
# TURRET™

## FLOATING INTAKE SOLUTION

*For shallow water pumping*

TURRET

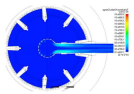
# Agenda


**About the Company**

**The Challenge & Solution**

**Turret Family & Handling**

**Case Study**



**Technical Information**

**Questions & Feedback**

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# Our Story

- We have been in dewatering since 1980s
- Often gets called to rescue pumps:
  - Submerged
  - Replace Cavitated Impellers
  - Poor Efficiency & Performance
- Been on the lookout for a solution globally
- Invented the 1st prototype after research
- Undertook simulation & design development
- Developed and evolved the design
- Manufactured in Western Australia
- Distributed to clients Globally

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# The Problem & Challenge

**Effectively extract, pump & circulate water from shallow water bodies**

- **Maximise Water Usage & Circulation:**
  - Water is a scarce natural resource. Storing, usage and managing water in mining, processing, tailings, farming and emergency services can be complex.

- **Vortexing & Cavitation**
  - Pumping Shallow Water bodies cause vortexing and cavitation, which damages pump and assets

- **Silt & Mud**
  - Lowering pump intake causes severe damages to pump & assets

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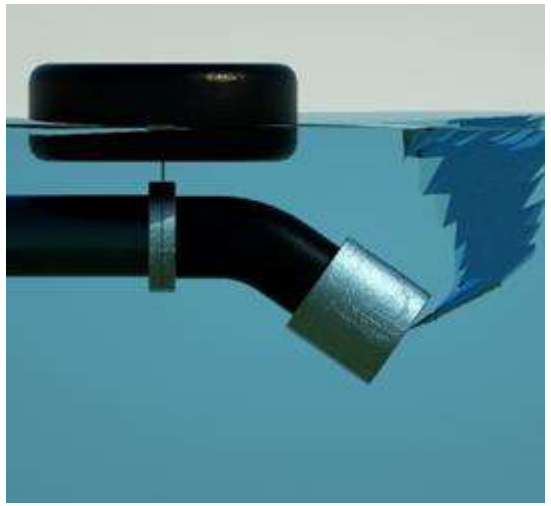
# Challenge 1 - Cavitation

**Vortex causes bubbles at low pressure in intake**



**Bubbles implode at high pressure in pump impeller**

**Shock waves of implosion damaging the pump**

## Cavitation Causing

- Production Loss
- Damaged Equipment
- Delays

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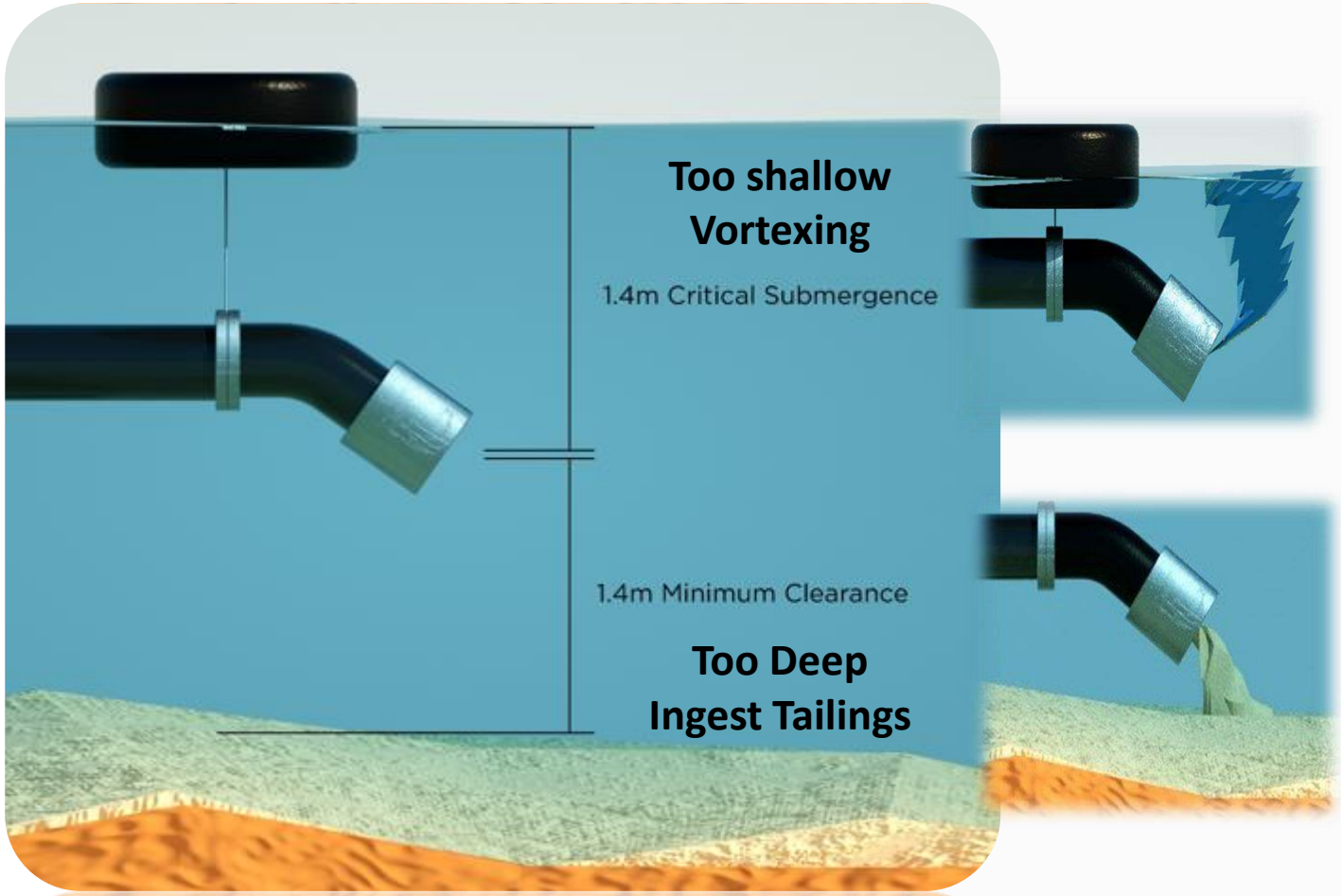
# Challenge 2 – Critical Submergence




## Critical Submergence

- Surface Vortices
- Ingest Tailings
- Reduced Flow & Pump Performance

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**Vortex causes bubbles at low pressure in intake**

# Challenge 3 – Complex Solution

**Calculating Using any of these Formulas and Methodologies**

| Author, Origin & Date | Formula |
|---|---|
| Hydraulic Institute (1998) [1] | $D \cdot (1 + 2.3 \cdot Fr)$ |
| Pumping System Manual | $(V^2/2g) + 0.5$ |
| Prosser (1977) [2] | $1.5 * D$ |
| Paterson & Noble (1982) | $D \cdot (1.5 + 2.5 \cdot Fr)$ |
| Hecker (1987) [3] | $D \cdot (1 + 2.3Fr)$ |
| Knauss (1987) [4] | $D \cdot (0.5 + 2 \cdot Fr)$ |
| Flyght (2002) [5] | $1.7 \cdot Fr$ |
| Werth & Frizzell (2009) [6] | $D \cdot (2.1 + 1.33 \cdot Fr^{0.67})$ |

**Extract From:**

*Determining Critical Submergence in tanks by means of Reynolds & Weber Numbers" Moreno, CJ. World Journal of Engineering and Technology, 2014, 2, 222-233*

## Choice is Yours

Tailings Storage Facility (TSF) specialist know there is a formula for working out depth of a water intake to prevent vortexing and cavitation.

1. Use one of eight Critical Submergence Calculations at every change in depth & flow
2. Make decant pond deep with a "margin of safety" of water above the intake

**OR**

**Just use Principle of Falsification**

- ✓ No Calculations
- ✓ No need for "Margin of Safety"

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# Challenge 4 – Cost of Infra Structure

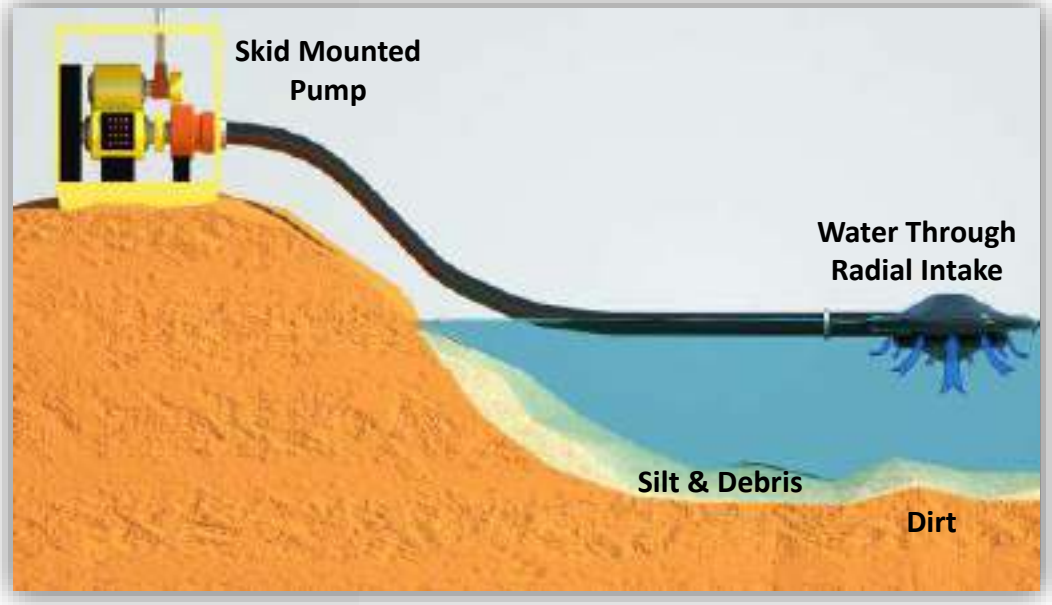
*Photo: Dynapumps*

- Decant Station Cost : $250K - $1000K+
- Dam levels continue to rise as tailings pumped
- Decant stations need to rise as well
- Need to maintain pond in vicinity of station
- Pontoons & barges - Safety of Personnel on water

