RPSC – Technical Matters Raised at RPSC Committee Meeting, 19th March 2015 and Subsequent WWTP Visit and LTS Visit

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The following questions were raised at the Committee Meeting and the subsequent visits on 19th March 2015. In order to advance these the following question and answer sheet has been prepared by Jim Bradley (TAG Chair and RPSC Facilitator) and Greg Manzano (RDC Project Manager).

The questions have been grouped in two ways, namely:

Group A - those that can be immediately answered as below from information already available from the Project and elsewhere. Further discussion and information relating to these questions can be considered at future RPSC Meetings if required.

Group B - those that require TAG consideration and/or external consultant and RDC engineering input. The answers on these will be reported through to RPSC meetings following TAG's and other consideration.

Shown in brackets is the name of the person who asked the question.

Group A: Questions & Answers

Question 1
Cost of UV plant for the Rotorua WWTP (Geoff Rice)

Answer
The preliminary estimated capital cost is set out as in included in the Mott McDonald report on options is "$4.6M". This has an accuracy of +/- 25%. It excludes the $3M also in the Option 1 Base Case Total for a UV Feed Pump Station. This may or may not be required depending on the discharge location. The estimated power (electricity) is $78,000 per annum. All costs given here exclude GST. On top of this there is the periodic replacement of the lamps, operator time and other maintenance items. This is included in Option 1 the Base Case. It is based on achieving faecal coliform level of between 100 and 1,000 organisms per 100 ml of treated wastewater sample.

On detailed design a UV plant would be selected to meet the desired receiving water or other receiving environment standard and also be based on the quality of the treated wastewater being subject to UV disinfection. Slide 12 of RPSC 19th March meeting depicts this.

***Question** 2*
This refers to the conclusion in the Cawthron Report (attached to the RPSC minutes on 19th March) on EDC's. Question on bullet 3 slide 8 about bioassays that Jim could not answer. The question was about whether in terms of the detection limits of bioassays in the Puarenga and Waipa Forest reference stream waters, estrogenic activities were encountered. (Deputy Mayor – Dave Donaldson)

Answer
Put simply, the bioassay process used firstly involved the preparation of the sample refer (Section 2.1.1 Cawthron Report) followed by the incubation of the sample prepared with a fluorescene direct measuring technique refer (Section 2.2 Cawthron Report).

The conclusion was that the bioassay results in the Puarenga and Waipa Forest reference stream waters are below the detection levels this in effect means they were zero or very very low as shown in the Table 1 in the Cawthron Report, which gives the below detection limit (BDL).

Question 3
How would activated carbon be engineered and operated? (Carpark discussion before LTS visit)

Answer
Activated carbon in water treatment and wastewater treatment is either used and engineered as:

- A powder which is dosed into the treatment plant early in the treatment processes and it settles out in those processes. Normally it would be used on a periodic basis rather than on a continuous basis for example algae blooms and taste, odour or colour problems. Traditionally, it has not been used in wastewater treatment in this way as use early in the wastewater treatment process would be costly and somewhat ineffective. That said however, recent development of a ballasted flocculation and sedimentation priority treatment unit with the addition of powdered activated carbon has been developed under the trade name of Actiflo® CARB.
- As a granular activated carbon (GAC) which is in the form of granules and is engineered in a filter bed either like a sand filter or a pressure filter. In water treatment this approach is usually used where activated carbon is required in the treatment process train continuously. Over time, the GAC needs replacement once it's treatment capacity becomes spent (declines).

In wastewater treatment activated carbon can be used to remove residual colour, trace organics and other micropollutants in the otherwise treated wastewater. The Water Environment Federation (WERF Project CEC4R08) Research Project referred to in slides 3 to 6 of 19th March RPSC meeting provides information comparing effectiveness and costs of the Actiflo® CARB process with ozone Ultra-Filtration (UF) and Reverse Osmosis (RO).

The combination of ozone and/or hydrogen peroxide to remove organic material, colour, turbidity and breakdown complex chemicals along with inactivation of microorganisms, followed by activated carbon can achieve very effective results particularly for removing this range of contaminants in the otherwise treated wastewater.

Question 4
What are the colour scales used for wastewater and how does the treated wastewater compare to these? (Discussion at the LTS)

Answer
There a number of different approaches used to measure colour and related parametres in water and wastewater. These include

- **APHA color**, also referred to as the Hazen scale, and more appropriately as the Platinum Cobalt(Pt/Co) scale, is a color standard named for the American Public Health Association and defined by ASTM D1209. It was originally intended to describe the colour of waste water, but its usage has expanded to include other industrial applications. Nowadays, it is not used to any great extent in wastewater, particularly in New Zealand. APHA color is a color scale sometimes referred to as a "yellowness index" that is used to assess the quality of liquids that are clear to yellowish in color.

  Developed in the 1890s by chemist Allen Hazen (1869-1930), this color scale's original purpose was to assist in the determination of the quality of public water supplies. Since then other uses of APHA color have been demonstrated in chemical, pharmaceutical, beverage, plastic and petroleum industries.

