Environmental Guidelines for the Ready-mixed Concrete Industry in Victoria

EPA Publication 628.2 (2019)

Good environmental management
is
good business management.
Efficient use of raw materials and recycling
result in increased productivity, cost savings,
and minimal environmental impacts.
Businesses with high environmental
standards
enjoy
an enhanced reputation and
business opportunities.

WORKING DRAFT FOR CONSULTATION – FEBRUARY 2019

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Cover photo will change

Commented [EG1]: Change title above from "Ready-mixed" to "Pre-mixed"

Publication 628.2 http://www.epa.vic.gov.au/xx
Published xx 2019
(Updating Publication 628; 1998)
Enquiries about this publication should be directed to
EPA Victoria 1300 372 842 (1300 EPA VIC) or contact@epa.vic.gov.au
By effectively regulating pollution in Victoria, we strive for clean air, healthy waterways, safe land and minimal disturbances from noise and odour.

Acknowledgements
Environment Protection Authority Victoria acknowledges members and staff of the concrete batching and related industries in Victoria; Cement Concrete Aggregates Australia (CCAA); Construction Materials Processors Association (CMPA); Local Government planners, and the Planning Institute of Australia for contributions to updating this guideline. US EPA for re-print of (Figure 1); Queensland Department of Environment and Science and Brisbane City Council, for guidance offered by the publications (General environmental duty - Code of Practice for the concrete batching industry EM1305; 2014) and (Industry environmental guide for concrete batching; 2015) to this guideline.

TABLE OF CONTENTS

1. About this guideline

This guideline describes the concrete batching process, the environmental risks of concrete batching, and how to assess these risks on site. Industry operators are expected to manage these risks to prevent harm to human health and the environment. The guideline describes *good environmental performance*, and four *practical (end-result) performance outcomes,* EPA Victoria considers necessary for concrete batching operators to achieve, to fulfil their environmental obligations. *Comprehensive checklists* of *control measures* to achieve each performance outcome (1-4) are provided. Figures and photos demonstrate risks and good practice. The guideline applies in Victoria to all new, existing, fixed, and mobile concrete batching plants of all sizes, and is also relevant to pre-cast concrete manufacturing.

2. Aims of guideline

- Help industry operators consider the environment with which they interact, and the environmental risks posed by their industry
- Demonstrate the risk-based approach to preventing harm, and support industry to prevent risk of alkaline and contaminated washwater/ sediment discharges, dust and noise emissions, and minimise waste to landfill
- Outline *good environmental performance*, and environmental performance outcomes to be met by the industry, while allowing for flexibility in implementation (provided equivalent or better outcomes are met)
- Support industry to adopt technology, internal processes, and monitoring tools for *ongoing systematic improvement* of environmental performance
- Facilitate constructive conversations between EPA inspection officers, industry environmental managers, company directors and staff, that lead to optimal environmental outcomes

3. Concrete batching process

Concrete is a mixture of cement (highly alkaline), sand, rock aggregate (graded per size and character), fly-ash (highly alkaline; contaminated by heavy metals), and high volumes of water (*c.* 16% by weight; or 130 L per m^3 concrete mix). Components of concrete include calcium, alumina, magnesia, iron and sulphur oxides, additives for specialist concrete products such as crushed glass, decorative pebbles, other additives, and chemical admixtures that modify concrete properties and setting rates.

Commented [EG2]: Remove: figures vary

Ready-mixed concrete is made (batched) by weighing dry ingredients in weigh hoppers, transferring them to agitator trucks, and mixing with water inside the bowls of the trucks. The loads are slumped, inspected, and immediately transported to the end user.

Commented [EG3]: Replace Ready-mixed (Boral) with Pre-mixed

Commented [EG4]: May contain water

Commented [EG5]: Change to agitator barrels

Underground storage & overhead bin batching. In large capacity concrete batching plants, sand and aggregate are stored in underground (drive-over) storage bins. Raw materials and additives are weighed, and correct proportions transferred to overhead hoppers by conveyor belts and dropped into agitator trucks in loading bays below. Cement and fly-ash are stored in overhead silos, weighed in overhead weigh hoppers and added. Ingredients are mixed and wetted inside the agitators. Agitator trucks move to slumping stations, loads are 'slumped,' inspected, trucks washed-down and dispatched.

Front-end loader batching. In smaller capacity plants, the process is modified by using front-end loaders to transfer sand and aggregate to weigh/hoppers from ground-level storage bays.

The concrete batching industry manufactures concrete slurry, dry-mix concrete and mortar, and many ready-mixed concrete products, ranging from high-tensile concrete for major infrastructure projects, to concrete for residential housing and specialist concrete products.

Commented [EG6]: Replace with pre-mixed

Figure 1: The concrete batching process

Photo (1-5): Underground storage & overheard bin batching

Photo (6-8): Front-end loader batching

(demonstrating batching process and good practice)

4. Environmental risks of concrete batching

4.1 A summary

The nature of materials used, and the large size of the industry, have the potential to create considerable environmental risks, further amplified by the industry's metropolitan location. Ready-mixed concrete is a perishable product, by necessity batched near the end-user and delivered within the hour. The industry thus operates within *c.* 50 km radius of construction sites, close to residential areas (minimum separation 100-300 m) and can, unless well managed:

Commented [EG7]: The separation distance needs to be clearly defined.

