The Pros and Cons of
Stormwater Harvesting Vs Sewer Mining

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Abstract:

The four primary water supplies are: potable water, groundwater, sewer and stormwater. With potable supplies at record lows and limited groundwater in most of the country, Water Engineers are now seriously looking at both stormwater and the sewerage system as potential water sources.

When we inevitably hit level 4 & 5 water restrictions, golf courses, schools, industry, agriculture, sporting clubs, Councils and others, are going to need an alternative water supply, and a lot of work is being done investing alternatives, their cost effectiveness and reliability.

CDS Technologies was the stormwater arm of Eimco Water Technologies who were/are at the forefront of sewer mining and stormwater harvesting solutions. As such, they have done the comparisons and looked at all the pros and cons of each option, and these are summarized in the paper.

This paper also provides summarized case studies on 3 stormwater harvesting projects, and 3 sewer mining projects. It notes the differences between each, and covers aspects of the decision making process for stakeholders, such as risk, cost and reliability.

Attendees will gain knowledge from the mistakes made, and lessons learned on those projects, along with the factors that dramatically influence the success of a project.

Call it “water reuse, water recycling, stormwater harvesting, water mining, sewer mining, or sustainability”, we live on the driest continent on earth, and this is our future. By understanding the pros and cons of the alternatives, and sharing our experiences, better advice and better decisions can be made by engineers in the pursuit of water sustainability.

Introduction:

Water has traditionally come from potable supplies stored in dams, rainwater tanks, and groundwater bores. But with our growing cities, and inland drought, demand is increasing and traditional supplies are decreasing. This has led to people finally looking seriously at the sewer and our stormwater as a water supply source.

"Water should not be judged on its past, but its value to us in the future".

Approximately 1% of the water demand in a metropolitan city is used for cooking or drinking. That leaves 99% that does not need to be drinking quality to be useful. But even if we want to wash our dishes and shower in potable water, we would still use less than 5%. The other 95% does not need to be potable. Our dams can supply that 5%, but we need to find other sources for the rest of it.

If economics was the only decision in sourcing our water, nobody would recycle and we'd use as much water as we liked. At approximately $1 for 1000 litres of water, the cost to mine the sewer or harvest the stormwater is unfeasible. But if those cheap supplies dry up, as they are doing, and you had to buy water by the bottle at approximately $1 per 1 litre, it's a very different story.

The commercial reality of many companies is that unless they can source a sustainable alternative supply of water, their future is in doubt. But for any project, there are many things that could influence the choice of where you get your water. The sewer and stormwater have different pros and cons, and these are discussed below.

Benefits of Sewer Mining over Stormwater Harvesting

1. It has the benefit of a regular and predictable flow,
2. Accessibility as it flows beneath our towns and cities is generally good
3. All we need to do is take some of the water out of it, and leave the undesirable components in there, resulting in no "waste management"
4. Because the sewer flows regardless of rainfall, it can "drought-proof" a company or project.
5. Ready access to the "water" means you do not need large/expensive storages.

Some of the Pitfalls of Sewer Mining:

1. Sewer Mining should be correctly called "Water Mining" since it's the water you are after not the sewage. You don't call gold mining "ore mining" do you. But any reference to a sewer or sewage conjures negative connotations and lots of people in the community would resist using this water because of its history. The failed referendum in Toowoomba is a perfect example.
2. Administrative hurdles when the user is not the water authority can be potentially onerous. This can lead to cost blowouts.

3. Funding of projects is always hard to justify based on financial payback or return on investment. Sometimes it requires a political input either in terms of funding or support, to get grants or government assistance (when available) to cover the capital costs of setting up a plant.
4. The Water Mining plant is a modified Sewage Treatment Plant, because after all it is treating sewage. So it will have power, chemicals, moving parts, cleaning, servicing, and require an operator to keep it operational.