**Solution The Turret™**

This floating water intake can be used with a wide range of pumps

**Skid |Amphibious |Submersible**

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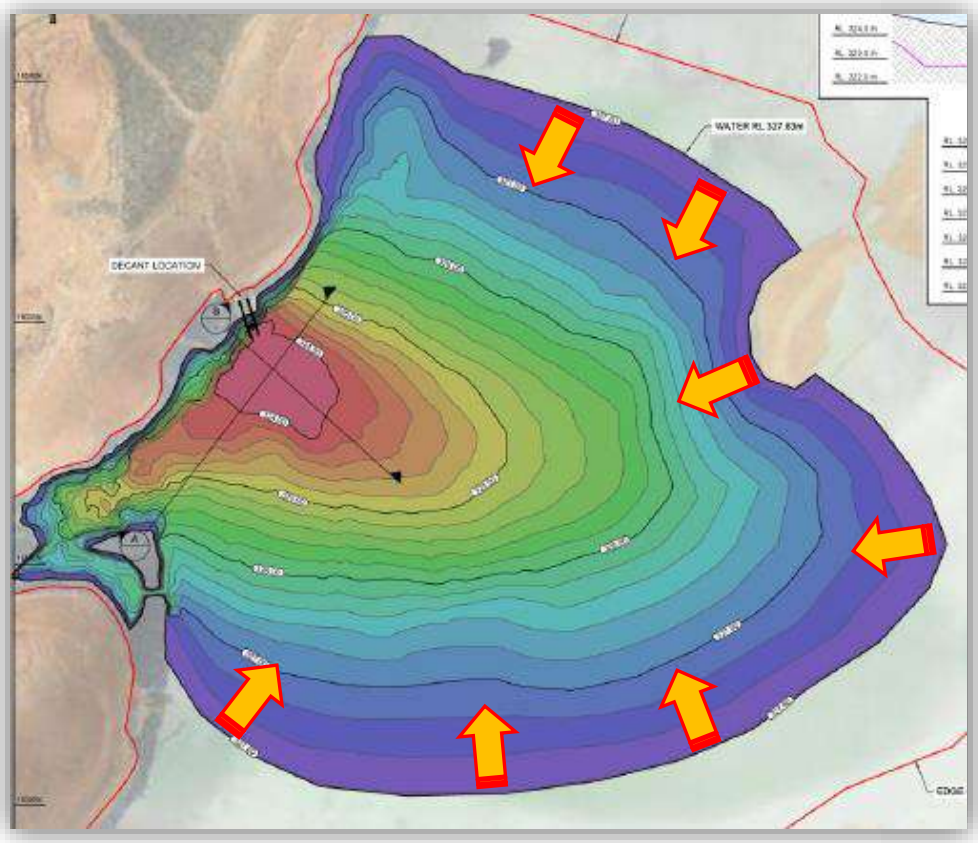
# Challenge 5: Stability & Failure Modes




## Challenges

1. Excess water volume control to keep pond levels away from embankment
2. Keep water volume as small as possible
3. Keep decant pond near fixed decant station
4. To reduce water-induced stability & failure modes:
   - Liquefaction of tailings
   - Internal and external erosion
   - Seepage through embankment
   - Overtopping

*Is there a decant system that will help move water body away from the embankment and/or keep volume low?*

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# Challenge 6: Collapse of Tailings Storage

In the last decade alone, globally there have been 35 tailings dam failures. The spot light is on safety & effective management of tailings dams.

Considering safety, effectiveness & environmental sustainability, the mining industry needs a reliable and effective solution to manage tailings and dewatering.

**Solution The Turret™**


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# The Solution …. *principle*

## Principle of Falsification

There is a principle for “tricking” water into thinking
your pump intake is critically submerged
when its not.

**The Principle Says:** “The Critical Submergence can be falsified by doing three things”

- **Turning It Side Ways** - Taking Critical Submergence depth and turning it sideways.
- **Virtually Expanding** the size of suction pipe intake with larger radial intake.
- **Vacuum** - Doing all this under a vacuum

This led to the ***solution ……..***

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Turret 3m

Turret 1m


Turret 2m

# Turret™ ..... *the effective solution*

- No Vortexing
- Lower Ingestion Levels
- Easy Handling
- Scalable Solution
- Suction at Shallow Levels
  - Depth of 400mm for Turret™ 3.0 (Turret™ 3m - *mega-flow*)
  - Depth of < 100mm for Turret™ 2.0 (Turret™ 2m - *maxi-Flow*)
  - Depth of 200mm for Turret™ 1.0 (Turret™ 1m - *mini-flow*)

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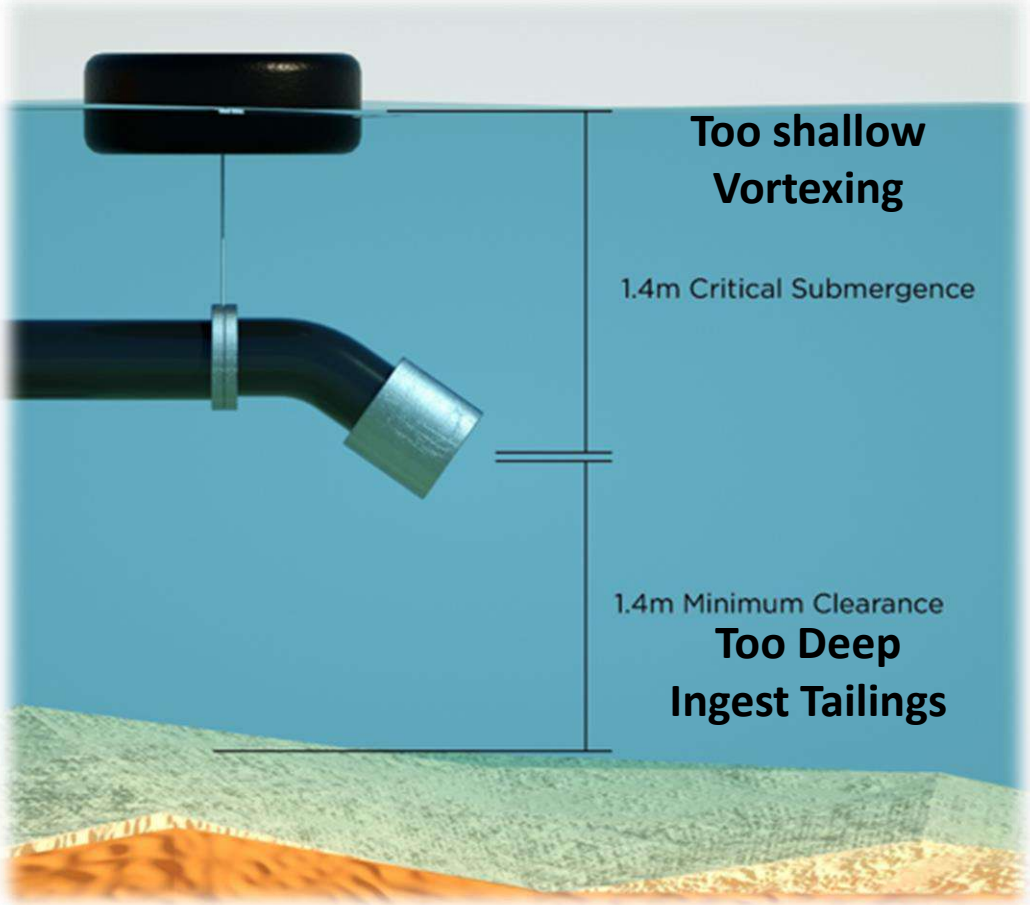
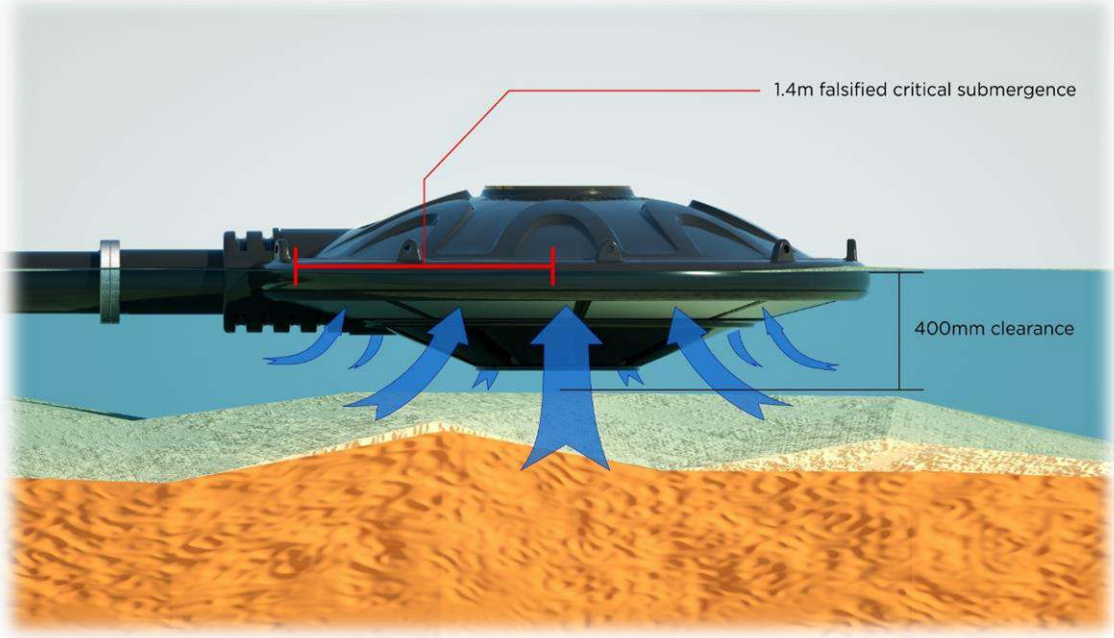
# Turret™ & Critical Submergence