1. ***adversely impact surrounding residential communities***
2. generate ***dust releases into the air*** *(alkaline cementitious dust; crystalline silica and other dust particles)*
3. generate ***alkaline and contaminated washwater and sediment releases to stormwater drains**, **accumulation of sediment, and blocking of drains***
4. pose ***groundwater pollution risks from stored chemicals***
5. generate ***waste concrete* to *landfill (long-term alkaline/heavy metal leachate)*** due to unused concrete returns
6. generate ***excess noise***
7. Concrete manufacture is ***highly water-intensive.***
   Unless efficient sediment-settling, water reclamation and recycling are in place, concrete batching generates high volumes of alkaline washwater to stormwater drains. Water efficiency is thus a central part of managing this risk.
8. Agitator trucks deliver concrete to construction sites and ***alkaline water and sediment discharges at point of delivery*** can therefore also occur, if truck shoots/ drums are rinsed away from home-base after unloading, and rinsate-capture is lacking.
9. Where premises are unsealed, dust from vehicle movement, poor management of raw materials, and dust/cement tracking by vehicles can combine to ***spread dust around the local environment.***

Commented [EG8]: Combine (3) with (7) due to similarity

Risks can be **acute,** or **ongoing and cumulative**:

10. Potentially the biggest on-going, cumulative risk, is contamination of groundwater by alkaline and contaminated washwater and sediment, which requires daily action to prevent.
11. Potentially the biggest acute risk to surrounding communities, stormwater, and air quality comes from catastrophic equipment failure leading to ***silo over-fill, filter blow-out, and release of tonnes of corrosive highly alkaline cement and toxic fly-ash into the local environment**, **as particulate air emissions, and groundwater pollution.***

Commented [EG9]: Replace groundwater with storm water

Photo (8): Silo 'blow–out': (red-cross)

4.2 Understanding hazards of particulate air pollution

Figure (2) summarises hazards of acute and ongoing air pollution relevant to concrete batching.

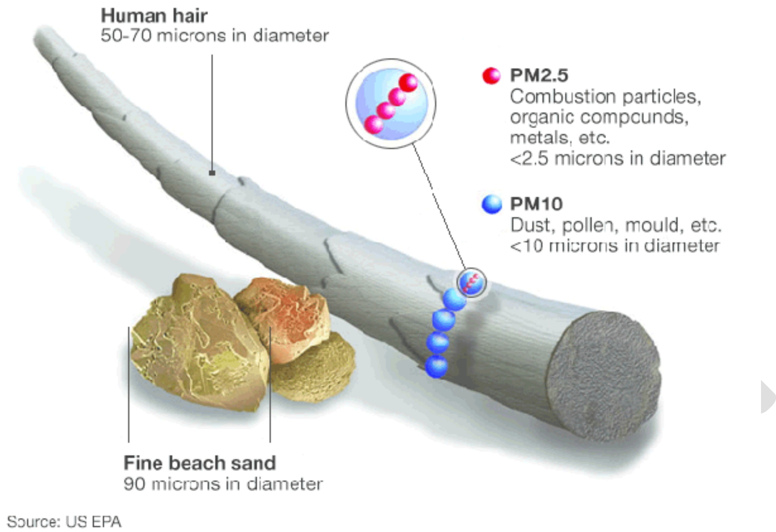


Figure (2). Understanding hazards of particulate air pollution

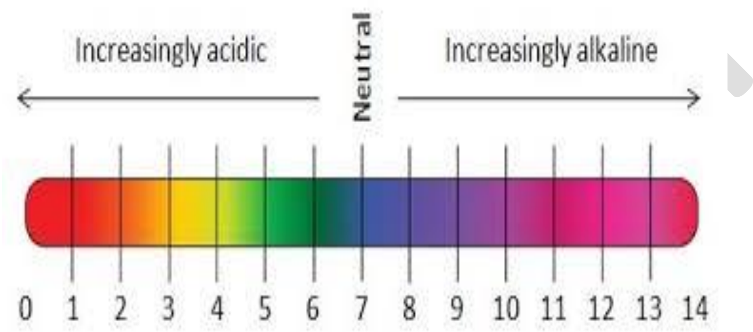
PM_{10} particles (aerodynamic diameter < 10 µm; micrometre) are smaller than 0.01 mm. When inhaled, these particles penetrate deep into lungs. The size fraction $PM_{2.5}$ (aerodynamic diameter < 2.5 µm) are particles smaller than 0.0025 mm. These particles travel deep into the lungs, cross the air/blood barrier (in tiny alveoli air-sacks) and enter the blood stream and body organs. This is highly toxic, especially when these particles contain heavy metals***. The concrete component fly-ash or flu-ash (particle size: 300 - 0.5 µm)*** is a by-product of high-temperature coal burning and ***contains heavy metals*** (naturally present in coal). ***Most common toxic metal in fly-ash is aluminium (Al). Heavy metals, including arsenic (As), cadmium (Cd), lead (Pb), mercury (Hg), nickel (Ni), thallium (TI), vanadium (V) are also present.*** Diesel fumes generated by agitator trucks turning heavy loads when mixing and delivering concrete contain $PM_{2.5}$ particles. *

*Heavy vehicle emissions are regulated federally and are not subject to this guideline.

4.3 Understanding hazards of alkaline washwater and sediment

Figure (3) summarises hazards of alkaline washwater and sediment relevant to concrete batching

CEG inserting circle around (pH 6-9), and in hand-written font – an arrow and a caption: "minimum requirements for washwater discharges to stormwater drains in Victoria"



The pH scale: alkalinity and acidity increase 10-fold every point away from neutral

Figure (3). Understanding hazards of alkaline washwater and sediment
The pH scale (e.g. litmus paper) is used to assess water discharges from batching plants. Most widespread biological and chemical impacts occur due to ongoing additive effects. Impacts can be locally severe, long-lived, and harm both land and water. Conditions (pH 8.5 - 10) cause ***severe disturbance to most fish*** (inhibiting ammonia excretion and leading to toxic build-up). Other effects include reduced diversity and abundance of zooplankton, flow-on biodiversity losses, and restricted growth of plants (not adapted to alkaline conditions). ***Alkaline discharges mobilise common contaminants and heavy metals from substrates into waterways by alkalinity-generated chemical reactions.*** Of greatest concern are highly mobile contaminants water soluble at high pH: e.g. heavy metals arsenic (As), chromium (Cr), molybdenum (Mo), vanadium (V). Additive impacts produce highly toxic areas of high concentrations. ***Heavy metals in fly-ash increase the hazard of alkaline washwater and sediment discharges from batching plants.***