The benefits of Stormwater Harvesting over Sewer Mining:

1. Its almost always cheaper to capture and treat the water.
2. People think of stormwater as not as polluted as sewage, so public acceptability to reuse it is much better than sewage.
3. The treatment is generally less complicated and except for cleaning the GPT, it can be virtually fully automated.
4. You are commonly cleaning up the environment by removing the pollution as well as the water, hence a cleaner environment, but more importantly, this feature can assist to get funding, because you are meeting multiple objectives.
5. Rain falls free from the sky, so on a $/kL basis, its very cheap water. This makes stormwater harvesting almost always a more "cost effective" supply of water.

Some of the pitfalls of Stormwater Harvesting:

1 The reliability of rainfall cannot be guaranteed, so you can't drought-proof a golf coarse with stormwater harvesting.
2 It has a higher level of "risk" associated with it since you almost always have a lower level of treatment.
3 It can't be classed C or B or A, since its almost impossible to do BOD reduction on stormwater (since this is a biological process and without a guarantee of "food" the bugs will die).
4 It can require large storage volumes, that can have a high capital cost.
5 You may not be able to take "all" the water (due to a requirement for environmental flows) and with the water you do take, there is still discussion on technically who owns it, and who is allowed to use it, or sell it.

Sewer Mining: What you need to know

Before any Council, company or consultant starts investigating the potential for sewer mining, here are the following things you will need to know:

- The location of the sewer: Do I have one? Where does it run?
- Ownership: Who owns it, and are they willing to let you have access? This will be the local Water Authority, (which in some cases is Council).

- The size of the sewer and flow in it: You might be able to take a reasonable volume of water, but remember you will need to keep minimum flow levels in the sewer to transport the solids. You can't take it all.
- Water demand: How much water do I need, based on peak usage rates
- Storage options: How much will I store? Will it be above ground, below ground, or in an open storage such as a dam? Where will the storage be located?
- Affording it: Based on the kL/day or ML/day usage does the project have access to sufficient funds? (based on ballparks from suppliers and installers)

Stormwater Harvesting: What you need to know:

Just like Water Mining, you need to get the base information together to determine if a project is feasible, before you start designing it.

- Water demand: How much water do I need, based on peak usage rates
- Location and volume: Where does the stormwater run, and how much water comes off the catchment above?
- What sort of pollutants can I expect regularly and irregularly.
- What technologies can I use to reliably treat the water with maximum effectiveness, maximum reliability and minimum long term cost.
- What sort of storage options are available (above ground vs below ground), and what does that do to my ability to capture the water?
- What sort of risk management will be acceptable, based on the potential for human contact? Ie, levels of treatment for physical, soluble and biological contaminants.

Once a Water Engineer has assessed these basic parameters, worked out the capture, treatment and storage strategy, they should be able to get a ballpark price to purchase it and have it installed. They should also be able to determine an approximate $/kL for the "new" water.

Then comes the time to involve the upper management, funding bodies or obtain political support for the project, because without backing and funding, everyone is just wasting time.

Case Studies: Stormwater Harvesting

Stormwater has many more variations than sewer, which can present both opportunities and complications. Eimco/CDS has been involved in dozens of stormwater harvesting projects from simple GPT screening, followed by storage and irrigation, to prescreening stormwater for Ultra Filtration membrane treatment at a zoo. In between are three examples of the kind of harvesting projects we expect to see more of.

<u>Case 1: Stormwater harvesting for reuse Cammeray Golf Course, Sydney</u>.

The project has been driven by North Sydney Council with a view to taking Cammeray Golf Course (9 holes) off potable irrigation, and to supply a secondary water source for many of the parks in North Sydney.

The catchment is about 94 ha of medium density urban land and takes in part of the Warringah Freeway. There is a large culvert with a continuous low flow running beneath the course. Council had the right hydraulic conditions, the golf course had the demand, and the state government kicked in the funding.

A medium sized diversion system diverts flows up to 2000L/s into a P3030 CDS unit. This GPT and size were chosen due to its effectiveness, it non-blocking functionality, its large storage volume and ability to be customized for the project. On the outside of the screening area, two pumps of 25L – 50L each will be set up to automatically start pumping during a storm event, with this water going to a specially built dam at the top of the course, so a gravity fed underground irrigation system can be utilized for course watering, and it will send water for further treatment to North Sydney oval and surrounds.