## Critical Submergence

- Critical Submergence (1.4m) Turned sideways
- Wider suction intake
- Barriers Top & Bottom = No Vortexing
- Less tailings ingested
- Suction at 400mm

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# Facts About Our Turret™

- Australian Innovation & Design
- Manufactured in Australia
- Trade Marked & Patented
- Scalable Product design
- Proven Performance
- Diverse Application
- Effective & Simple
- Global Footprint

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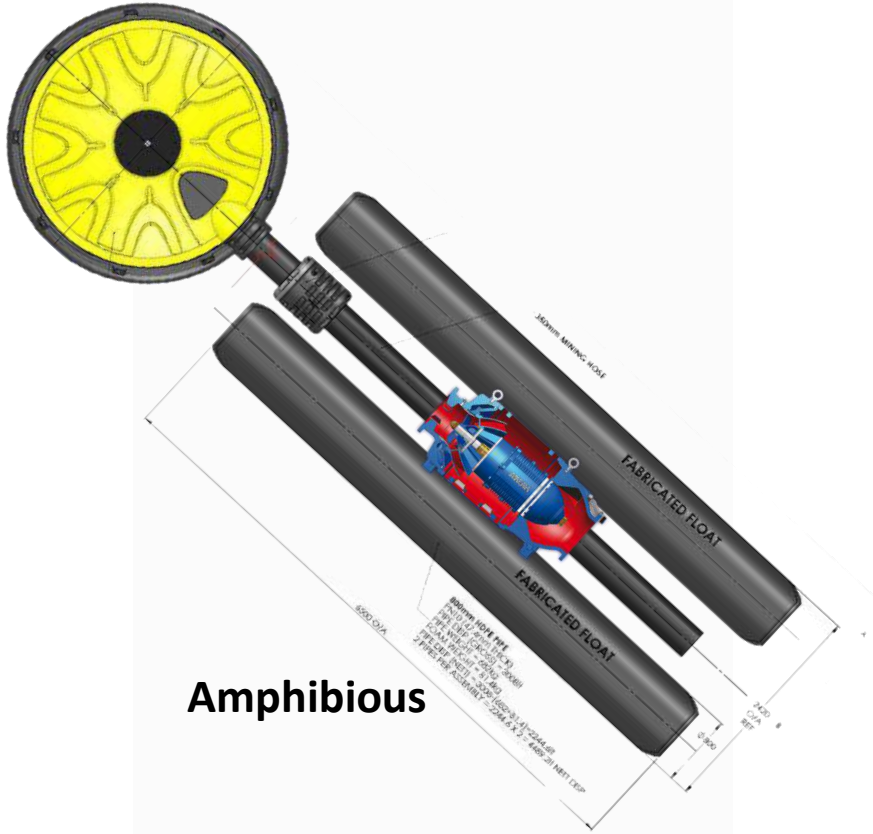
# Options for Dewatering in Shallow Water

Submersible




Amphibious

**Solution The Turret™**


Skid Mounted

Simple | Reliable | Movable | Scalable

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# Mobilisation and Access Issues

Consider various aspects involved in mobilisation & access:

- Risk
- Challenges
- Cost Associated

**Photos: Courtessy Flo Services**


Logistics and complexity involved in the process:

- People
- Equipment
- Infrastructure

**Photos: Courtessy JPS Dewatering**


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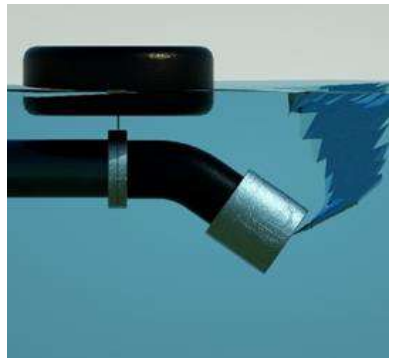
# Vortexing & Pump Damage

**Vortexing**



**Imploding**

**Damaging**

**Solution The Turret™**


- Push out into water & move it easily
- Slides over rocks where vehicles can’t access
- Fewer machines, personnel to deploy

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# Management of Tailings & Storage

**Proven methodology demonstrated:**

- Improve Safety of Tailings Storage
- Safe Working Conditions
- Operational performance
- Reduce Infrastructure Cost
- Savings on Maintenance of Pumps


**Turret™ In Action**

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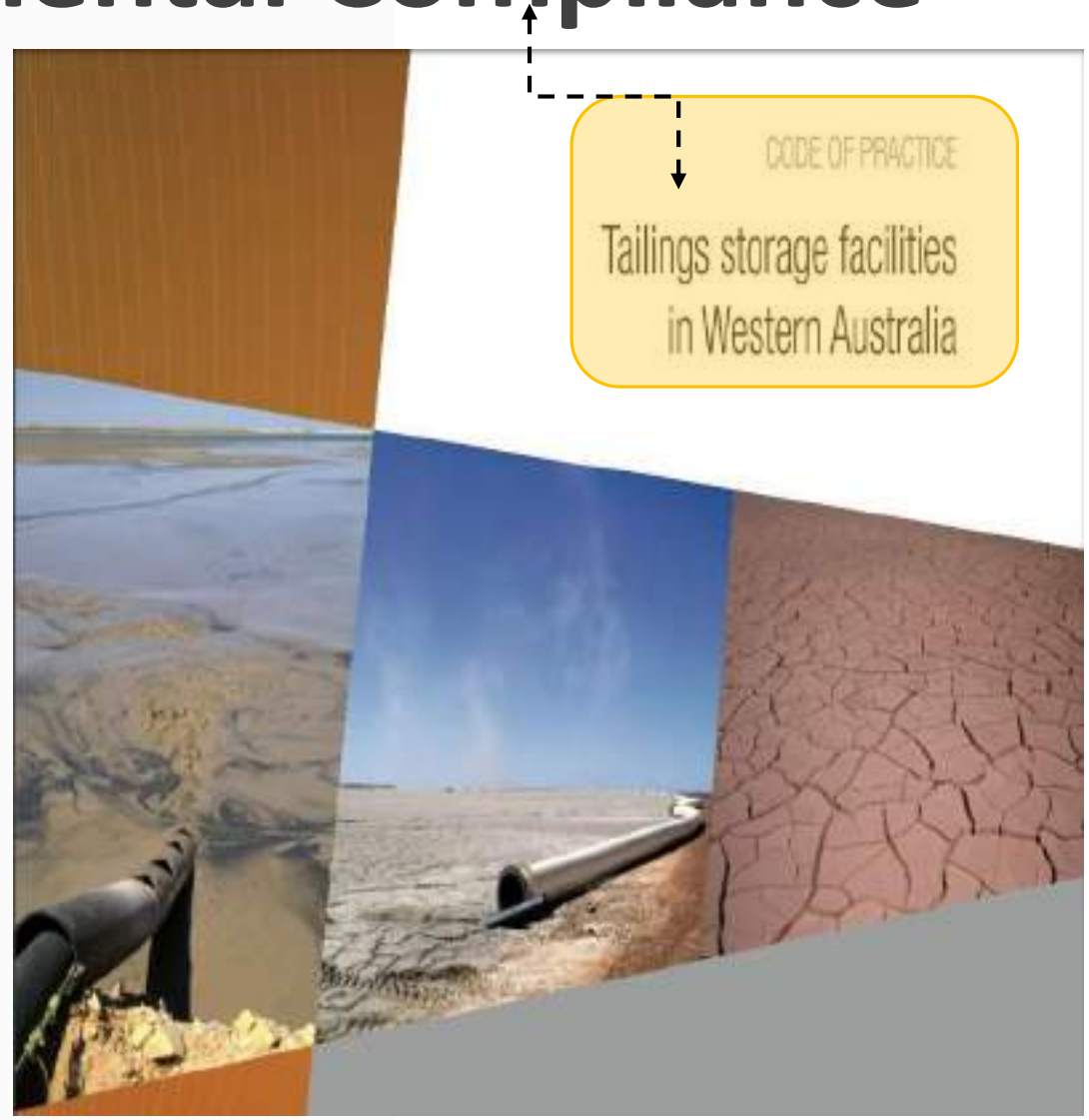
# Safety & Environmental Compliance

