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ENVIROSWIM COMPARATIVE RISK ASSESSMENT

Swimming Pool Sanitation: Enviroswim Multi-Barrier Treatment vs Conventional Chlorine-Based Benchmark

Company name: Watertech Services International Pty Ltd / Enviroswim

Assessment documentation carried out by: Enviroswim, Tweed Laboratory, Dr Simon Toze and NSF

Date assessment was carried out: May 2026

Date of next review: Review after regulatory, operational or scientific evidence changes, after site-specific installation review, or within 12 months

Risk assessment method

This assessment has been prepared to objectively examine the relative operational, health, environmental, and infrastructure risks associated with conventional chlorine-dependent swimming pool sanitation systems compared with lower-chemical multi-barrier treatment systems such as Enviroswim.

The assessment process evaluates:

- the nature of each identified hazard,
- the likelihood of the hazard occurring under real-world operating conditions,
- the potential consequences to workers, pool users, operators, infrastructure, and surrounding environments,
- and the effectiveness of existing and proposed control measures.

The assessment considers key factors including microbiological performance, chemical exposure risks, airborne contaminant generation, disinfection by-product formation, corrosion potential, energy consumption, maintenance requirements, operational reliability, and broader workplace health and environmental impacts. Conclusions within this assessment are supported, where available, by independent laboratory testing, accredited microbiological reports, scientific literature, public pool operational data, occupational exposure considerations, and long-term field performance observations.

The purpose of this document is not to advocate for the complete elimination of chlorine from the swimming pool industry, but rather to evaluate practical methods capable of reducing chemical dependency and the associated health, safety, and infrastructure impacts commonly linked with chlorine-based sanitation systems. Particular attention is given to treatment methods that maintain effective microbiological control while reducing airborne chlorine exposure, disinfection by-products, corrosion, chemical handling risks, and overall operational costs.

Likelihood and Consequence matrix

Impact
How severe would the outcomes be if the risk occurred?

What is the probability the risk will happen? — **Probability**

	Insignificant 1	Minor 2	Significant 3	Major 4	Severe 5
5 Almost Certain	Medium 5	High 10	Very high 15	Extreme 20	Extreme 25
4 Likely	Medium 4	Medium 8	High 12	Very high 16	Extreme 20
3 Moderate	Low 3	Medium 6	Medium 9	High 12	Very high 15
2 Unlikely	Very low 2	Low 4	Medium 6	Medium 8	High 10
1 Rare	Very low 1	Very low 2	Low 3	Medium 4	Medium 5

