2040 being factored into the analysis.

This approach to cost-benefit analyses should be considered by Victorian water corporations so that they can start to predict what impact future carbon offset costs will have on their current financial position. This does require the establishing a baseline of carbon created by the business at both the build phase and the throughout operations so that the relevant financial metrics can be deployed in the Value Review tool with confidence by the Executive.

Scottish Water – Designing out concrete

- Scottish Water has set a **net zero target to 2040** and produced a Net Zero Emissions Routemap to outline the pathway to achieving this target (refer to Figure 1).
- The Routemap found that civil engineering investments in 2019/20 accounted for 60% of carbon emissions. Concrete accounts for 18% + rebar = 25% of total emissions.
- Opportunity of up to 10-12% reduction of concrete emissions through alternative concrete adoption.

Key actions include:

- **Designing out concrete using optioneering tool.** Designers need to rationalise use of concrete e.g., reducing kiosk slab thickness will reduce 33% of concrete required. Modularisation of kiosk design means that the metal frame now sits on compacted Type 1 fill instead of concrete slab (refer to Figure 2).
- Historically, projects were delivered using CEM I (100% OPC) concrete because this was the cheapest option. Scottish Water has now **banned the use of CEM I concrete on its sites** identifying it as a 'non-conformance' if a contractor inadvertently uses it.
- Developed a **low carbon concrete matrix** to select concrete mixes.
- Revised **concrete supply framework** to only price CEM II and CEM III (concretes which replace cement with GGBS and PFA).
- **Commenced trials on low carbon blended mixes** (EcoPact/Ventura), Carbon Cure; looking to trial Calcined Clays, Cemcor, Hoffman Green etc.

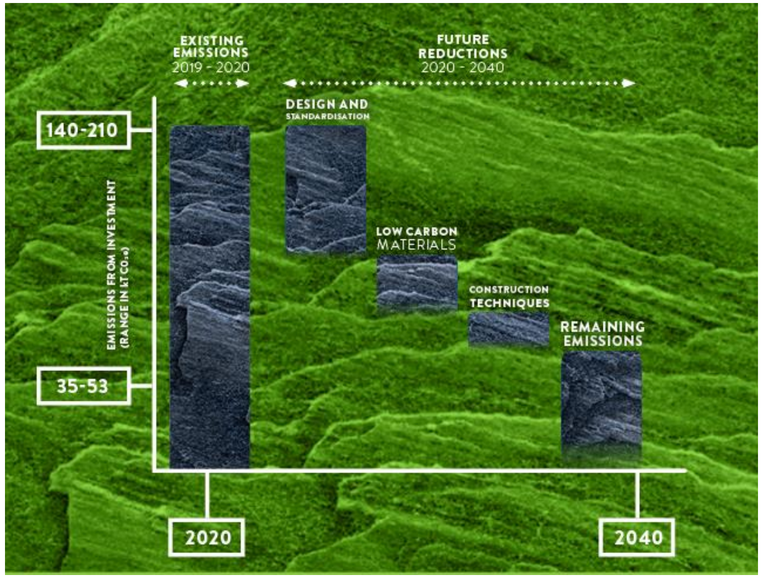


Figure 1: Pathway to net zero

Kiosk Slabs	Vol Conc (m3)	Reduction
Traditional (3x3) 300 deep	2.7	baseline
Traditional (3x3) 200mm deep	1.8	33%
Strip footing (2nr [3x0.3x0.3])	0.54	80%
Pad footings (4nr [0.3x0.3x0.3])	0.108	96%
Compacted Type 1	**0.0**	**100%**

Figure 2: Design optioneering to reduce concrete

Biochar: the circular economy opportunity for the water sector

Biochar is the product of biomass (food and garden waste or biosolids) turned into a carbon rich charcoal type substance by the process of pyrolysis (oxygen free incineration). It is traditionally used to improve soil quality, but its other uses include cement replacement in concrete.

The challenges of using biomass (quality and quantity of product, limited market value) are outweighed by the opportunities, namely:

- Improved sustainability outcomes through circular economy principles to assist decarbonisation journey
- Possible enhanced revenue diversification opportunity if biochar utilisation is feasible
- Possible insulation from lack of market supply of recycled / low carbon content for construction materials

North East Water are kicking off biochar trials in 2024.

- **Phase 1** trials consist of testing a range of feedstocks (biosolids, FOGO and wood products) through a biochar pilot plant in Melbourne.
- The trial will identify the quality and quantity of feedstocks and Chemicals of Emerging Concern (CEC) removal %.
- Phase 1 will build the business case to progress to **Phase 2**, which will include a processing unit on a NEW site running larger volumes of the desired mix.
- **Phase 3** will build the business case for a larger, 20,000 to 60,000 tonne per year biochar plant.
- The business case includes signing contracts with organisations that would supply different wastes outside of water corporations.
- NEW plans to use the products produced from Phase 1 and 2 for cement trials. Opportunities exist with locally located concrete suppliers for mutually beneficial circular economy outcomes.