- **Regulations:** show embankment increases are constructed/managed in environmental responsible manner:
  - Ministerial statement (Part IV of EP Act)
  - Approval & License (Part V of EP Act, prescribed premises category 5(c)
  - Mining Proposal (Mining Act)
- **Objections:** often based on impacts & risks
  - Overtopping & free board capacity
  - Weather responses
- **Approval:** Best practice & technical help
  - Turret lowers TSF|RDA volume
  - Increase response capability

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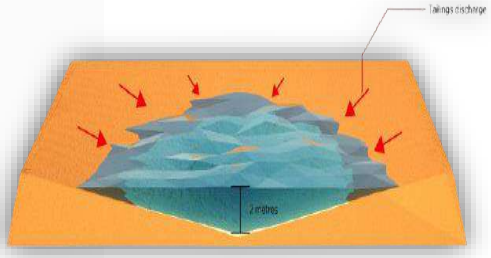
# Comparative benefits of Turret™

**Comparison at flow rates of 1000 $m^3/h$**



| Features | Factors | Steel Screens | Pontoon | Deeper Pond | Turret™ |
|---|---|---|---|---|---|
| Efficiency | Cope with Flow Rates | Poor | Capable | N/A | Excellent |
| Effectiveness | Pump at Low Depth | > 1.4m | > 1.4m | Very Deep | Shallow |
| Maintenance | Prevent Pump Damage | Low | Mid | Mid | Excellent |
| Cost Benefit | Overall Cost Effectiveness | Low | Low - Mid | Low - Mid | Very High |
| Handling | Mobilise & Immobilise | Easy | Intensive | Intensive | Very Easy |
| Operating Cost | Total Operating Cost | Low | Very High | High | Very Low |
| Infrastructure | Cost of Additional Infrastructure | Low | Very High | Very High | Very Low |

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# Our Turret™ Family

There is a solution for *almost* every dewatering need ……

# The Turret™ Family

**Turret™ (3m) – mega-*flow***
*with Capacity > 1000* $m^3/h$

**Turret™ (2m) – *maxi-flow***
*with Capacity > 500* $m^3/h$


**Turret™ (1m) – *mini-flow***
*with Capacity > 100* $m^3/h$

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# Turret™ Features

| Information | Turret™ 1m (mini-flow) | Turret™ 2m (maxi-flow) | Turret™ 3m (mega-flow) |
|---|---|---|---|
| Suction Shallow Depth | 200mm | <100mm | 400mm |
| Connection Size | 110mm | 225mm | 355mm |
| | | | |
| Material | HDPE | HDPE | HDPE |
| Flange - Option 1 | Stub Flange | Stub Flange | Stub Flange |
| Flange - Option 2 | Threaded | Nil | Nil |
| Backing Ring - Option 1 | SS316 | SS316 | SS316 |
| Backing Ring - Option 2 | On Request | On Request | On Request |
| Table (For backing Ring) | Table E | Table E | Table E |
| Product Weight (approx.) | 15 Kg | 150 Kg | 490 Kg |
| Lifting Lug | 2 | 5 | 9 |
| Material | LLDPE | LLDPE | LLDPE |
| SWL per Lug | 10 Kg | 150 Kg | 150 Kg |
| K Factor (Turret™) | 0.50 | 0.5 | 0.50 - 0.55 |
| Volume Flow Rate (Max VFR) | 28 L/S | 138 L/S | 277 L/S |
| Volume Flow rate (Min) | 0.28 L/S | 0.28 L/S | 111 L/S |
| Best Efficiency Point (BEP) | 23 L/S | 124 L/S | 236 L/S |

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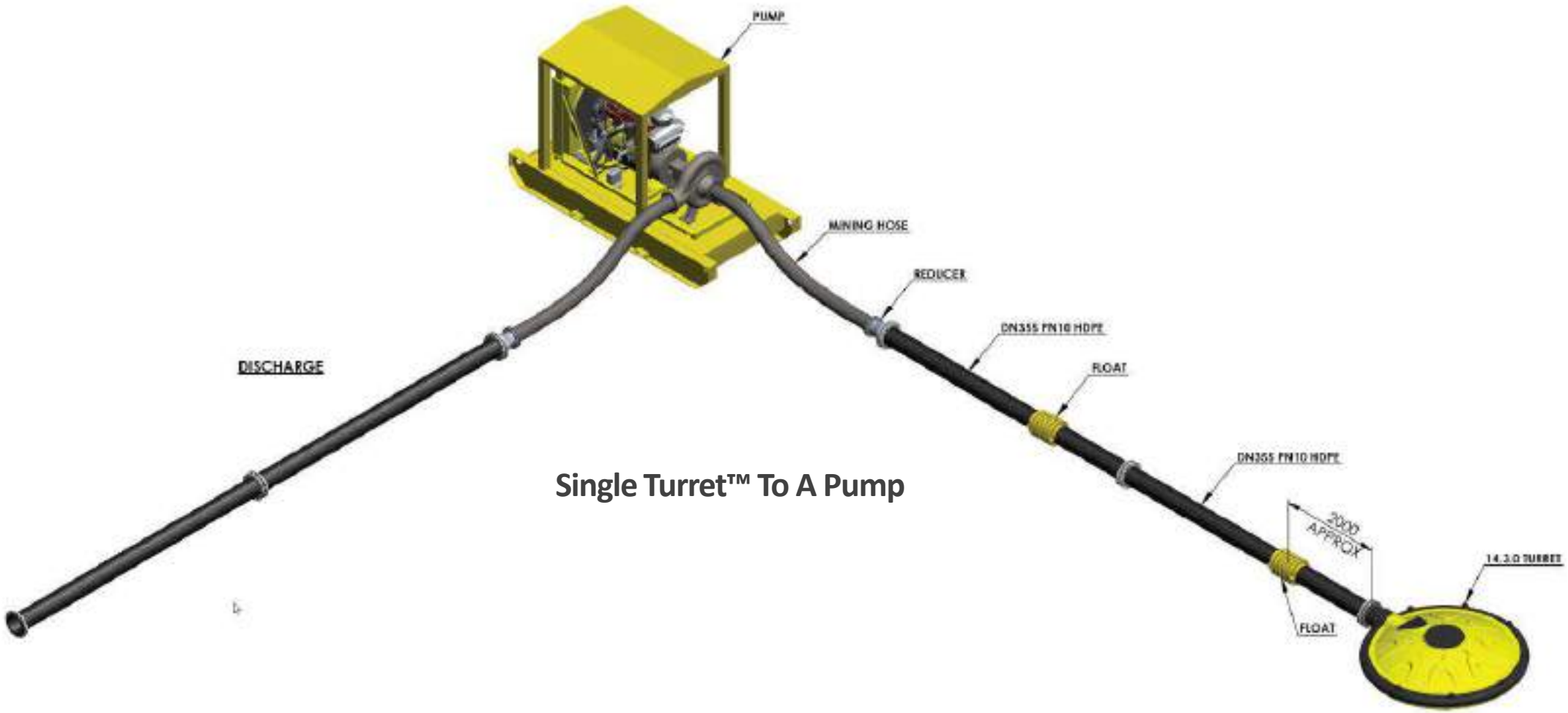
# Typical System & Connection