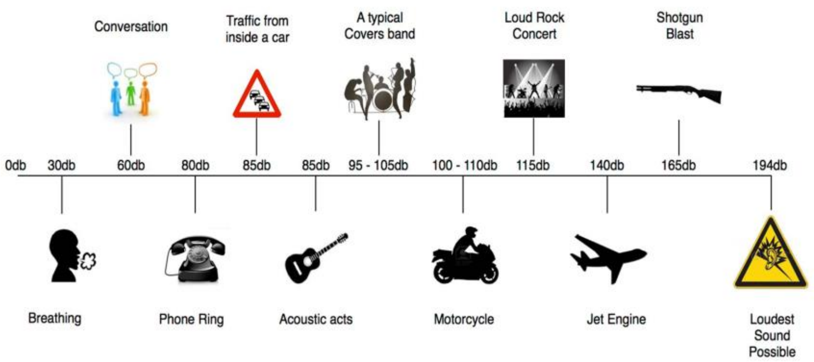
4.4 Understanding sound and hazards of industrial noise emissions

Noise is an unwanted, poorly managed sound, a form of pollution and a key environmental issue in the urban environment due to proximity to sensitive uses (e.g. residential areas). Noise pollution from concrete batching plants can cause chronic stress, harmful to human health, and is a potential source of conflict between concrete batching plants and surrounding residential communities. Disturbing effects of noise depend on the level and character of the sound, such as tone, intermittency, and frequency. High frequency tones are more disturbing than low, but lower-tone emissions (such as noise generated by front-end loader work, coarse aggregate dumping into hoppers) can be harder to control.

Noise is measured in units of decibel (db or dbA), where 'A'-weighting approximates how human ear perceives sound. Sound travels from point source reducing over distance: *sound pressure level (SPL).* Figure (4) shows how sound is measured, gives examples of typical noise levels (*at point source*), and ***maximum noise limits*** measured *(at nearest sensitive receptor)* allowed to reach these receptors in metropolitan and regional Victoria.

Concrete batching industry operators (and all industry) need to achieve these limits to industrial noise emissions, to prevent harm to the acoustic environment and protect sensitive uses.

CEG inserting a circle around 30-35(40) db, an arrow and a caption:
'Maximum 'background' noise from all industry sources incl. concrete batching (in any one area) allowed to reach sensitive receptors (30-35(40) db; Victorian zoning regulations) & 'hearing safety limit (85db; WorkSafe Victoria)'



The decibel scale: sound levels double every 3db-interval

Figure (4). Typical noise levels (*at point source*) and maximum industrial noise emission levels allowed to reach sensitive receptors in Victoria
Threshold of hearing safety *(at point source)* and maximum industrial noise zoning limits (sound pressure level: SPL) measured *(at nearest sensitive receptor*) are indicated**.** Many factors combine to reduce industrial noise emissions over distance (such as atmospheric absorption, sound barriers, other containment); separation distances are critical. Beyond zoning, ***reducing industrial noise emissions at point source and reducing the residual noise travel over distance are the bases for managing risk of harm.***

Typical sources of industrial noise at concrete batching plants

Individual sources of noise pollution at concrete batching plants are listed. An overall site noise prevention plan need be developed to minimise emissions from all these sources:

☐ delivery & tipping of raw materials

☐ general movement of heavy vehicles and machinery on site (loaders, excavators, forklifts, tip trucks, fly-ash/cement-delivery trucks)

☐ agitator truck engine noise, air brakes, reverse-warning devices

☐ agitator truck engine revving to turn heavy loads during concrete mixing

☐ sand and aggregate transfers to storage bins and hoppers

☐ front-end loader work, engine noise, reverse-warning devices

☐ forklift engine noise, reverse-warning devices

☐ swinging, scraping, loading devices

☐ hydraulic pumps

☐ compressors

☐ conveyor belts

☐ air valves

☐ filters☐ alarms

☐ radios ☐ other

Commented [EG10]: Use dot points otherwise will be confused as check boxes

Commented [EG11]: Insert “air”

Commented [RM12]: “Conveyors”

Commented [EG13]: Insert “pneumatic control”

Commented [EG14]: Insert:
Pneumatic/electric vibrators;
Unloading cement

Table 1. Typical sound pressure levels (SPL) generated by concrete batching, and other industrial equipment (1m) from point source

5. Environmental risk management

5.1 Site risk assessment

It is the responsibility of industry operators to understand how environmental and human health risks of concrete batching summarised (Section 4) apply at individual batching sites. Industry operators are responsible for managing these risks to prevent harm to human health and the environment, including harm to air, water, land, harm from waste and excess noise. Operators need to assess and understand all hazards posed on site, embedded in industrial processes, and the pathways to environmental harm. Then take all reasonable and practicable steps to implement control measures to prevent these pathways from being realised.

EPA Publication 1695 (May 2018): Assessing and controlling risk: a guide for business can assist, by providing a structured four-step-process for environmental risk assessment, intended as an ongoing cycle of evaluation, re-assessment, and continuous improvement (Figure 5). It is a general guide, and more complex assessments may be required.

Figure (5). Four-step-process for assessing and managing hazards and risks

STEP (1): Identify all hazard points and hazardous activities and record and document these in a Hazards and Risk Register (for an example of a register see EPA Publication 1695)

Examples of some common hazard-points at concrete batching plants:

Dust hazard points
- ☐ front-end loader work
- ☐ above ground storage bay over-fill
- ☐ uncovered conveyor belts
- ☐ lack of sprinkler system maintenance

Fly-ash/cement escape
Hazard points
- ☐ automatic cut-out switch malfunction
- ☐ poor maintenance of silo filters

Alkaline discharge
Hazard points
- ☐ stormwater drains connected to production
- ☐ inadequate hardstand contouring or bunding/ cracked hardstand
- ☐ agitator truck rinsing away from home base after delivery
- ☐ inadequate 'first-flush' capacity
- ☐ lack of housekeeping to keep hardstand clean

Noise hazards
- ☐ typical sources of noise emissions in concrete batching (see p. 9)

Commented [EG15]: Replace with "Cementitious material" (includes fly ash, cement, slag and silica fume)

Commented [EG16]: All concrete cracks – use "significant" cracked hardstand
Rural sites will not have hardstand

STEP (2): Assess level of risk by estimating likelihood of harm occurring (has it occurred before, is it certain, very likely, likely, unlikely, or rare?) and the severity of potential consequences

This table (Table 2) can be used to help estimate level or risk based on likelihood of an event occurring, and the severity of potential consequences. Where these are difficult to estimate, apply the precautionary principle. The table is useful in assessing individual risks but ***cannot*** quantitatively compare or rank one risk against another. It is important to eliminate all risks as far as it is reasonably practicable.