Comparative risk assessment table

What are the hazards?	Who might be harmed and how?	Current chlorine benchmark controls	Further action / Enviroswim risk reduction	Responsible person	Review timing	Residual risk position
Sunlight degradation of chlorine in outdoor pools	Swimmers and operators may be exposed to reduced `disinfection protection if active chlorine is photodegraded faster than it is replenished.	Increase chlorine dosing; extend pump run times; add cyanuric acid stabiliser; frequent manual testing.	Use Enviroswim copper/silver residual, which Dr Toze states is not photodegraded by sunlight, with oxidation/ultrasonics as supplementary treatment barriers.	Pool owner / facility manager / service technician	Seasonal review; high UV periods; after heavy use	Chlorine: High to Extreme. Enviroswim: Very Low to Low.
Cyanuric acid dependence and reduced chlorine efficacy	Swimmers may face slower pathogen inactivation in stabilised outdoor chlorine pools; operators may add more chlorine to compensate.	Maintain CYA within recommended range; raise chlorine concentration; monitor frequently.	Reduce reliance on CYA by using Enviroswim residual ionisation that is not dependent on chlorine stabiliser for sunlight protection.	Facility manager / pool technician	Monthly in outdoor pools and after dilution/top-up	Chlorine: High. Enviroswim: Low.
Organic load and bather load consuming chlorine	Swimmers face variable disinfection protection; workers increase chemical handling and dosing.	More chlorine, shock dosing, extended filtration, stricter bather hygiene controls.	Dr Toze notes silver/copper ions do not interact with organics in the same way as chlorine, allowing residual to be maintained under heavy bather loading.	Facility manager / operators	Daily during peak season; after events	Chlorine: High. Enviroswim: Low to Medium.
pH and temperature sensitivity of chlorine	Reduced hypochlorous acid performance can occur when pH moves out of target range; warmer water increases chlorine losses.	Tight pH control, acid dosing, frequent testing, chemical correction.	Enviroswim ion residual is described as not materially impaired by pH, temperature or volatilisation in the same way as halogen disinfectants.	Pool operator / service technician	Daily/weekly depending on pool class	Chlorine: Medium to High. Enviroswim: Low.
Disinfection by-products: chloramines, THMs, HAAs and related compounds	Swimmers, lifeguards, teachers, coaches, maintenance staff and patrons may be exposed through inhalation, ingestion and dermal contact; complaints include odour, eye/skin irritation and respiratory symptoms.	Ventilation, dilution, breakpoint chlorination, water replacement and chemical balancing. These manage consequences after DBPs form.	Reduce DBP generation at source by reducing chlorine dependency. Dr Toze notes no recorded instances of DBPs produced by silver/copper disinfection systems in the literature he reviewed.	Facility owner / WHS officer / aquatic manager	Quarterly and after air quality complaints	Chlorine: High to Extreme indoors. Enviroswim: Low to Medium.
Effect of chlorine based disinfection by-products on male genital development	Research is finding that disinfection by-products from chlorine in swimming pools can affect testicular development of pubescent males involved in high pool training	Maintain chlorine within guideline limits; ventilation; water replacement; minimise chloramine formation through conventional pool management.	Reduce chlorine dependency and associated DBP exposure through Enviroswim multi-barrier sanitation and lower combined chlorine formation. Consider precautionary exposure reduction for high-use training pools involving children and adolescents.	Facility owner / WHS officer / aquatic manager	Annual health-risk review and after publication of new scientific evidence	Chlorine: Medium to High Enviroswim: Low to Medium.
Airborne chlorine/chloramine exposure in indoor pools	Workers and frequent users may experience irritant exposure; operators face ventilation and workplace exposure obligations.	High-volume ventilation, air monitoring, HVAC maintenance and operator procedures.	Source reduction: lower chlorine demand and lower chloramine formation through Enviroswim multi-barrier operation; maintain ventilation but avoid relying on it as the primary control.	WHS manager / facility manager	At WHS review, after complaints, before Dec 2026 exposure framework changes	Chlorine: High to Extreme. Enviroswim: Low to Medium.
Chemical storage, transport and handling hazards	Pool staff, service technicians, retail staff and householders may be exposed to corrosive/oxidising chemicals; risks include mixing incidents, spills and fumes.	Chemical segregation, SDS, PPE, training, bunding, transport controls.	Reduce chlorine volume, delivery frequency and manual handling through Enviroswim operation. Continue SDS/PPE for remaining chemicals.	Business owner / WHS officer	Every chemical stock review and incident review	Chlorine: High. Enviroswim: Low to Medium.
Microbial control failure under real-world pool conditions	Swimmers may face infection risk when disinfection performance is reduced by stabiliser, organics, pH, sunlight, equipment failure or poor operation.	Residual testing, dosing equipment, manual correction, operator vigilance.	Use multiple barriers: ionisation, electronic oxidation and ultrasonics. Tweed Laboratory evidence shows Enviroswim achieved the NSW Health 4-log *Pseudomonas* reduction benchmark within 30 seconds.	Facility manager / service technician	Routine microbiological testing; after any incident	Chlorine: Medium to High. Enviroswim: Low to Medium.
Cryptosporidium and *Giardia* limitations	Swimmers face gastroenteritis risk because *Cryptosporidium* is highly chlorine resistant and filtration is imperfect.	Faecal incident response, filtration, hyperchlorination, closure procedures.	No system is perfect. Enviroswim should be used with good filtration and incident procedures. Potential silver/copper effects on protozoa require further research.	Facility manager / public pool operator	After faecal incidents and annually	Chlorine: High for *Cryptosporidium*. Enviroswim: Medium pending further specific research.
Biofilm and opportunistic pathogens including *Legionella* and *Pseudomonas*	Susceptible users may face elevated risk where biofilm protects pathogens from disinfectants.	Maintain disinfectant residual, cleaning, pipework and filter maintenance.	Dr Toze notes silver/copper ion systems are used for *Legionella* control where biofilms occur; Enviroswim ultrasonics assist biofilm disruption.	Facility manager / maintenance contractor	Quarterly or after elevated bacterial counts	Chlorine: Medium to High. Enviroswim: Low to Medium.
Corrosion of building fabric, plant and electrical systems	Facility owners, workers and patrons may be exposed to infrastructure degradation, electrical faults and higher maintenance costs, particularly indoors.	Ventilation, material selection, maintenance, replacement programs.	Reduce chloramine/DBP burden at source through lower chlorine dependency; lower salinity than salt chlorination reduces salt-related corrosion pressure.	Asset manager / facility owner	Annual asset inspection; after corrosion complaints	Chlorine/salt chlorination: High. Enviroswim: Low to Medium.
High operating cost and energy burden	Operators face recurring chemical, labour, ventilation, water replacement and filtration costs.	Bulk chemical procurement, automation, scheduled maintenance.	Enviroswim reduces chemical dependency, backwashing, filtration burden and corrosion-related replacement costs; ROI depends on site-specific data.	Business owner / finance manager	Annual budget review	Chlorine: Medium to High. Enviroswim: Low to Medium.
Absence of independent sanitation-equipment certification as an industry baseline	Pool owners, workers, regulators and consumers may be harmed where product claims are accepted without consistent efficacy, construction and safety testing.	The chlorine benchmark is generally embedded by regulation and convention, but product/equipment claims across the wider market may not be tested against a single transparent global protocol.	Use NSF/ANSI 50 or equivalent independent certification as a minimum benchmark for sanitation-equipment claims. Enviroswim's existing NSF/UL pathway materially lowers the claims-validation and due-diligence risk.	Management / regulator / procurement officer	Immediate for procurement and standards work	Chlorine: Medium to High. Enviroswim: Low.