Yarra Valley Water have been exploring biochar in concrete together with RMIT. Sourcing adequate amounts of biochar of the right quality has been a limiting factor. Testing at lab scale is achievable but getting enough for field trials and applications at large is more challenging.

Barwon Water have been researching the production and application of biochar in batteries (Biochar 2 Batteries) with RMIT, Deakin University and others. Their Regional RON is expected to produce 5000 tonnes of biochar per year from November 2026.

Geopolymer trial on retaining walls in transport sector

ecologiQ performed site inspections (visual, sampling, on-site testing and laboratory testing) in 2023 on two retaining walls that were built in Melbourne in 2013 using **geopolymer concrete manufactured from blast furnace slag (100% Portland cement replacement with approx. 90% GGBS and 10% fly ash)**.

The main objective of the investigation was to assess the long-term performance of the geopolymer exposed to field conditions. The retaining walls are located at M80 WRR (inbound), Sunshine North and Dudley St. Bridge, West Melbourne.

The results of the investigation were as follows:

- The **visual inspection of both retaining walls revealed no major defects or deterioration**. Some cracking was identified, and this has been assessed to be related to shrinkage cracking in the early ages of the structure's life. The maximum crack width measured during the inspection of the panels was 0.35 mm and the overall cracking was typically ranging between 0.15 and 0.35 mm.
- The mixes used on both walls were designed to meet the requirements of VR400/40 as per VR610. The **compressive strength results confirmed that the mixes are above 40 MPa**, providing good evidence that the geopolymer was durable and did not lose strength over time.
- Some superficial fretting was observed in both retaining walls near the edge of the panel interface. Testing hasn't been able to conclusively identify the cause of this fretting. It is understood that some early age efflorescence might have occurred in the panels and may have contributed to this fretting. No efflorescence was present during this survey. The observed fretting was localised in nature and superficial in depth and largely had a local aesthetic impact.
- Except from the superficial fretting, **no durability issue was identified** on the tested structures which would impact on the ability of the structure to achieve its design life for the proposed function, providing **evidence of the long-term performance of slag based geopolymer mixes** under field conditions.

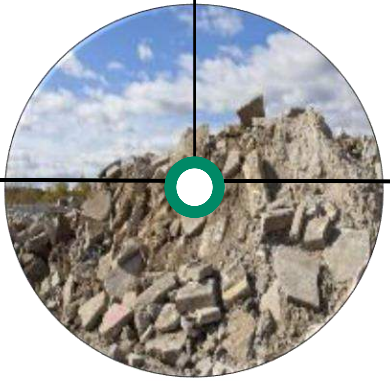
Example of a proving field trial undertaken on a project - Recycled concrete aggregate

July 2022

Initial discussion with project:
1. Developed recycled concrete aggregate (RCA) initiative assessment and approval process
2. Deflection wall application

July – Aug 2022

Industry engagement:
1. Engaged Boral, Hanson and Holcim to develop trial mixes
2. Developed initial testing plan



Aug 2022

Initiative proposal:
1. Design team review
2. MTM review
3. Academic peer review
4. DTP review

Sep 2022

Proposal acceptance
Technical review group

Sep - March 2022 - 2023

Trials and visits
1. RCA supply visits
2. Lab trials visits
3. Technical review group workshops

March 2023

Protection slab pour
Supply chain upgrade

Hanson RCA mix submitted for DTP certification

TBC 2023 - 2024

Identify project application

Conditional approval (2024)
Future Specification update (2024 onwards)

Key requirements to succeed:
- Clear path to what the end goal is and how to get there.
- Ensure adequate staffing and resources to make a change happen. Many engineers, supervisors and suppliers operate on a least path of resistance.
- Make calculated, measured approaches to implementing something. Small incremental changes from a base approved mixed will help get closer to a complaint
- Most importantly, collaboration from all parties is required: Design, Procurement, Delivery.

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Resources and References

Resources and References

Resources

1. WSAA: Guide to Scope 3 Emissions Management for the Water Sector
2. MECLA: A Guide to Low Carbon Concrete in Australia
3. ecologiQ - ecologiQ resources - Victoria's Big Build
4. Victorian Big Build Recycled First Policy
5. Scottish Water- Net Zero Emissions Routemap
6. Institution of Structural Engineers UK Concrete technology tracker
7. CEMBUREAU's Map of Innovation Projects

References

Department of Energy, Environment, and Climate Action (DEECA), (2024). A net-zero emissions water sector by 2035. Retrieved June 03, 2024, from https://www.water.vic.gov.au/our-programs/climate-change-and-victorias-water-sector/greenhouse-gas-emissions-from-the-water-sector/a-net-zero-emissions-water-sector

Intergovernmental Panel on Climate Change (IPCC), (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Retrieved February 20, 2024, from https://report.ipcc.ch/ar6/wg2/IPCC_AR6_WGII_FullReport.pdf

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Thank you.

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