The additional treatment will be via multimedia filters or sand filters to filter down to 20 microns, with flow then undergoing UV treatment. Storages will be underground tanks due to aesthetic and vandalism drivers. Chlorine dosing will also be used as per DEUS requirements.

The project underwent feasibility and concept planning before going to tender for the first stage (the GPT). With this now operational, the environment is being protected and the second stage is out to tender. The staging of the project allowed it to be done as funds became available, due to it being several million dollars. This approach is highly recommended for large projects, and this project is likely to become a showcase for future large scale stormwater capture, treatment and reuse.

Case 2: Stormwater Harvesting for Reuse, Regents Park, Sydney

At Regents Park in Sydney's western suburbs, Auburn Council approved an innovative stormwater reuse system proposed by Storm Consulting for a residential subdivision.

The project aims to capture water coming from a standard urban drainage system and treat it through several small CDS units, followed by Hydrocon pipes, and a sand matrix. The water "percolates" through the treatment train into pipes, then into a large centralized storage tank from where a 3rd pipe stormwater reuse system distributes water to residents via UV treatment for non-potable uses.

The project has lots of potential, but due to poor silt/sediment control during the construction phase, and no GPT maintenance prior to the handover, the whole stormwater system filled with sediment, and needs to be completely cleaned out. The risk of project complications during a subdivision building phase can be large, and

ownership of the stormwater reuse needs to be active from the moment the system comes on line.

This "community" stormwater reuse system takes advantage of all the non-roof areas as well as the roofs to allow capture of more runoff, than if it was done on individual lots. A centralized storage is also cheaper (and more reliable) than dozens of individual household systems.

Case 3: Stormwater Harvesting for reuse at Balmoral Oval, Mosman, Sydney.

Mosman Council went to tender for the design of a site specific stormwater harvesting solution to meet the irrigation demands for Balmoral Oval. The stormwater comes from a 100% old urban catchment, that is very steep and discharges next to the oval into a dry creek.

The capture will be via a low level screened off-take from the creek, and the treatment will be via a CDS unit. The CDS will be customized to have the treated flow preferentially going to the storage tanks, with high flows and excess treated flow being returned to the creek. The requirement for additional filtration will be assessed once the system is operational, and the water quality is known. Due to the coarse sandstone nature to the catchment additional filtration may not be required, and just settlement plus chlorine and UV may be acceptable for treatment.

The interesting aspect to this project is the decision on the storages. If the storages are above ground, it will necessitate the use of a stormwater pump station (and the pump flowrate will be the limiting factor in stormwater reuse water volume attainable). It will also require the pump-station, sensors, power, telemetry, etc and be much more visible than if it were below ground. Whereas if the tanks were all below ground, and flow gravitationally drained to them, there would be no need for the pump or pump-station. But, the water table is high, and the ground was discovered to contain some contamination, which of course has more cost implications. At the time of printing we are still awaiting Councils decision on the preferred storage solution.

This "simplified" stormwater treatment process should be adequate, when combined with a controlled irrigation program at night and appropriate signage. It is always cheaper to manage the risk, than to try to eliminate it.

Case Studies: Water Mining

Case 1: Water Mining for reuse at Port Augusta, SA.

The sewerage system operator is SA Water, the client who owns and operates the plant is Port Augusta County Council and the designer and constructor was Eimco.

HBNR stands for Hybrid Biological Nutrient Removal. It is a robust and well tested form of wastewater treatment. It involves a two tank system that is essentially an aeration tank, followed by an intermittently aerated clarification tank. The plant

produces 500kL/day of Class B water for subsurface irrigation of the main sporting ovals in town.

Raw sewage is drawn from a local main with plenty of flow, it is treated in a series of underground tanks, and finally discharged into their subsurface reuse network. Waste from the process is periodically discharged back to sewer.