What are the hazards?	Who might be harmed and how?	Current chlorine benchmark controls	Further action / Enviroswim risk reduction	Responsible person	Review timing	Residual risk position
Reliance on laboratory assumptions rather than long-term public-pool field evidence	Facility operators, bathers and regulators may be exposed to false confidence if sanitiser performance is assumed from idealised laboratory conditions rather than real operating pools.	Conventional chlorine control relies on free/total chlorine and pH monitoring. This does not itself prove performance under sunlight, bather load, temperature and organic contamination.	Use public-pool microbiology and chemistry records as part of risk review. The Sleeman Centre data set shows multiple pool types, changing bather loads and repeated microbiological monitoring over time.	Facility manager / independent laboratory / auditor	At annual review and during technology selection	Chlorine benchmark assumptions: Medium to High. Enviroswim: Low.
Energy and pump-runtime dependency	Operators and households may face higher energy costs, lower resilience during demand-response events, and greater risk if chlorination depends on long pump/chlorinator runtime.	Chlorine and salt systems commonly require extended daily runtime to maintain oxidant generation, circulation and residual.	Recognise energy/runtime as a safety and operational risk factor. Enviroswim's persistent ion residual and multi-barrier approach may support shorter runtime, lower energy demand and improved load-shedding resilience, subject to site validation.	Pool owner / facility manager / energy program assessor	At design, upgrade and energy-review stage	Chlorine: Medium to High. Enviroswim: Low to Medium.
Chemical storage, transport and security exposure	Pool-shop staff, service technicians, facility workers, householders and emergency responders may be exposed to oxidisers, acids, chlorine products and reactive chemicals during storage, transport and handling.	Chemical stores, SDS documentation, segregation, PPE, staff training and emergency procedures are required controls, but the hazard remains because the chemicals are still stored and handled.	Apply substitution/minimisation principle. Lower-chemical systems reduce the quantity and frequency of hazardous chemical handling and associated occupational, storage, transport and misuse risks.	Business owner / WHS officer / service manager	Immediate and ongoing	Chlorine: Medium to High Enviroswim: Low to medium
Failure to consider long-term monitoring from hospitality/wellness sites	Guests, staff and operators may be affected if assessment only considers single tests rather than ongoing monitoring in high-expectation accommodation/wellness environments.	Conventional compliance generally relies on routine testing, but the comparative evidence base should include documented independent monitoring programs.	Use ongoing water-quality monitoring reports such as the Gwinganna monthly reports as supporting evidence that the technology can be managed within formal operating and public-health monitoring frameworks.	Facility manager / auditor / independent hygienist	At procurement and annual review	Lower where monthly independent monitoring supports ongoing control