**Single Turret™ To A Pump**

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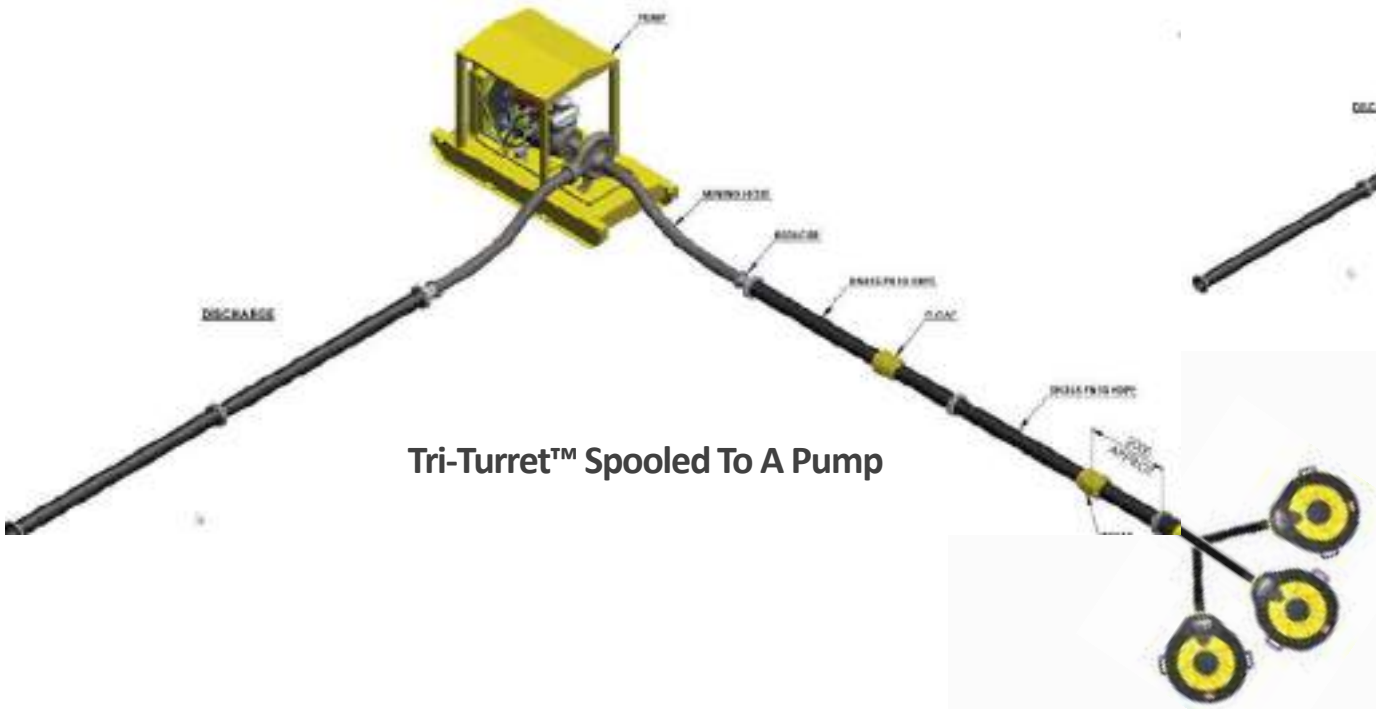
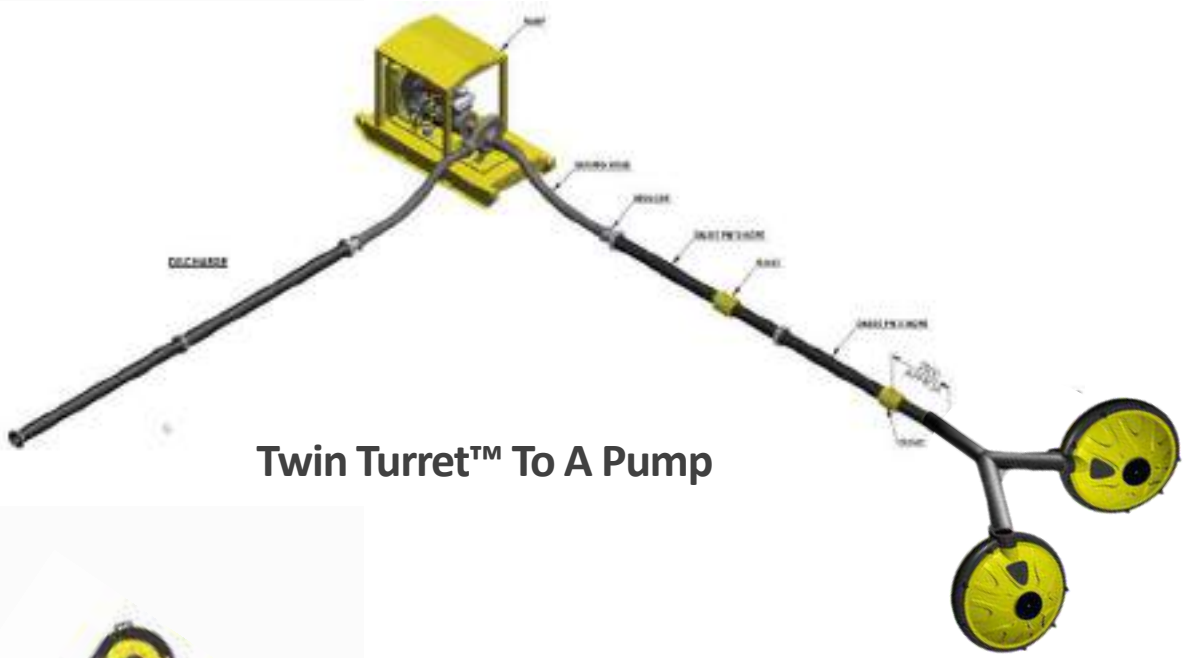
# System & Connection - *enhancements*




Tri-Turret™ Spooled To A Pump




Twin Turret™ To A Pump

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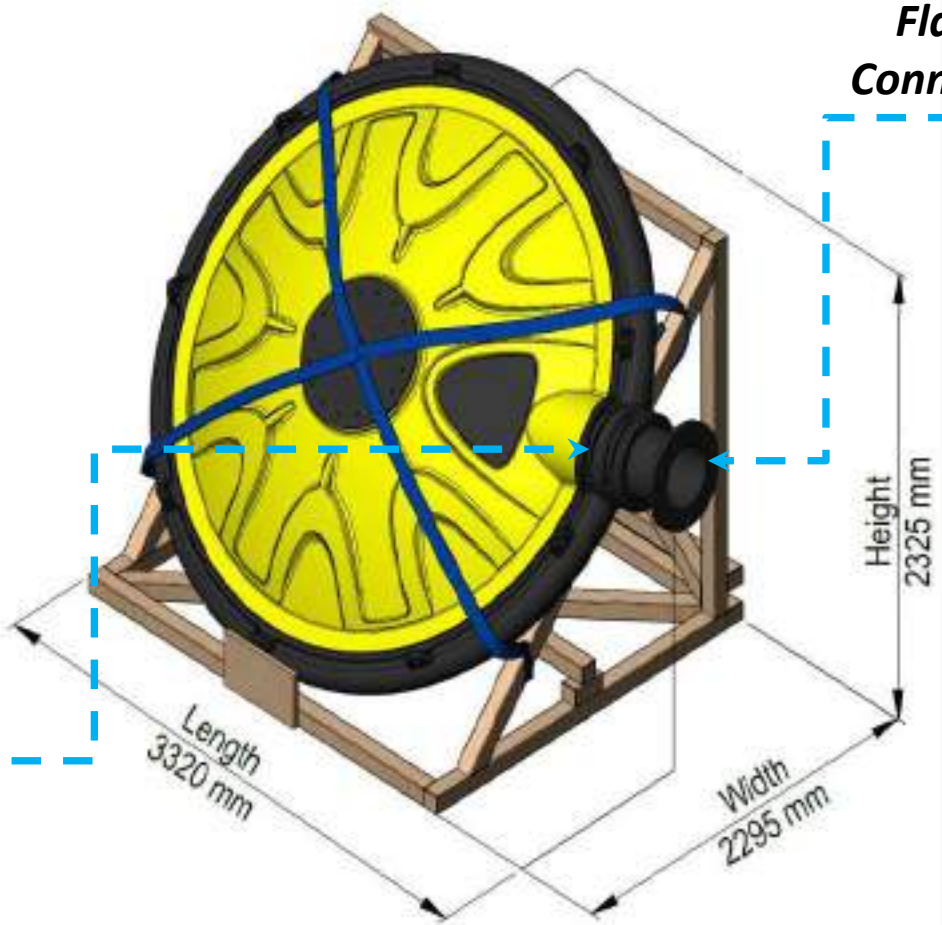
# Handling & Transportation

We have designed in consideration of possibilities and engineered it to be ……

# Handling Turret™ 3m (mega-flow)

***9 x Lifting Points***
***WLL 150 Kg each***




***Flange Connection***

***Check & Screw In Breather***

***Pockets For Fork Tynes***

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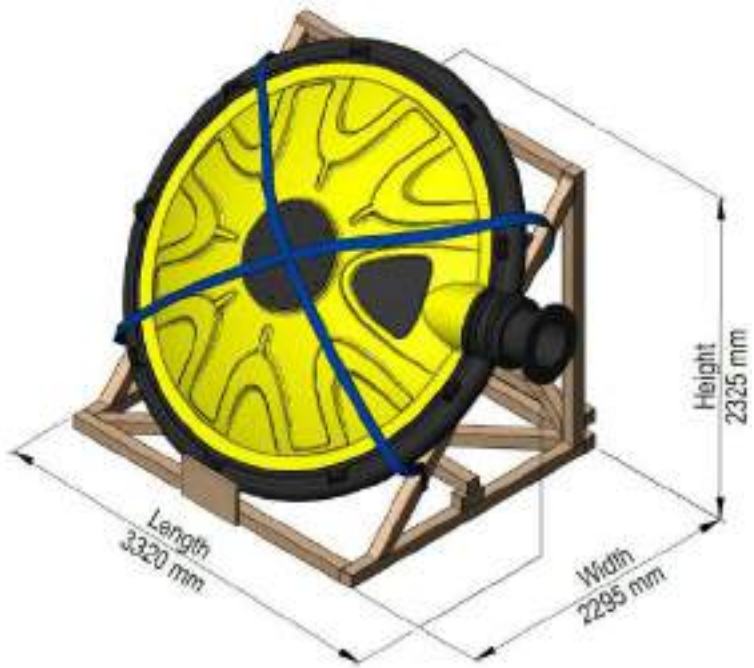
# Handling & Transportation Turret 3m *mega-flow*