CEG – inserting arrows to various parts of table and hand -written font captions: 'Silo-blow-out', tracking out, drain baskets and contamination of storm water, etc.'

	Consequence					
Permanent or long-term serious environmental harm / life threatening or long-term harm to health and wellbeing.	Severe	Medium	High	High	Extreme	Extreme
Serious environment harm / high-level harm to health and wellbeing.	Major	Medium	Medium	High	High	Extreme
Medium level of harm to health and wellbeing or the environment over an extended period of time.	Moderate	Low	Medium	Medium	High	High
Low environmental impact / low potential for health and wellbeing impacts.	Minor	Low	Low	Medium	Medium	High
No or minimal environmental impact, or no health and wellbeing impacts.	Low	Low	Low	Low	Medium	Medium
		Rare	Unlikely	Possible	Likely	Certain
		Likelihood				
		Could happen but probably never will	Not likely to happen in normal circumstances	May happen at some time	Expected to happen at some time	Expected to happen regularly under normal circumstances

Description of risk ratings

Risk level	Description
Extreme	Totally unacceptable level of risk. Stop work and/or take action immediately.
High	Unacceptable level of risk. Controls must be put in place to reduce to lower levels.
Medium	Can be acceptable if controls are in place. Attempt to reduce to *low*.
Low	Acceptable level or risk. Attempt to eliminate risk but higher risk levels take priority.

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Low	Acceptable level or risk. Attempt to eliminate risk but higher risk levels take priority.

Table 2. An example of a risk-matrix application to concrete batching plants
Estimating level of risk and the severity of potential consequences of some common concrete batching hazards.

STEP (3): Implement all reasonably practicable control measures to prevent harm from occurring. Apply hierarchy of controlling hazards and risks (Figure 6) in preference to using mitigation measures that only manage but do not eliminate residual risk.
Refer to checklists 1-4 (Section 7) for control measures to prevent and minimise harm.

Figure (6). Hierarchy of controls for hazards and risks: demonstrating the approach required for risk management.

Examples of hierarchy of controls from concrete batching:

- Underground raw material storage keeps materials optimally dampened most of the time, to naturally minimise dust dispersal during transfers. Whereas, water sprinklers on ground-level storage bays, manage dust dispersal by daily operation of sprinklers, regular servicing, and re-capture and re-use of water.

- Alkaline discharges to stormwater drains are eliminated by isolating stormwater drains from concrete production, and by installing a triple interceptor system for the minimal 'emergency' off site discharges that need to occur.

When assessing how best eliminate and mitigate hazards and risks, it is important to also consider the site as a whole, and design areas and zones for set activities. This reduces both, the risk of harm, and the cost of preventing it. For example, dedicated slumping stations; truck wash-down areas at dispatch; truck wash down areas on return; and linking these units into a washwater recycling system; dedicated chemical storage area, fitted with its own preventative control measures. This contains the risk of spills into limited areas and allows for efficient secondary containment measures.

STEP (4): Check control measures to ensure ongoing effectiveness and improvement
Please refer to EPA Publication 1695 for further information.

5.2 Additional acoustic site assessments

An additional tool is available for industry operators to self-assess compliance with noise emissions zoning requirements (see Appendix II). Industry operators can use this tool to: (1) calculate their overall site noise emissions, (2) determine compliance, and (3) determine if a further, expert acoustic assessment is required.

6. What good environmental performance looks like

6.1 Underground storage & overhead bin batching plants

These are highly automated high capacity plants, dispatching approximately ≥ 300-700 m³ of ready-mixed concrete a day and achieve good environmental performance by application of the following control measures:

Dust. Raw materials are transported to site in fully enclosed trucks. Sand and aggregate are transferred from compartmentalised underground storage to an overhead storage hopper by fully enclosed conveyor belts and all transfers, preventing dust dispersal. Weigh hoppers are situated beneath overhead storage hoppers (all hoppers roofed and otherwise fully enclosed) where sand, and aggregate, cement and fly-ash (from overhead silos) are weighed and transferred to agitator trucks in loading bays below. Loading bays fitted with dry dust extraction/or spray misting system. Water is added to loads. Loads are further 'slumped' at slumping stations, trucks washed clean of alkaline debris, and dispatched. Dust dispersal is optimally controlled by good design and automation: underground (drive over) sand and aggregate storage; enclosed conveyor belt and hopper transfers; moisture is well-maintained via underground storage; adequately-contoured and bunded hardstand surfaces capture all washwater.

Commented [EG17]: Replace with "aggregate and sand" tarped trucks

Cement and fly-ash are stored in sealed, dust-tight storage silos (filter-fitted; well-maintained; feed pipes, valves, filters, and all materials withstand cement/fly-ash). Filter standard and maintenance ensure maximum performance and capacity to withstand silo pressures. Silos are filled via fully enclosed pneumatic transfers; fitted with emergency pressure alerts and cut-outs for overfill protection (set at high to ensure no over-fill); fitted with overfill protection back-up; burst-filter-bag-detection system; test circuits test operation of all alarm sensors prior to each delivery.

Commented [EG18]: Does not exist.

Water. Washwater reclamation, storage and recycling systems are well-designed, fulfil capacity, and are isolated from stormwater drains. Hardstand surfaces are sealed, bunded, and contoured to capture all washwater in wedge/front-end-loader pits where sediments settle, water diverts to storage tanks for re-use. Loading-bay floors are grated to capture washwater for recycling. Adequate daily housekeeping ensures hardstand is clear of loose material (cement, send) and washwater, to prevent tracking waste outside premises. Some plants employ dry dust-extraction systems (to minimise water use), some use misting, or both. Where misting is used, rinsate is recovered to water reclamation system. Where connection to stormwater is present, a triple interceptor system facilitates treatment of washwater, settling of sediments, and regular monitoring and treatment of pH prior to washwater discharge. Triple interceptor systems are used only as 'an emergency valve' for storm events, not as a regular water discharge facility; instead all washwater is reclaimed and recycled into production.