Risk assessment register and comparative matrix

Risk scores are indicative and should be adjusted for each pool type, bather load, indoor/outdoor setting, operator competence, existing controls and available site data. The purpose is to show the relative risk difference between conventional chlorine dependency and Enviroswim source-reduction controls.

No.	Risk description	System assessed	Likelihood	Consequence	Score / level	Evidence-based rationale	Controls / recommended action	Priority
1	Sunlight impact on outdoor sanitation residual	Chlorine	Almost certain (5)	Major (4)	20 / Extreme	Chlorine is photodegraded by sunlight; outdoor pools commonly require stabiliser and/or repeated dosing.	Reduce chlorine dependency; monitor residual; consider Enviroswim for more stable outdoor residual.	High
1A	Sunlight impact on outdoor sanitation residual	Enviroswim	Rare (1)	Insignificant (1)	1 / Very low	Dr Toze states silver/copper ions are not photodegraded by sunlight and are not affected by volatilisation in the same manner as chlorine.	Routine ion/pH/water balance checks.	Routine
2	Cyanuric acid dependence	Chlorine	Likely (4)	Major (4)	16 / Extreme	CYA protects chlorine from sunlight but reduces available active chlorine and can materially slow inactivation of pathogens.	Strict CYA control; avoid excessive stabiliser; reduce chlorine reliance where practicable.	High
2A	Cyanuric acid dependence	Enviroswim	Rare (1)	Minor (2)	2 / Very low	Enviroswim does not require CYA	Maintain Enviroswim parameters and any jurisdictional residual requirements.	Routine
3	Organic load, sweat, urine, oils and sunscreen consume active chlorine	Chlorine	Likely (4)	Major (4)	16 / Extreme	Chlorine reacts with organics, reducing free chlorine and forming chloramines/DBPs; high bather load increases demand.	Increase testing and turnover; reduce source formation by reducing chlorine burden.	High
3A	Organic load, sweat, urine, oils and sunscreen consume active chlorine	Enviroswim	Unlikely (2)	Moderate (3)	6 / Low	Dr Toze states silver/copper ions do not interact with organics in the same way and residual can be maintained in heavily used pools.	Maintain filtration, oxidation cell and ion levels; continue bather hygiene controls.	Routine
4	DBP and chloramine formation	Chlorine	Likely (4)	Major (4)	16 / Extreme	Chlorine reacting with organics produces chloramines, THMs, HAAs and other DBPs; literature identifies respiratory, irritation and chronic health concerns.	Ventilation, dilution and monitoring are secondary controls; reduce formation at source.	High
4A	DBP and chloramine formation	Enviroswim	Unlikely (2)	Moderate (3)	6 / Low	Dr Toze notes no recorded DBPs from silver/copper systems in the literature reviewed; lower chlorine dependency reduces DBP precursors.	Verify with site-specific water/air testing.	Low
5	Indoor airborne exposure requiring ventilation/HVAC controls	Chlorine	Likely (4)	Major (4)	16 / Extreme	Indoor chlorine pools can accumulate volatile DBPs and chloramines; ventilation is costly and	Use hierarchy of control: reduce chemical generation at source before relying solely on ventilation/PPE.	High