**Road Freight**




| Weight | |
|---|---|
| Stand | 178.00 kg |
| Turret | 476.50 kg |
| Total | 654.50 kg |

**Export & Container**

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# Handling & Transport


**maxi-flow**

**2m Back to Back**
**Export Crate Packing**


***5 x Lifting Points***
***WLL 150 Kg each***

***Screw In The Breather***
***Provided***

***Connect to Flange***
***or Coupling***

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# Handling & Transport

mini-flow
in hardboard Box

Float

***2 x Lifting Points***
***WLL 10 Kg each***


***Connect to Flange or***
***Coupling etc.***

Stacked & Packed

Export Crate Packing

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# Simple Steps for Mobilisation

## Unload

Unload the Turret™ to location

## Couple

Join Turret™ to pipe via couplings

## Attach

Attach Breather, Float & fasten

## Slide

Slide Turret™ & Float to position

## Connect

Connect suction line to pump

## Start

Start and Prime the Pump

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# Simple & Right Way to Get Started

Keep it horizontal and floating … *it is that simple!*

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# Get Turret™ Floating On Water

- ☒ No Floats
- ☒ Pipe above water surface
- ☒ ***Turret™ not floating horizontally***

- ☒ No Floats
- ☒ Pipe below water surface
- ☒ ***Turret™ not floating horizontally***

- ✓ 1 or 1/2 Float
- ✓ Pipe on water surface
- ✓ ***Turret™ floating on surface***


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# Case Study

We work with you ***to solve*** … *not just sell it!*

# Evolution of Turret™ … *the Generation 1*

See our Preliminary Proof of Concept design of the Turret™ Solution in action. Our prototypes and products are tested across a wide range of applications:

- ✓ Mining
- ✓ Construction
- ✓ Farming

Another version of our Original Version of the hand-made Turret™ (3m) in action providing effective dewatering in shallow and muddy waterbody.

Even safe for the Ducks to swim around our Turret™

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# Mine Dewatering – *efficient solution*

**Hand Made 3m Turret™**
**Generation 2 (G2)**

Typically a large mining client was encountering challenging situations to effectively manage water levels in the dam. Considering the RLs, Static Head and Friction Loss we proposed our solution incorporating The Turret™ G2 delivering:

- ✓ Enhance Pump performance
- ✓ Effective Dewatering Solution
- ✓ Efficient way to control & manage cost

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# One Stop Solution .. *Turret™ & Accessories*

Turret™ G3 mega-flow in action

Easy to install and float it with ½ or 1 Float with fastener kits


*Turret™ (3m) Generation 3 (G3) – mega-flow in action*

Wide Range of Diesel Pump & Skids

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# When Efficiency & Effectiveness Matter

Consider the infrastructure investment and ongoing operational cost in comparison with simple and effective solution:

- ✓ No vortexing & cavitating at shallow levels
- ✓ Efficient & Cost effective solution
- ✓ Improved performance

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# Extremely Shallow & Muddy Waters

An example of our Original Version (G1) of the Turret™ (3m) in action providing effective suction of water in shallow and muddy waterbodies.

A “tried, tested and proven” solution for shallow waterbodies.

We continue to operate and deliver value proposition in dewatering Tailings TSF & RDAs for clients across Australia & Globally. With a wide range of pump skids, spools and accessories we have got you covered!

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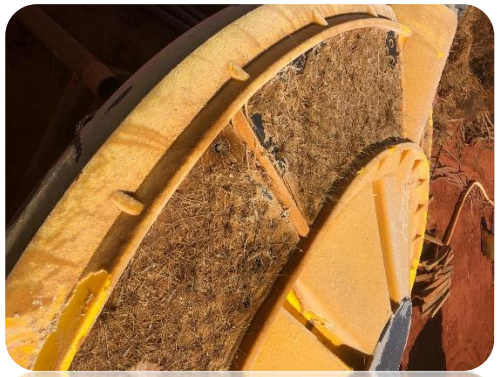
# Adapting to conditions & requirements



***Technical Design Changes to prevent blockage … aquatic weed, salt and minerals***

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# Solution for Weeds and Suction

***Conventional Methodology***

- ☒ Blocked Screens
- ☒ Vortexing
- ☒ Cavitation
- ☒ Pump damage

***Turret™ Suction***

- ✓ No Vortexing
- ✓ No Cavitation
- ✓ Better Performance
- ☒ Blocked Screens

***Turret™ Suction***

- ✓ No Vortexing
- ✓ No Cavitation
- ✓ Better Performance
- ✓ ***Problem Solved***

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# Fire & Emergency

**Tankers drive past shallow water to refill from deeper water, wasting fire-fighting time. Longer drive time means less water on fire.**

- ✓ **Enabling effective fire fighting even at shallow levels of 180mm**
- ✓ **Effective solution for emergency responses in Regional Australia**
- ✓ **Easy to handle and use < 20Kg**
- ✓ **Low suction … Turret™ is even “*Duckling Safe*”**

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# Coupling & Flanges

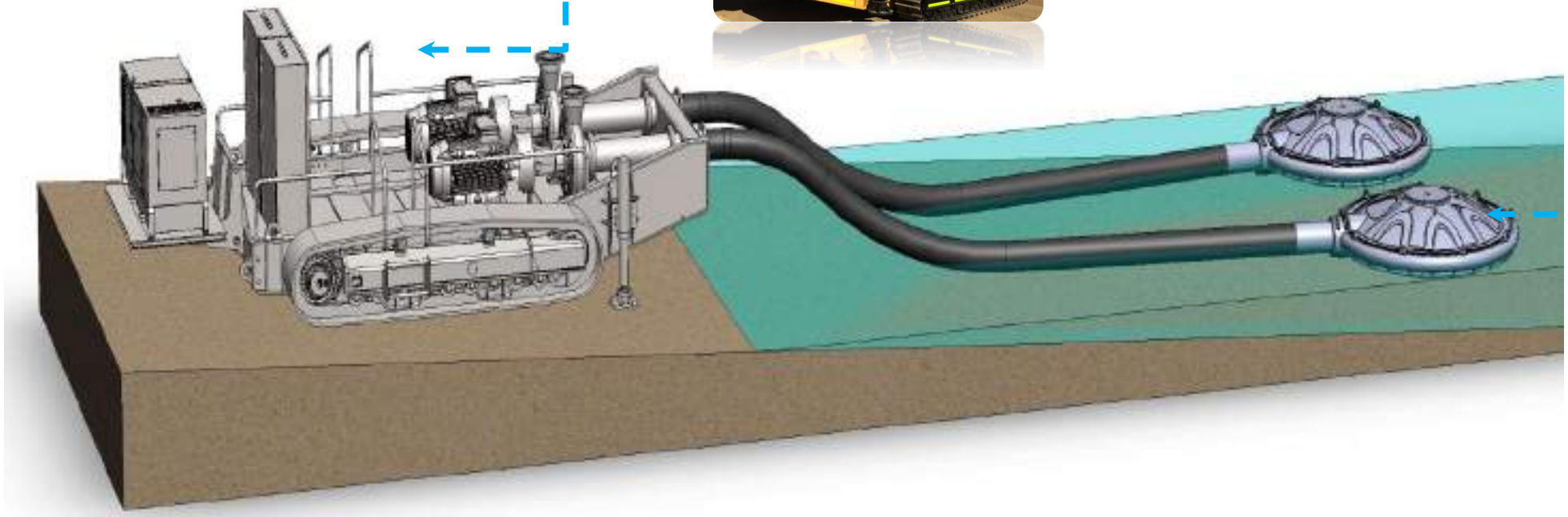
**Considering various requirements of clients, use and application we continue to ….**

- ✓ **Innovate and enhance features**
- ✓ **Choice of couplings – flanged, threaded etc.**
- ✓ **Easy to handle and use < 20Kg**
- ✓ **Suitable for 2” Camlock**

# Future Direction … *concept to reality*

Mobility → Safety → On demand → Simple

- ✓ **Remote Operated**
- ✓ **Move In & Out of Tailings Dam & Mines**
- ✓ **Mobilise & Immobilise with ease**