Initial fears about the impact on the sewer of flow abstraction were quashed when it became evident that the only impact was a positive one whereby the downstream Sewage Treatment Plant started reaching its nutrient discharge consent conditions due to nutrient load reductions by the "water mining plant".

With good cooperation from the Water Authority, and Council driving the project, it was an instant success, with almost no administrative hurdles, and the project completed on time and on budget.

Case 2: Water Mining for reuse at Beverly Park Golf Course in Sydney

Kogarah Council are driving this project, and it is being done in cooperation with Sydney Water, Beverley Park Golf Course and Eimco.

The ReAqua HyRate process utilizes "continuous deflective separation" non-blocking screening technology, plus chemicals, followed by a Submerged Aerated Filter (SAF), sand filter, UV, chlorination and storage. This high rate physical-chemical- biological process produces Class A water ready for reuse with unrestricted public access. It has received formal approval from DEUS (the Dept of Energy, Utilities and Sustainability).

The greater number of stakeholders, plus 3 additional relevant state government departments, plus this being the first water mining project done by a Council accessing a Sydney Water sewer, led to an arduous administration process, which took more time and money than the other water mining projects.

Kogarah Council is recognized as one of the leaders in water sustainability within Sydney. This project had the duel aims of drought proofing the golf course, and providing 100% of the water that Council uses for irrigation of all its nearby parks, and playing fields. At present 70% of Council's water use is on irrigation, but by mining the raw sewage to produce Class A water, this 70% will be dropped to zero.

Whilst Council did assess the alternative of stormwater harvesting on this project, they opted for sewer mining as a means to "drought proof" the course, when stormwater harvesting was estimated to only deliver 67% of the water required. Also, initial figures on the cost of large storage ponds meant overall project costs were likely to be quite similar.

Case 3: Water Mining reuse at New Farm Park in Brisbane, QLD

Brisbane Water is the water authority, project manager and client. Eimco was the designer and supplier of the technology, and ran the demonstration water mining project for them.

The ReAqua MBR process utilizes an above ground Membrane Bio-Reactor, that was their preferred technology of the three available from Eimco primarily because of the security benefits of having a physical membrane. The plant consists of a balance tank followed by the aerated flat sheet membranes that allow both biological breakdown and fine filtration in a single operation. Flow then receives UV disinfection, chlorination and is sent to the storage tank, prior to irrigation on a sporting field and rose beds. The unit is producing Class A^+ water at approx 25kL/d.

Because Brisbane Water is both the Water Authority (sewer owner) and the organization doing the project, the approval process was swift and simple (and therefore cheap). Council also did the off-take arrangements, provided the storage tanks and did the required water quality testing.

While Brisbane Water do the sewer, it is mainly the regional branches within Council that handle the stormwater, and they have some interesting projects on the go at present too.

Summary

The following points are worth taking away from this paper and presentation:

- Stormwater harvesting and sewer mining can both provide excellent sources of non-potable water.
- Both have a variety of pros and cons, and unless the project Water Engineer has a good understanding of all of these, they would be well advised to get assistance from those with relevant experience.
- Stormwater harvesting is generally more cost effective, but has a higher risk associated with it, (depending on the level of treatment used).
- Sewer mining can "drought proof" a project, but will have higher costs and require more operator input to reach the desired outcome.
- Stormwater harvesting generally has an associated environmental benefit.
- Mined sewage can be given a "Class" to depict its quality, but since one of the parameters is Biochemical Oxygen Demand, it is near on impossible to treat stormwater to a standard where it can be classified like treated sewage
- Stormwater harvesting projects don't have the "sewage" stigma associated with them and are considered cleaner and safer, and more publicly acceptable.

So, when considering whether to investigate stormwater harvesting or water mining, it is worth discussing some of these pros and cons with the final owner/operator, so they can at least have a limited understanding of the myriad of issues that could arise and that can change the technical, administrative and financial direction of a project.

But in its most simplified form, if the project is cost limited its more likely to go with stormwater harvesting, and if it has a requirement for a “guarantee of supply” or “drought proofing”, then sewer mining should be your choice.