No.	Risk description	System assessed	Likelihood	Consequence	Score / level	Evidence-based rationale	Controls / recommended action	Priority
						treats consequences after formation.		
5A	Indoor airborne exposure	Enviroswim	Possible (3)	Minor (2)	6 / Low	Lower chlorine demand should reduce airborne chlorinated compounds, although site-specific monitoring should verify results.	Maintain adequate ventilation; collect before/after chloramine/THM/air quality data.	Low
6	Chemical storage, transport and manual handling	Chlorine	Likely (4)	Major (4)	16 / Extreme	Chlorine products are hazardous oxidising/corrosive chemicals requiring transport, storage, PPE and mixing controls.	Reduce chemical volumes handled; maintain SDS, segregation and PPE.	High
6A	Chemical storage, transport and manual handling	Enviroswim	Possible (3)	Minor (2)	6 / Low	Reduced chlorine dependency lowers chemical volume, delivery frequency and manual handling exposure, but does not remove all chemical management duties.	Maintain remaining chemical controls and operator training.	Low
7	*Pseudomonas aeruginosa* disinfection benchmark	Chlorine	Possible (3)	Major (4)	12 / High	Tweed/Dr Toze material states 2.0 mg/L chlorine did not achieve the same 4-log reduction in under 15 minutes in the referenced test.	Do not assume laboratory chlorine performance equals real pool performance; monitor.	High
7A	*Pseudomonas aeruginosa* disinfection benchmark	Enviroswim	Rare (1)	Major (4)	4 / Low	Tweed Laboratory reported Enviroswim achieved the NSW Health 4-log P. aeruginosa reduction in 30 seconds; NSF testing also reported >6.4-log reduction by first 15-minute sample.	Keep system within validated operating parameters; retain reports in compliance file.	Routine
8	Biofilm sheltering opportunistic pathogens	Chlorine	Possible (3)	Major (4)	12 / High	Pathogens may integrate into biofilms or protozoa, protecting them from disinfectants.	Mechanical cleaning, filtration, residual control, pipework maintenance.	High
8A	Biofilm sheltering opportunistic pathogens	Enviroswim	Unlikely (2)	Moderate (3)	6 / Low	Silver/copper is used for *Legionella* control in biofilm-prone water systems; Enviroswim ultrasonics assist biofilm disruption.	Continue cleaning and monitor microbiology; do not rely on one barrier only.	Low
9	Corrosion and infrastructure degradation	Chlorine/salt chlorine	Likely (4)	Major (4)	16 / Extreme	Chloramines, airborne chlorinated compounds and high salinity contribute to corrosion of plant, fixtures, steelwork and electrical systems.	Ventilation, material selection, inspection and replacement.	High
9A	Corrosion and infrastructure degradation	Enviroswim	Unlikely (2)	Moderate (3)	6 / Low	Lower chlorine dependency and much lower salt reliance reduce major corrosion drivers.	Track maintenance costs and asset condition; collect comparative evidence.	Low
10	*Cryptosporidium* control limitation	Chlorine	Possible (3)	Major (4)	12 / High	*Cryptosporidium* is well documented as highly resistant to chlorine; outbreaks can occur even with treatment in place.	Filtration, faecal incident protocols, closure/hyperchlorination procedures.	High
10A	*Cryptosporidium* control limitation	Enviroswim	Possible (3)	Moderate (3)	9 / Medium	Dr Toze notes this remains an area requiring further specific research; Enviroswim should not be oversold as a stand-alone *Cryptosporidium* solution.	Maintain filtration, incident response and conservative public health controls.	Medium
11	Operating and energy cost burden	Chlorine	Likely (4)	Moderate (3)	12 / High	High chemical demand drives acid/CYA use, labour, water replacement, ventilation power and maintenance.	Automate where possible; document total cost of ownership.	High
11A	Operating and energy cost burden	Enviroswim	Possible (3)	Minor (2)	6 / Low	Enviroswim materials report reduced chemical demand, reduced backwashing, lower filtration load and lower maintenance burden.	Automate where possible; document total cost of ownership	Low
12	Independent certification and claims-validation risk	Chlorine benchmark / market generally	Likely (4)	Major (4)	12 / High	The NSF/ANSI 50 proposal document states that NSF/ANSI 50 provides rigorous protocols for sanitation equipment efficacy, safety and construction and directly supports validation of claims such as chlorine-free, chemical-free or drinking-water-safe.	Require NSF/ANSI 50 or equivalent independent evidence for sanitation technologies; prefer technologies already assessed through recognised third-party certification.	High
13	Certification and due-diligence risk	Enviroswim	Rare (1)	Moderate (3)	6 / Low	The additional NSF documents mean Enviroswim achieved independent certification through UL and NSF International..	Keep certificates current; include certification documentation in tenders, WHS files and standards submissions.	Medium