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# Technical Information

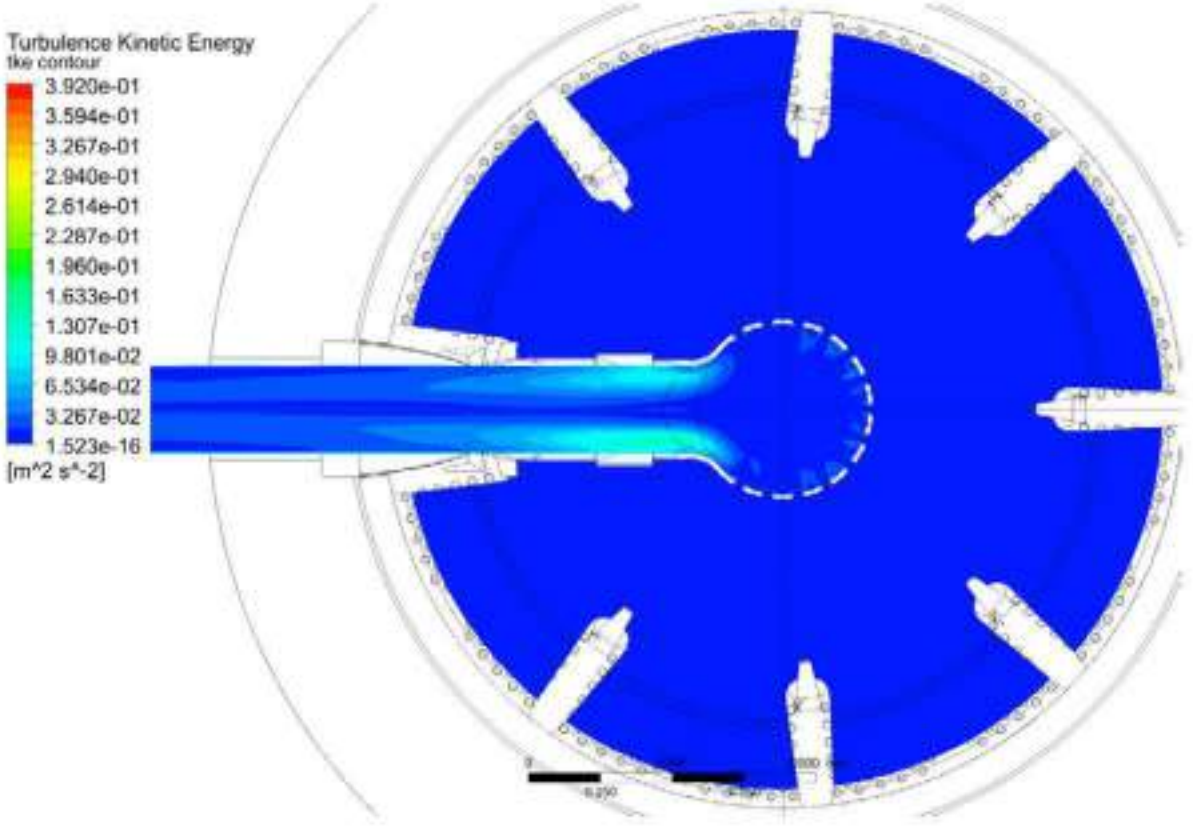
Steady state CFD models of the 3m Turret™ incorporating a “Trumpet” inlet to the outlet pipe and a Baffle Support have been formulated and executed using ANSYS Fluent version 2019r2 for flow rates ranging from 500 to 3000 m3/hr.

# Turbulence Kinetic Energy (TKE)

**Our Design, Prototype and Development Engineering team has considered various factors to ensure the Turret™ delivers effective solution:**

**Turbulence Kinetic Energy (TKE)**

TKE is typically generated in regions of high shear (regions where there are sharp velocity gradients). Since TKE generation and dissipation rates are coupled, increasing the generation of TKE will increase the energy losses in a flow.




TKE contours plotted on an XZ plane passing through the outlet pipe centreline for the 120-9-9 mesh at a volume flow rate of 1000 m3/hr.

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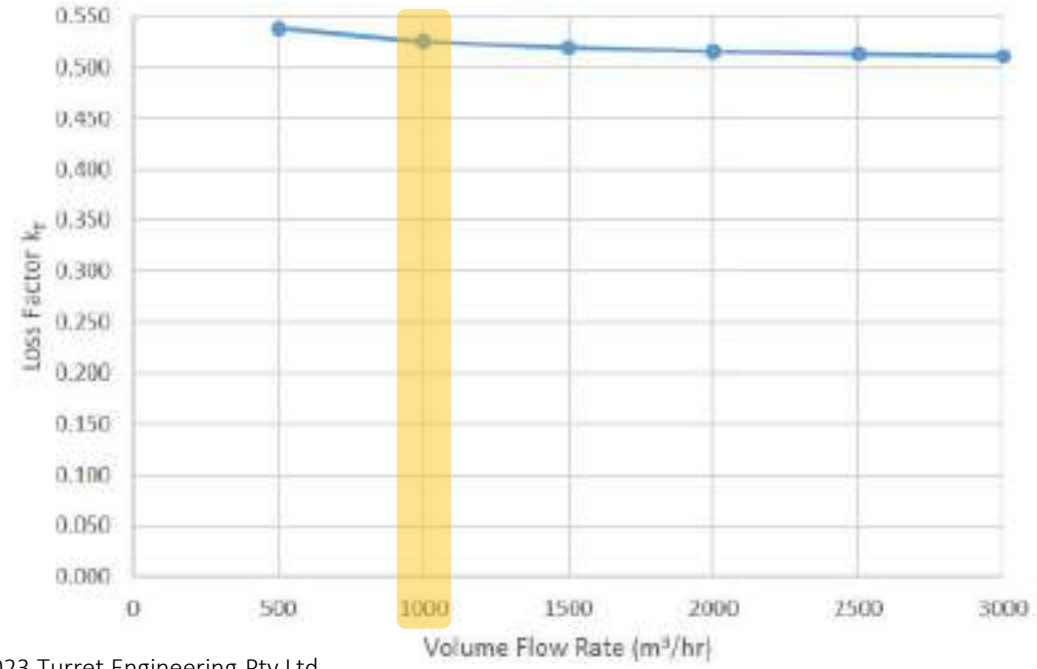
# Predicted Head Loss Factor kT

**The friction head loss factor kT for the Turret™ with the Trumpet inlet is predicted to range from 0.51 to 0.54…**

***more like 0.526***




**With Inlet Screen**

| Flow Rate ($m^3$/hr) | Inlet Pressure (Pa) | Average Outlet Pressure (Pa) | Average Outlet Velocity (m/s) | Friction Head Loss (m) | Loss Factor $k_T$ |
|---|---|---|---|---|---|
| 500 | 101325 | 98726 | 1.8402 | 0.0928 | 0.538 |
| 1000 | 101325 | 91012 | 3.6803 | 0.3628 | 0.526 |
| 1500 | 101325 | 78217 | 5.5205 | 0.8065 | 0.519 |
| 2000 | 101325 | 60346 | 7.3606 | 1.4234 | 0.515 |
| 2500 | 101325 | 37409 | 9.2008 | 2.2125 | 0.513 |
| 3000 | 101325 | 9415.7 | 11.0409 | 3.1727 | 0.511 |

**Without Inlet Screen**

| Flow Rate ($m^3$/hr) | Inlet Pressure (Pa) | Average Outlet Pressure (Pa) | Average Outlet Velocity (m/s) | Friction Head Loss (m) | Loss Factor $k_T$ |
|---|---|---|---|---|---|
| 1000 | 101325 | 91186 | 3.6803 | 0.3451 | 0.500 |

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# Flow Rate for the Onset of Cavitation

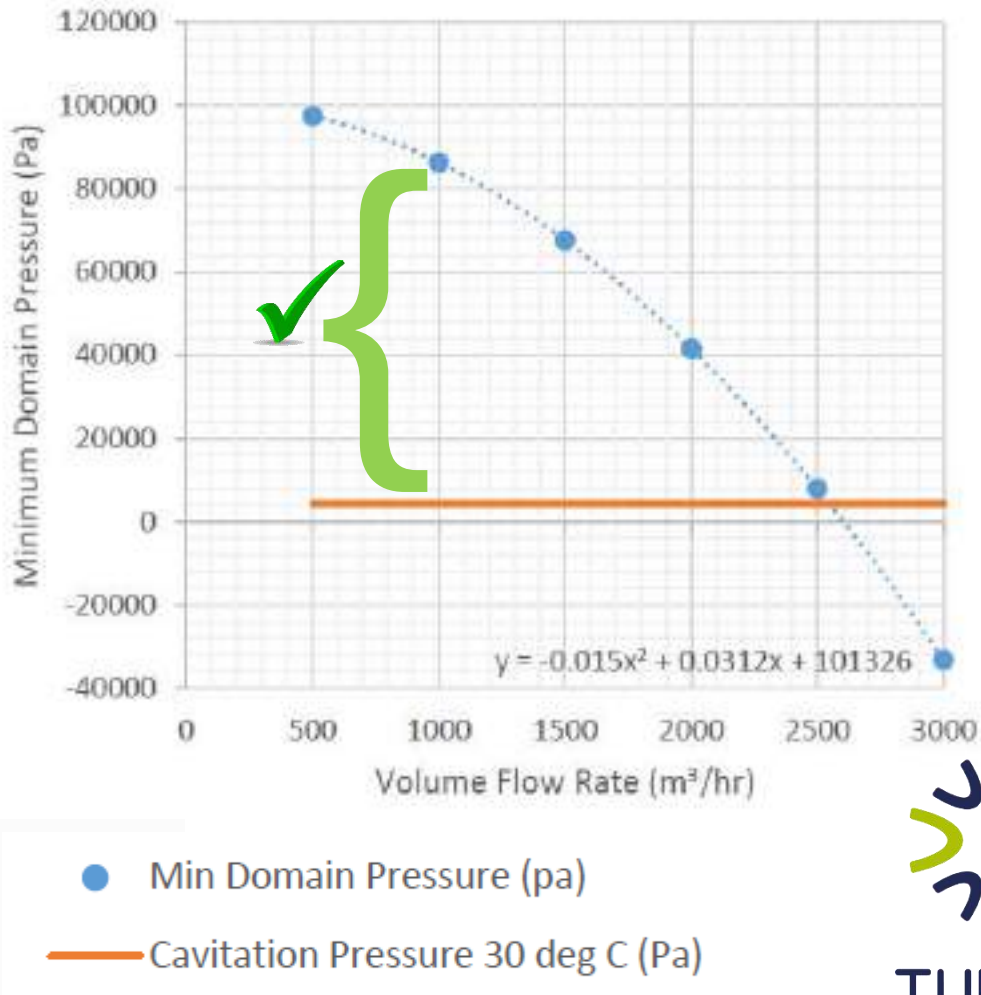
## Limiting Flow Rate for the Onset of Cavitation Within the Turret™