Commented [EG19]: Contaminated catchment area?

Commented [EG20]: Replace with "sand"

Water - chemicals. Stored chemicals are labelled and segregated. Storage area roofed and enclosed within adequate-capacity secondary containment bunds (Figure 6). Material Safety data sheets (MSDS/SDS) kept on premises and applied into practice. Staff are trained in chemical safety, and read, understand and apply labels and MSDS/SDS in daily work. Functional spill kits are equipped, ready on site, and any spills immediately and correctly cleaned. All washing of trucks/machinery ensures no releases to stormwater drains take place.

Commented [EG21]: Approved neutralising agent?

Waste concrete. All excess-order concrete is returned to point of origin for reclamation. Company policy/practice ensure third-party delivery contractors are not forced to dispose of excess concrete on construction sites or in landfill. Reclamation processes for wet and solid excess concrete operate on site and via third-party recycling. Recycling fulfils capacity to prevent landfill.

Commented [EG22]: Insert "or incorporated into future deliveries"

Noise. Noise mitigation measures complement zoning separation distances, and typically include: underground storage; conveyer belt transfers in lieu of front-end loader work; silencing devises on all pressure-operated equipment; efficient muffling on all engines; enclosed pumps, compressors, other equipment; sound barriers; appropriate sound alarms; weighing of fine aggregate before coarse; limits to operating hours; liaison with surrounding communities; acoustic self-assessments (Appendix II).

6.2 Above ground storage & front-end loader batching plants

These are medium - small plants, dispatching approximately ≤ 300m³ concrete a day, and have a high potential to generate high levels of dust, if sand and aggregates are insufficiently dampened or incorrectly stored. These plants also achieve good environmental performance by application of the following control measures:

Sand and aggregate are stored in above ground storage bays and kept damp by well-maintained sprinkler systems. Bays are (3-sides) enclosed (height ≥ 1m above the highest aggregate point or roofed; depth of bays allows 2 m clearance to stored material). Dampened aggregate is transferred by front-end loaders to (roofed or otherwise enclosed) weigh hoppers, and via enclosed conveyor belts to agitator trucks.

Commented [EG23]: Note - underground storage increases the risk to the employee.

Commented [RM24]: "Covered"

All other systems and processes are in place as per section (6.1) above. Water is added, loads slumped, and trucks cleaned as above. Cement and fly-ash are stored, weighed, and loaded as above. Hardstand surfaces are sealed, contoured, and water reclaimed and recycled, water recycling system fully isolated from stormwater drains, and/or triple interceptor system in place as above. All systems are adequately maintained to prevent blockages in water reclamation systems and tracking of dust outside premises. Hardstand is swept during regular housekeeping to prevent tracking out. Noise and waste are well managed as above.

Commented [EG25]: Insert "cementitious material"

6.3 Photos demonstrating good practice

7. Environmental performance outcomes (1-4) and Control measures – Checklists (1-4)

There are four environmental performance outcomes EPA Victoria considers necessary for concrete batching industry operators to achieve, in order to meet their environmental obligations of preventing harm to human health and the environment. These performance outcomes are the practical end-result to be achieved to meet these environmental obligations. Control measures recommended to achieve these outcomes are outlined below. One suggested way to use this guideline is to adopt the control measures (Checklists 1-4 below) into a business Environmental Management System.

Air — Performance Outcome 1:

Dust and particulate matter associated with all concrete batching activities controlled to minimise risks of harm to air

Control measures - Checklist 1

Transport of raw materials

☐ Transport sand and aggregate in trucks with enclosed top covers

☐ Transport damp sand and aggregate or wet on receipt, to avoid dust dispersal during unloading

☐ Transport cement/fly-ash in fully enclosed containment systems

Storage and transfers of raw materials (sand and aggregate)

Underground storage

☐ Underground storage installed in preference to above ground bays

☐ Underground storage optimised for moisture levels, to avoid dust dispersal during transfers

☐ 'Do-not-overfill' management procedures in place and enforced to prevent over-filling

Above ground storage bays

☐ Bays roofed and fully enclosed by automatic roller doors

☐ Bays enclosed on three sides by solid walls

☐ Bays fitted with additional screening over and above wall height as required (e.g. shade cloth)

☐ Bays fitted with functional, well-maintained sprinkler systems

☐ Bays - stockpiles kept damp to maintain adequate moisture levels to prevent dust dispersal

☐ Bays - stockpiles kept at least (i) 1.5 m below the top of walls, (ii) 2m inside open end of bays

Commented [RM26]: Not reasonably feasible – maybe "Stockpile heights and depth do not exceed reach or operation of dust suppression measures"

☐ Bays clearly sign-posted instructing staff: "Do not overfill"

☐ Other 'do-not-overfill' management procedures in place and enforced

Overhead silos (cement and fly-ash storage)

☐ Fitted with fully enclosed pneumatic transfers

☐ Fitted with emergency pressure alert and automatic cut-out overfill protection

☐ Fitted with back-up over-fill protection

☐ Fitted with high quality dust filters

☐ Burst-bag detector system ducted to about 1m above ground-level adjacent to filling pipe

☐ Emergency pressure alert/ overfill protection systems well maintained

☐ Filter type ensures maximum performance: such as reverse pulse filters

☐ Filters regularly maintained and replaced ☐ maintenance records kept

☐ Emergency management plan, procedures for cement and fly-ash recovery and lawful disposal in place- to prevent air emissions and stormwater contamination in the event of catastrophic equipment failure resulting in silo 'blow-out'

Transfer of sand and aggregate

☐ Front-end loader transfers prevent dust emissions by adequate moisture levels

☐ Hoppers and dusty transfer points – all screened (or otherwise sheltered) from wind

☐ Dry dust extraction systems fitted around hoppers; open sides of enclosure

☐ Conveyor belts fully enclosed

☐ Conveyor belts enclosed on side of prevailing winds/ partially enclosed

Commented [RM27]: Is this a Hierarchy?