Additional Analyses

No.	Risk Description	System Assessed	Analyses
1	Real-world public-pool microbiological performance risk	Enviroswim at Sleeman Centre	The Sleeman Centre reports from 2004-2005 show repeated sampling across main, community, diving, toddlers, slide and waterjet pools. In the spreadsheet set reviewed, 169 records showed *Pseudomonas aeruginosa* as <1 cfu/100 mL; coliform/faecal-coliform and *Staphylococcus* aureus results were overwhelmingly <1, with only isolated low detections.
2	Chemical residual stability and corrosion/salt load risk	Enviroswim at Sleeman Centre	The Sleeman chemistry reports include copper and silver residuals recorded across multiple public pool vessels, with TDS levels generally far below typical salt-chlorination salinity. This supports the argument that residual sanitation can be maintained without high salt loading.
3	Ongoing monitored hospitality/wellness site risk	Gwinganna / Enviroswim	The Gwinganna monthly reports were prepared by OCTIEF and describe ongoing water-quality monitoring to meet Environmental Authority, Public Health Regulation, Queensland Health pool/spa guidelines and site operating procedures, with pool parameters including free chlorine, total chlorine, pH, *E. coli*, HPC, *Pseudomonas* and thermotolerant coliforms.
4	Energy, operating-cost and demand-response risk	Chlorine / salt benchmark	The energy white paper states conventional chlorine/salt systems commonly require 6-8 hours/day operation, are sensitive to load shedding, and can contribute significant aggregate residential pool-pump demand.
5	Energy and resilience advantage	Enviroswim	The energy paper states Enviroswim can operate with shorter runtimes, reports a 50,000 L pool case using 326 kWh over 91 days and estimates annual operation at 1,307 kWh.
7	DBP toxicology and exposure uncertainty	Chlorine benchmark	The EPA Six-Year Review 3 technical support document contains dedicated chapters on health effects, occurrence/exposure, treatment and regulated/unregulated DBPs, including THMs, HAAs, bromate, chlorite, nitrosamines, haloketones, haloacetonitriles and other DBP classes.
8	Drinking-water-style risk framing	Enviroswim	The drinking-water standards document frames Enviroswim around Australian Drinking Water Guidelines-style microbiological and chemical parameters.