Cavitation will occur within the Turret™ if the pressure falls to the vapour pressure of water at any location.

The vapour pressure of water is a function of temperature:

- 20°C 2338 Pa (abs) 0.239 m (water)
- **30°C 4245 Pa (abs) 0.434 m (water)**
- 40°C 7381 Pa (abs) 0.752 m (water)

The minimum domain pressures predicted by the CFD models are plotted as a function of flow rate in figure. Fitting a quadratic function to the data, the onset of cavitation (at 30°C) is expected at 2545 $m_3$/hr.

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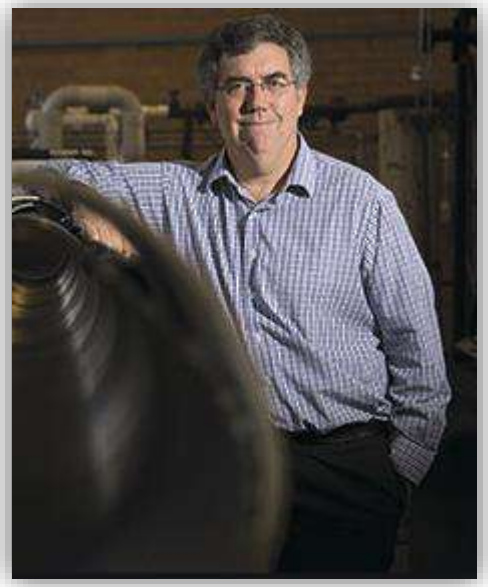
# Summary of Features & Benefits



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Senior Lecturer, School of Engineering
The University of Western Australia

It is clear then, that in addition to the other advantages of the Turret™ (the ability to ***operate in shallower water***, the associated ability to ***operate with shorter pipe lengths***, and the ***inhibition of vortex*** induced air entrainment), the new Turret™ design ***offers reduced friction losses compared to most conventional intake configurations*** – even with screens fitted.

TURRET

TURRET

# Achievements

*Our team has achieved major milestones since 2016*

- Innovative Solution
- Handmade Solution
- Prototype & Patent
- Rotomolded Turret™
- Global Footprint

# Trusted by Global Leaders

*with a proven history* …… Turret™

TURRET

# Turret™ growing @ Global Scale

Global names, logo, South Africa, Quinnie, Xman, Marradong fire













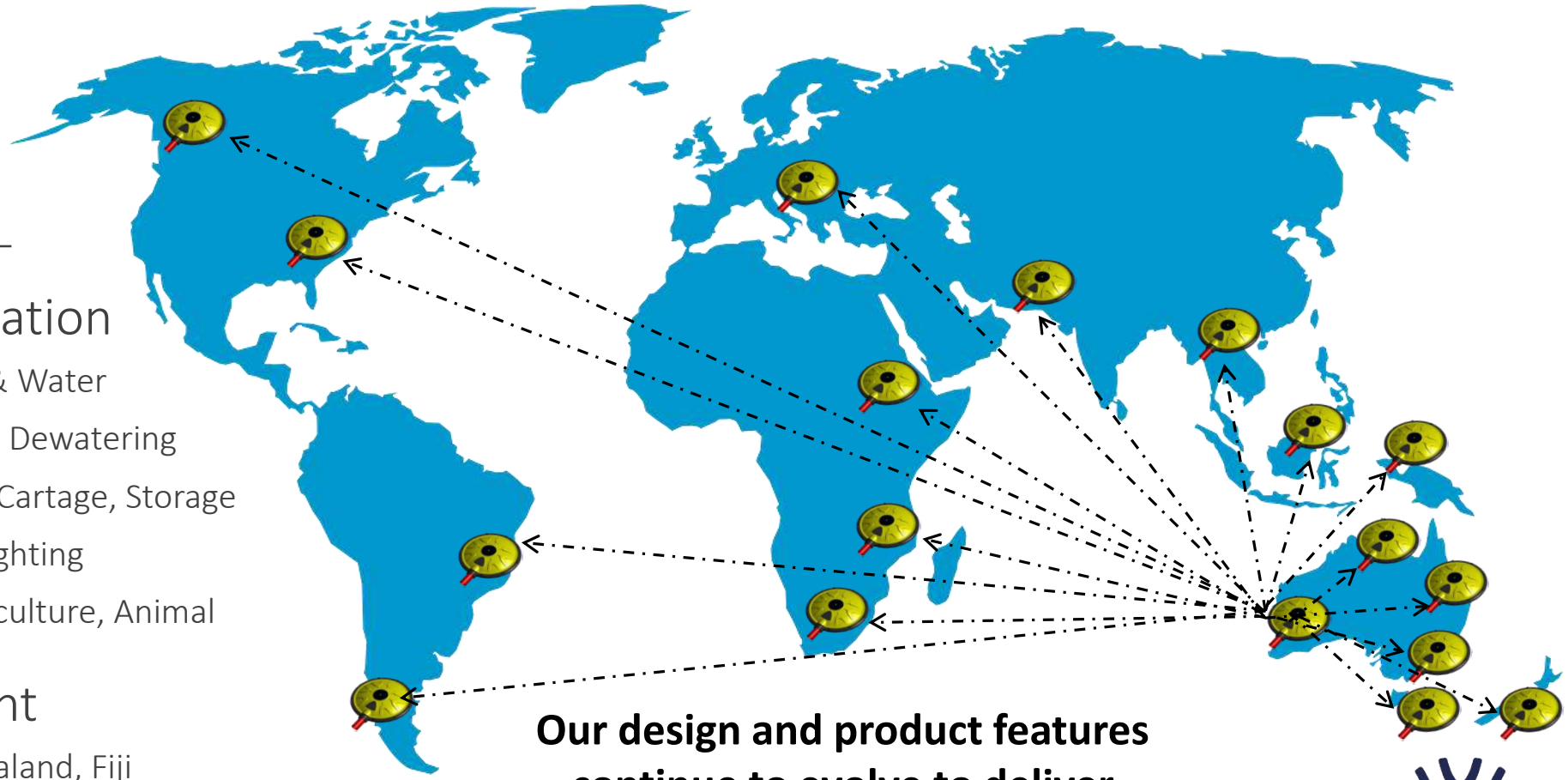







# Turret™ at a Global Scale

- Wide Range of Application
  - Mining – Tailings, TSF|RDA & Water
  - Water – Desalination, Slurry, Dewatering
  - Construction – Dewatering, Cartage, Storage
  - Emergency Services – Fire fighting
  - Agriculture – Farming, Horticulture, Animal
- Geographical Footprint
  - Oceania – Australia, New Zealand, Fiji
  - Americas – North, Central and South
  - Africa – South Africa, Kenya, Sierra Leone



**Our design and product features continue to evolve to deliver diversified solution for unique global challenges**

TURRET

# Development & Executive Team

TURRET



## Rob Hair

### Inventor & MD

**Mechanical Trades Professional & Successful Entrepreneur involved in dewatering since 1989**

## Manufacturing & Admin

**Team of professionals experienced in pumps, poly welding, material handling, maintenance & contract management.**

## Dr Jeremy Leggoe

### Fluid Dynamics

**Computational Fluid Dynamics (CFD) Modelling & Simulation**

## Angus McDonald

### Design & Moulding

**Extensive expertise in rotamoulding and manufacture**

## Peter Tomasovszki

### Mechanical Engineer

**Trucad Engineering Pty Ltd Design Engineering Specialist.**

## Vinnie Rajaratnam

### Supply Chain

**Manufacturing Engineering & Process Improvement (Six Sigma)**

# Questions & Wrap Up

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www.turrets.com.au



# Thank you