☐ Conveyor belts - secondary containment bunds fitted to contain spillage and dust accumulation

☐ Conveyor belts - smooth operation ensured by regular maintenance ☐ records kept

☐ Spills from conveyor belts and other equipment monitored and promptly cleaned

Hardstand surfaces

☐ Hardstand - installed across entire site

☐ Hardstand - all internal roadways sealed

☐ Hardstand - installed in key production areas:

Commented [RM28]: Is this a Hierarchy of controls?

- ☐ Internal roads used by agitator trucks
- ☐ Underneath silos (fly-ash /cement storage areas)
- ☐ Concrete-mix loading bays
- ☐ Slumping stations
- ☐ Truck wash areas
- ☐ All areas of water recycling system
- ☐ All areas of concrete recycling system
- ☐ Reclaimed water storage tanks area
- ☐ Truck maintenance areas

☐ Chemical storage areas

☐ Other areas as required

☐ Hardstand – adequately contoured and bunded

☐ Hardstand - adequately maintained by regular sweeping to prevent tracking out

☐ Hardstand - management process in place to prevent and promptly clean spillages

☐ Hardstand - management process in place to prevent dust accumulation on driveways, internal roads, along property boundaries, etc.

☐ Hardstand - cracks promptly repaired

Commented [RM29]: Major cracking? Cite examples?

☐ Speed limit on internal unsealed roads enforced (to 'drop dust')

Agitator truck loading and wash down

☐ Loading bays ☐ Slumping stations roofed or otherwise enclosed

☐ Loading bays ☐ Slumping stations fitted with grated floors to capture water/ sediment

☐ Loading bays fitted with dry dust extraction systems

☐ Loading bays fitted with misting system for dust suppression

☐ Trucks washed with water to remove all dust on dispatch and prevent tracking outside premises

☐ Focus includes draw bar

☐ Tailgate

☐ Wheels

Agitator trucks and plant machinery

☐ All diesel vehicles and machinery fitted with diesel particulate filters (DPF)

☐ DPF filters regularly replaced ☐ records kept

☐ Regular maintenance of all agitator trucks ☐ records kept

☐ Regular maintenance of all plant equipment ☐ records kept

☐ Regular maintenance on all emission-control equipment ☐ records kept

Boundary screening

☐ Additional screening at boundaries of premises and around dust-generating areas

Photos:

Water Performance Outcome 2.1 (Stormwater and washwater)

Storm and washwater (process water) managed to prevent release of contaminants off-site and to groundwater

Control measures - Checklist 2.1

Washwater (process water) capture and recycling

☐ Plants operate to a well-developed water management plan

☐ Stormwater management plan regularly reviewed

☐ Plans available on site for inspection

☐ All washwater from concrete manufacture recycled back into production via a fully integrated system including, collection, reclamation, capacity storage, and re-use

☐ Washwater recycling system is fully isolated from stormwater drains

☐ Stormwater is directed to a sump to be recycled and does not divert to stormwater drains

☐ Reclaimed process water storage tank capacity matches batching plant output capacity

Stormwater capture on site (First flush capture)

☐ Tank storage capacity above includes provision for 1st flush, contaminated water capture following rain events

☐ 1st flush storm water capture in place

☐ 1st flush system size: system contains and re-uses runoff from 1st 20 mm of rain over a 24-h period

☐ 1st flush storage size calculated based on surface area that generates polluted run-off:
storage capacity $(m^3) = 0.02\ (m) * \text{catchment area}\ (m^2)$

Hardstand surfaces

☐ Installed as per Environmental Performance Outcome 1

☐ Incorporated into washwater reclamation and recycling systems by being contoured and bunded

☐ Contoured ☐ Bunded to direct all washwater on site to front-end loader accessible settling pits

☐ Contoured ☐ Bunded to intercept washwater at site entrance/exit points (to prevent tracking out)

☐ Contoured ☐ Bunded to intercept **all** stormwater drains and direct washwater away from drains to sediment-settling pits

☐ Contoured ☐ Bunded to direct washwater from slumping stations to sediment-settling pits

☐ Contoured ☐ Bunded to direct all washwater from truck-wash stations to sediment-settling pits

☐ Drainage system servicing hardstand areas in place

☐ regularly checked ☐ maintained to ensure drains and recycling systems do not become blocked with sediment

☐ Bunded along the edge of premises to contain washwater, rain events, and dust on site

☐ Maintained by adequate sweeping to prevent sediment build-up and tracking out

Load slumping & truck wash on dispatch

☐ Slumping stations - slumping and truck washing with re-cycled or rain water

☐ Slumping stations/ truck wash areas – wash -water directed to sediment settlement pits

☐ Slumping stations/ truck wash areas - fitted with grated floors to direct run-off to sediment settlement pits

☐ Grated floors system regularly maintained to prevent blockage

Stormwater drains

☐ No discharges to stormwater drains (washwater recycling system fully isolated from drains)

☐ Triple interceptor system (or equivalent) in place for water treatment prior to discharge

☐ Triple interceptor system sediment-settling pits regularly maintained

☐ Triple interceptor system: final water pH monitored and adjusted prior to discharge

- ☐ pH records kept

☐ Triple interceptor system: final suspended solids monitored and adjusted prior to discharge

- ☐ suspended solids/ NTU records kept

☐ If any stormwater drain discharges need to occur:

- ☐ discharges take place only via the triple interceptor system, and
- ☐ only after water pH and turbidity requirements are adjusted and met
  - ☐ **pH range 6 – 9**
  - ☐ **Turbidity below < 30 NTU (Nephelometric Turbidity Units)**

Figure (7~~8~~): Site diagram of a water reclamation and recycling system

Water Performance outcome 2.2 (Chemicals)

Storage and handling of all chemicals (including waste) managed to prevent releases off-site and to groundwater