Comparative risk summary

Risk category	Conventional chlorine risk position	Enviroswim risk position	Practical conclusion
Outdoor sunlight stability	High to Extreme	Very Low to Low	Chlorine needs stabiliser/dosing; Enviroswim ion residual is materially more stable outdoors.
Organic/bather load resilience	High	Low to Medium	Chlorine is consumed and produces DBPs; silver/copper residual is less compromised by organics.
Rapid *Pseudomonas* benchmark	Medium to High	Low	Tweed evidence favours Enviroswim against NSW Health 4-log/30-sec criterion.
DBP/chloramine formation	High to Extreme	Low to Medium	Best control is source reduction, not simply ventilation after formation.
Indoor workplace exposure	High to Extreme	Low to Medium	Enviroswim provides a credible lower-chemical pathway for WHS consideration.
Chemical handling	High	Low to Medium	Less chlorine volume reduces storage, transport, spill and handling exposure.
Corrosion/infrastructure	High	Low to Medium	Reduced chlorine/chloramine and lower salt burden reduces corrosive pressure.
Protozoa/*Cryptosporidium*	High	Medium	Do not overclaim. Keep filtration and public health protocols regardless of system.
Operating cost	Medium to High	Low to Medium	Site-specific ROI should be documented with before/after chemical, energy and maintenance data.
Independent certification	Extreme due to no third-party testing and certification	Very Low due to achieving NSF/ANSI 50	Similar independent third-party testing and certification to NSF/ANSI 50 should be required for comparative public-health and efficacy validation of pool sanitation systems
Public-pool field evidence	Not available	Low	Greater emphasis should be placed on real-world microbiological testing and public-pool performance outcomes rather than chlorine residual testing alone
Hospitality/wellness monitoring	Not available	Low	Independent microbiological monitoring and operational performance assessment should be prioritised over reliance on chlorine residual measurements alone
Energy and resilience	High	Low	Closer attention should be given to higher sanitation efficacy while simultaneously reducing overall operating, chemical and energy costs

Conclusion

This comparative risk assessment concludes that the continued treatment of chlorine as the unquestioned benchmark swimming pool sanitiser warrants urgent and independent scientific, regulatory and occupational review.

The evidence examined throughout this assessment demonstrates that many of the recognised operational and public-health limitations associated with chlorine are not isolated or theoretical concerns, but systemic and increasingly documented realities across both residential and commercial aquatic environments. These include:

- rapid degradation under ultraviolet exposure,
- dependence on cyanuric acid stabilisation,
- reduced efficacy under real-world organic loading,

- formation of chloramines and disinfection by-products (DBPs) with subsequent health impacts,
- airborne exposure risks in indoor facilities,
- increased corrosion of infrastructure and electrical systems,
- elevated energy and ventilation requirements,
- and significant ongoing chemical handling, transport and storage risks.

Importantly, the evidence reviewed also demonstrates that chlorine's long-standing benchmark status appears to rely more heavily on historical convention and regulatory entrenchment than on transparent, independently validated real-world comparative efficacy evidence.

The NSW Health "New Disinfection Process Criteria" established a requirement for a 4-log reduction of *Pseudomonas aeruginosa* within 30 seconds under controlled testing conditions. The Tweed Laboratory testing demonstrated that the Enviroswim system achieved and exceeded this benchmark, while chlorine-only treatments failed to achieve the same result within the prescribed timeframe under multiple chlorine concentrations.

Further, the APVMA Freedom of Information response stating that "the documents sought do not exist" in relation to requested efficacy evidence for certain registered pool sanitisers raises legitimate and serious questions regarding the scientific basis upon which chlorine and other registered sanitisers continue to be treated as default regulatory benchmarks.

In contrast, the evidence reviewed in this assessment indicates that Enviroswim represents a materially different and lower-risk sanitation model based on:

- multi-barrier treatment,
- reduced chlorine dependency,
- persistent copper/silver residuals,
- electronic oxidation,
- ultrasonic treatment,
- reduced to no disinfection by-product generation,
- reduced airborne contaminant formation,
- reduced chemical storage and transport requirements,
- lower corrosion pressures,
- lower operational energy burden,
- and extensive long-term field performance.