  The scale for APHA color goes from 0 to 500 in units of parts per million of platinum cobalt to water. Zero on this scale represents distilled water, or what is more commonly called white water.
- **HUE** is a measure colour and has recently been used in the Hastings Wastewater Project in terms of assessing the treated wastewater discharge effects in Hawkes Bay (Pacific Ocean) after the discharge out the offshore ocean outfall and the initial mixing with seawater. Hue is one of the main properties of a colour, defined technically (in the CIECAM02 model), as "the degree to which a stimulus can be described as similar to or different from stimuli that are described as red, green, blue, and yellow," (the unique hues). Orange and violet (purple) are the other hues, for a total of six, as in the rainbow: red, orange, yellow, green, blue, violet. The other main correlatives of color appearance

are colourfulness, chroma, saturation, lightness, and brightness. There are standards methods of measuring and 0-360 degree scale.

- **Turbidity** is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality. It is also used from time to time in wastewater, but not universally.

  Fluids can contain suspended solid matter consisting of particles of many different sizes. While some suspended material will be large enough and heavy enough to settle rapidly to the bottom of the container if a liquid sample is left to stand (the settable solids), very small particles will settle only very slowly or not at all if the sample is regularly agitated or the particles are colloidal. These small solid particles cause the liquid to appear turbid.

  In drinking water, the higher the turbidity level, the higher the risk that people may develop gastrointestinal diseases. This is especially problematic for immunocompromised people, because contaminants like viruses or bacteria can become attached to the suspended solids. The suspended solids interfere with water disinfection with chlorine because the particles act as shields for the virus and bacteria. Similarly, suspended solids can protect bacteria from ultraviolet (UV) sterilization of water.

  The most widely used measurement unit for turbidity is the Formazin Turbidity Unit (FTU). ISO refers to its units as FNU (Formazin Nephelometric Units).

- **UVT (UV Transmissivity)** is the transmission of UV light (254 nm) through water. This a key measurement for determining the UV disinfection plant requirements as they relate to the treated wastewater being disinfected and the level of disinfection required for certain microorganisims. The scale is from 0-100% - below 25% UV disinfection is difficult, above 50% good UV disinfection effectiveness can be achieved. Testing on Rotorua's treated wastewater has given results (included in Slide 18 of the RPSC 19th March) of Bardenpho of 60% UVT and MBR 60% UVT and accordingly the combined at 60%.

  UVT must be considered when sizing any UV system. Using a meter is the only method of determining an application's true %T. It is important to mention that UVT is not linear.

  Further UVT testing should take place on Rotorua's treated wastewater as part of the current project once the option selection is further advanced.

Question 5

What is the cost of power (electricity) for LTS and what is the head (static lift) from the WWTP to the LTS holding basins? (Discussion at the LTS)

Answer

The total operating and maintenance cost for the LTS System is approximately $870,000 per annum (excludes GST). The annual power cost has yet to be confirmed but is a significant proportion of this amount. The actual power cost varies from year to year with the actual volume of wastewater to be pumped, electricity prices and tariffs. This figure is still being obtained. The system is operated to maximise the use of the lower cost and night tariffs.

Question 6

Marked up particle size graph given out at RSPC 19th March showing the Rotorua WWTP MBR with the 4 micron pore (membrane hole) size.

Answer

- The matter of particle and microorganisim size was covered in relation to the discussion on reverse osmosis at the RPSC 19th March. Slide 15 shows the relative sizes of a reverse osmosis membrane pore to a herbicide and pesticide molecule smallest virus, smallest bacteria and giardia cyst.
- During the Rotorua WWTP visit on 19th March, Plant Manager Andy Bainbridge, confirmed that the MBR pore size is 4 microns. This 4 mircron pore size has been marked up on Figure 1 Relative Particle Sizes (Koch 2004). This figure elaborates on the relative size presentation in Slide 15 referred to above. It needs to be appreciated however, that the micron scale on this figure is a log scale.

  Figure 1 has been taken from the New Zealand paper authored by Mott MacDonald

(RDC's technical advisors for the alternative study) entitled *"Removal of Viruses and Endocrine Disrupters across the MBR Process".* This paper is attached for RPSC member's information. It is obviously a rather technical paper.

This paper has been made available by RPSC member, Annaka Davis of Toi Te Ora – Public Health Services. Thank you Annaka.

Annaka has by way of summary provided the following comment:

"*micro-organism removal from wastewater treatment protozoa (giardia and cryptosporidium) are 10-20 microns, viruses - enterovirus is 0.025-0.085 microns and calicivirus is 0.027-0.040 microns. Common Norovirus is 0.020 microns or 20 nanometres and Rotovirus is 0.060 microns or 60 nanometres. Therefore ultra- filtration at 0.01 microns is effective against all viruses*"

Ultra-filtration (UF) is the process that is being used after secondary treatment of wastewater and before reverse osmosis when an advanced treatment system that can produce potable type water is used as has been discussed for Orange County, Singapore and other plants. Refer to the technical paper entitled *"San Diego to Spearhead – Direct Potable Water Reuse"* handed out at the RSPC meeting 19th March and further attached to the minutes for that meeting.