Control measures - Checklist 2.2

Ensure all systems in place to guarantee only clean water leaves site

☐ 1st Flush system in place

☐ Triple interceptor system (or equivalent) in place

☐ Oil /water separator systems in place

☐ Uncontaminated storm water diverted away from all areas where contaminants may occur

☐ Dedicated roofed chemical storage area in place

☐ Chemical delivery & dispatch
☐ Chemical storage
☐ Piping and transfer areas
☐ Process tanks areas
☐ Vehicle/equipment cleaning areas

} ALL located within bunded areas or within other secondary containment areas

Chemical and liquid storage area (incl. chemical waste storage)

☐ Dedicated roofed impervious solid-walled area (bunded or a compound)

☐ Isolated from stormwater to prevent rain entry, pollutant overflow, rusting of metal drums and storm water contamination

☐ Well-ventilated (e.g. vents in walls, ceiling, or open windows to cool, and prevent fume build-up)

☐ Bund holds 110% volume of largest tank or 25% maximum drum inventory, whichever greater

☐ Bund holds 110% of combined volume of ALL tanks where thanks are connected

☐ Containers and tanks set back from edge of bund

☐ Drain valves and pump-out valves locked in closed position

☐ Storage segregated to keep apart materials that cannot be stored safely together (see Figure 6)

☐ Clearly labelled ☐ Displaying relevant warning signs ☐ well lit

☐ Regularly inspected and maintained (whole area and bunding) to ensure free from cracks

☐ Chemical spill kits on site ☐ prominently sited & labelled ☐ service-ready ☐ all staff trained

☐ Secured against unauthorised access

Acceptable types of temporary bunding or other secondary containment

☐ Temporary bunds must not replace chemical storage requirements above, and are:

☐ non-combustible ☐ resistant to chemicals stored ☐ positioned to prevent flow out of bund

☐ Commercial pallet bunding units may be used for minor temporary chemical storage

☐ Splash shields may be used to deflect leaks within a bunded area

Commented [RM30]: Is "all" the appropriate wording? Depending on the plant setup, an oil/water separator may not be required.

Commented [RM31]: Contradictory with Checklist 2.3, whereby vehicle/equipment cleaning is called to be separated from sediment settling pits and recycling system.

Chemical management & handling (incl. waste chemicals)

☐ Chemicals ordered/stored in smallest quantity practicable to reduce storage needs

☐ Surplus chemicals do not accumulate

☐ Up-to-date records of chemicals and volumes stored

☐ Material Safety Data Sheets (MSDS/SDS) on site: ☐ up-to-date ☐ accessible ☐ applied to practice

☐ Containers are labelled and ☐ display hazard ratings from point of entry to correct disposal

☐ Staff adequately trained in chemical use and safety

☐ Staff read and understand chemical labels and ☐ MSDS/SDS of products they use

☐ Emergency management plan is in place to manage spills

☐ Chemical spills/ leaks cleaned-up promptly: none leave site and escape to the environment

☐ Additional storage requirements for acids, flammable chemicals, and some other liquids in place

Stormwater drains - summary

☐ Zero discharges of chemicals to stormwater drains achieved

☐ Practices to avoid all discharges of all chemicals to stormwater drains in place:

- ☐ Secondary containment of chemical storage and handling areas (incl. concrete admixtures)
- ☐ Secondary containment of fuel, fuel additives, lubricants, oils storage area
- ☐ Secondary containment of all derived liquid wastes
- ☐ Other means of achieving this

Water Performance outcome 2.3

Cleaning of all plant equipment and vehicles to prevent contamination of soil and groundwater

Control measures - Checklist 2.3

☐ Use of all wash chemicals and detergents minimised

☐ Least environmentally toxic wash chemicals and detergents substituted for more toxic ones

☐ Dedicated equipment washing area segregates this water from washwater recycling

☐ Truck and equipment wash areas drain to separate water collection and recycling pits; not connected to washwater sediment settling pits and recycling system

☐ Wash chemicals prevented from entering stormwater drains in all other ways

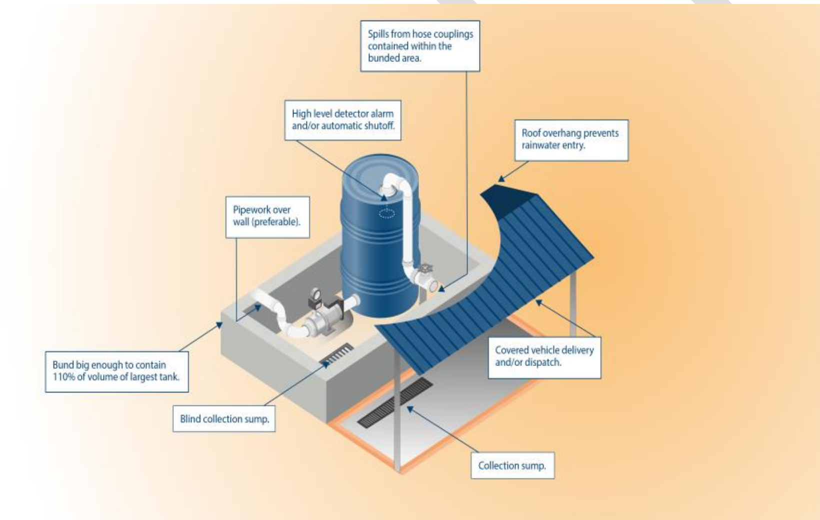

Figure (8~~7~~): Chemical storage bunding at a glance: summary of requirements
Secondary containment (bunding barriers and all other means) prevent chemical liquids escape into the environment, should primary storage or transfer mechanisms fail. ***Volume and non-permeability of secondary containment barriers are critical to risk reduction.*** (1) Bunding to contain 110% of largest chemical storage tank, or (2) 25% of total drum inventory stored plus a minimum 10% freeboard, whichever greater. (3) Where two or more tanks operate as a single unit, the collective tank capacity must be used to calculate required bunding volume. (4) Additional requirements apply to storing flammable liquids, such as fuels, diesel fuel additives, waste oil often stored at concrete batching sites.