Importantly, Enviroswim is not presented as an experimental concept or theoretical alternative. The system has undergone:

- accredited laboratory efficacy testing,
- independent microbiological monitoring,
- NSF/ANSI 50 certification review processes,
- public-pool operational evaluation,
- long-term commercial deployment,
- and scientific review over approximately 25 years across Australia and international markets.

This assessment therefore supports the position that future swimming-pool sanitation standards, procurement policies, and public-health frameworks should move beyond simplistic reliance on chlorine residual measurements alone and instead place substantially greater emphasis on:

- independently verified microbiological performance,
- whole-of-system risk reduction,
- workplace exposure outcomes,
- reduction of DBPs and airborne contaminants,
- infrastructure sustainability,
- chemical minimisation,
- energy efficiency,
- and long-term real-world operational evidence.

The hierarchy of risk control used throughout modern workplace health and safety frameworks strongly favours elimination, substitution and source reduction ahead of reliance on ventilation, PPE and administrative controls. In that context, technologies capable of materially reducing chlorine dependency at source warrant serious regulatory consideration.

Based on the totality of the evidence reviewed throughout this assessment, Enviroswim demonstrates a substantially reduced overall operational, environmental and workplace risk profile when compared with conventional chlorine-dependent swimming pool sanitation systems.

Accordingly, this assessment concludes that:

- chlorine should no longer be accepted as an unquestioned benchmark sanitiser without rigorous independent reassessment against modern efficacy, workplace exposure and public-health expectations; and

- lower-chemical multi-barrier systems such as Enviroswim should be given serious and objective consideration as a safer, more sustainable and more effective direction for the future of swimming pool sanitation.

Enviroswim should not be presented as eliminating all risks or replacing normal pool management, filtration, testing, incident response and compliance obligations. The correct position is that Enviroswim materially reduces several key hazard sources when compared with chlorine-dependent sanitation.

References

Australian Pesticides and Veterinary Medicines Authority (APVMA). Freedom of Information Response relating to scientific evidence and efficacy documentation for registered swimming pool sanitisers. Canberra, ACT.

Dr S Toze. Scientific literature review and technical assessment relating to swimming pool sanitation, chlorine performance, disinfection by-products, and copper/silver ionisation technologies.

Environmental Protection Agency (EPA). *Six-Year Review 3 Technical Support Document for Disinfection Byproducts Rules*. United States Environmental Protection Agency, Washington, DC.

Gwinganna Lifestyle Retreat & Spa. Independent Water Quality Monitoring Reports prepared by OCTIEF (2021–Present). Queensland, Australia.

National Sanitation Foundation (NSF International). *NSF/ANSI/CAN 50: Equipment and Chemicals for Swimming Pools, Spas, Hot Tubs and Other Recreational Water Facilities*. NSF International, Ann Arbor, Michigan, USA.

Sleeman Sports Complex. Independent Microbiological Monitoring Reports (2004–2005). Queensland, Australia.

Tweed Laboratory Centre. *Evaluation of Enviroswim Copper/Silver Ionisation System Against NSW Health New Disinfection Process Criteria* (2001). Tweed Heads, NSW.

Tweed Laboratory Centre. *Spa Pool Efficacy Testing of the Enviroswim ES3 System* (2004). Tweed Heads, NSW.

United States Patent and Trademark Office (USPTO). *United States Patent No. 8,545,682 – Swimming Pool Cleaning and Sanitising System*. Assigned to EnviroSwim Pty Ltd.

Watertech Services International Pty Ltd. *Drinking Water Standards Assessment: Enviroswim Technology Review Against Australian Drinking Water Guidelines (ADWG)*. Internal Technical Assessment.

Watertech Services International Pty Ltd. *Fortitude Valley Aquatic Centre Municipal Pool Field Trial Report* (2001). Brisbane, Queensland.