Commented [RM32]: Not clear on the need for this measure. The detergents used for vehicle cleaning (when recycled) are not detrimental to the concrete batching process.
Also an oil/water separator would imply servicing and underbody cleaning of vehicles is taking place on site. This is not usually the case.

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For further information please see *(Australian Standard AS1940: 2017- The storage and handling of flammable and combustible liquids)* and *(Liquid storage and handling guidelines - EPA Publication 1698: June 2018)*

Photos ~~()~~ Demonstrating correct waste oil storage, chemical drums storage, dry chemical storage

Waste   Performance outcome 3

Waste generation and disposal minimised, and any waste generated managed to prevent harm to human health and the environment

Control measures - Checklist 3

Waste minimisation is an integral part of any company's environmental management. Producing waste has environmental impacts from resource extraction to disposal in landfill. Disposal in landfill has significant environmental impacts due to transport, leachate, and greenhouse gas emissions, and must be prevented and minimised as far as is reasonably practicable. Waste management practices must follow the legislated waste management hierarchy.

☐ **Waste management hierarchy (from most to least preferred) implemented for all wastes**

- ☐ Set up processes to avoid producing waste
- ☐ Set up processes to minimise waste production
- ☐ Re-use remaining waste as much as reasonably practicable
- ☐ Re-cycle remaining waste as much as reasonably practicable
- ☐ Segregate and clearly label remaining waste to encourage further re-use
- ☐ Disposal to landfill

Waste concrete management

☐ Minimise generation of waste concrete by careful planning and execution of concrete production

☐ Responsibility for all waste concrete returns stays with batching plant

☐ Third party agitator truck contractors not forced to dispose of waste concrete in landfill, instead:

☐ Re-cycle wet-waste concrete back into concrete batching as much as feasible

☐ Re-cycle wet-waste concrete into other production
(e.g. concrete manufacture of low tensile strength concrete products by third parties)

☐ Reduce solid concrete recycling by above processes as much as feasible, to reduce energy inputs required for crushing solid concrete for recycling as aggregate

☐ Re-cycle remaining solid waste concrete back into production as aggregate by crushing

Agitator truck rinsate (truck wash-out) after delivery

☐ Agitator truck rinsing after concrete delivery back at batching plant

☐ Agitators are rinsed with re-cycled water or rain water

☐ Rinsate reclaimed and re-cycled back into production as:

☐ washwater directed from wash stations to sediment steeling pits and re-cycled

☐ wet- concrete mix recycled directly back into production as much as feasible

☐ waste concrete dried and recycled by third party contractors as aggregate by crushing

Photos (): Alternatives to landfill
(a): wet waste concrete recycling back into production
(b): wet waste concrete recycling into manufacture of alternative low tensile concrete products
(c): dry waste concrete - crushed and re-cycled back into production as aggregate

Noise — Performance outcome 4

Industrial noise emissions minimised to comply with zoning requirements to prevent harm to sensitive receptors

Control measures - Checklist 4

Noise prevention plan - general principles

□ All individual sources of noise pollution on site identified
□ Overall site, noise prevention plan developed to minimise emissions from all sources

□ Plan for noise mitigation for each point source ***implemented***:

- □ delivery and tipping of raw materials
- □ general movement of heavy vehicles and machinery on site:
- □ loaders □ excavators □ forklifts □ tip trucks □ fly-ash/cement-delivery trucks □ other
- □ agitator truck engine noise, air brakes, reverse-warning devices
- □ agitator truck engine revving to turn heavy loads during concrete mixing
- □ sand and aggregate transfers to storage bins and hoppers
- □ front-end loader work, engine noise, reverse-warning devices
- □ forklift engine noise, reverse-warning devices
- □ swinging, scraping, loading devices
- □ hydraulic pumps
- □ compressors
- □ conveyor belts
- □ air valves
- □ filters
- □ alarms
- □ radios
- □ other

□ Natural topography and layout of the plant used to best advantage as noise barriers where possible

□ Quieter new equipment replacing old – new equipment policy acquisition

□ Alter or enclose equipment to *reduce noise at point source*

□ Acoustic shielding, barriers, enclosures of sound-absorbing materials to *isolate noise at point source* and *prevent noise travel over distance*

□ Use of equipment silencing and muffling devices

Community liaison

□ Liaison with local community to prevent, and promptly respond and resolve issues

□ System for capturing and addressing community complaints in place

Some individual control measures

Surfaces

□ Hardstand surfaces
□ Internal roads sealed
□ Underground (drive over) aggregate storage

Enclosure of noise (at point source)

□ All pumps enclosed
□ All compressors enclosed
□ All pressure-operated equipment fitted with silencing devices
□ All engines fitted with efficient muffling devices

Use of sound-absorbing materials (at point source)

□ Hoppers - lined with sound-absorbing material (e.g. rubber)
□ Hoppers - use of self-cleaning weigh hoppers
□ Hoppers - work flow organised to weigh fine aggregates before coarse

Sound-barriers and buffers (prevention of noise travel over distance)

□ Buffers between plant and neighbours erected (screens, barriers, trees and shrubs, etc.)
□ Noise-generating equipment located behind sound barriers or other absorbers

Locating within site to increase distance to sensitive receptors

□ Entrance and exits sited away from noise sensitive areas
□ Noise-generating equipment located away from noise sensitive areas
□ Sirens located away from sensitive areas □ used only in emergency

Substituting quieter equipment

□ Visual alarms used in lieu of audible alarms, where appropriate and not contravening OHS
□ Agitator truck reversing alarms are 'squawker type' rather than 'beepers'

Maintenance

□ Regular best practice maintenance of all equipment, heavy machinery and trucks □ records kept
□ Regular best practice maintenance of all sound-reducing equipment □ records kept

Operating hours

□ Operating only within approved operating hours
□ Operation of trucks and heavy machinery to appropriate hours wherever practicable
□ If operating outside normal business hours: liaison with local community to prevent conflict

8. Factsheets
9. References and electronic links

APPENDIX I

List of figures and tables

List of photos