Question 7

How are the wastes from embalming processes handled? Do they go to the treatment plant and is there a measure of human matter that goes plant? (Peter Staite)

Answer

The waste for mortuaries are defined as a "trade waste" and included for in Rotorua District Council's Water Services and Trade Waste Bylaw 2010. This Bylaw, as it relates to trade waste is generally based on the New Zealand Standards Model Trade Waste Bylaw (NZS 9201: Part 23:2004). Council's Bylaw and a brochure introducing the Bylaw are available on their website.

The Council's Bylaw has a number of groups of trade activity and premises. Mortuaries are including in the grouping entitled (Health Practices/Mortuaries/Hospitals/Resthomes). The Bylaw sets out procedures for Council to accept on their terms, or reject discharge of trade waste into public sewers. When accepting trade waste Bylaws, Council sets the limits for various contaminants and for certain larger trade waste discharges can require a cleaner reduction and waste minimisation procedures to be put in place through the preparation of management plans prepared by the trade waste discharge. These procedures as well as setting pre-treatment approval schedules in place for that trade waste discharger to meet.

Currently there is one embalming establishment in the Rotorua urban area. This has an enclosed, self-contained waste system which is being dealt with as a medical waste and does not discharge to the sewer. The Rotorua Hospital waste is a consented trade waste and the system consented includes the grinding of wastes prior to discharge.

Group B: Questions for which answers which will follow after TAG and Consultants/RDC Engineering considerations

Question 1
Effect of wastewater treatment of health compounds in sewage – effects on humans. Reference the US Dept of Health Household products list. (Peter Staite)

Question 2
Reverse Osmosis (RO) Indicative Costs and further data to provide best quality possible. (Geoff Rice, Antoine Coffin and others)

Question 3
Reverse Osmosis systems. What happens to the waste (concentrate) stream and what proportion of the total wastewater volume would this be? (unsure who asked)

Question 4
Information is required on the water quality of unpolluted springs and lake water for comparison with the treated wastewater presently and the options? (Peter Staite)

Question 5
Further information on Black Mica in terms of actual usage for polluted water/wastewater treatment. (To expand on information presented at RPSC on 19th March – slide 2)

Question 6
The status of various "add-on's" that have arisen during the project to date and are being considered. Summaries of these are being prepared and these and TAG recommendations and will be presented to the RSPC.

Question 7
Further information on TERAX in terms of the compatibility and interactions with the short-listed treatments options being considered. This information will be presented at the scheduled workshop on 22nd April.

Question 8
Information on the treated wastewater discharge options and locations. This information will be presented at the scheduled workshop on 22nd April.

Question 9
Is an option to totally use MBR's for the full plant (100% MBR's) if this gets a low Total Nitrogen (TN).

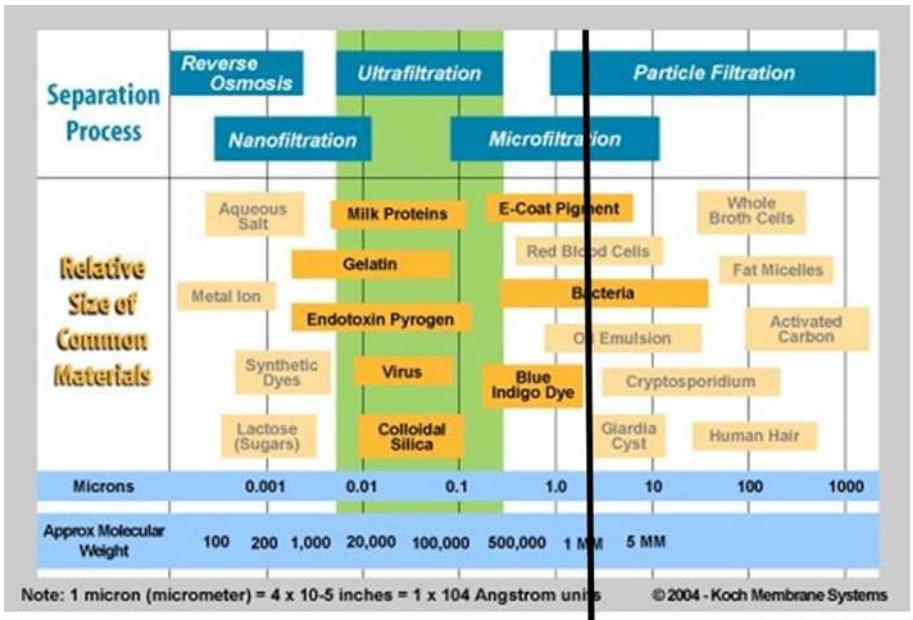

Figure 1.0 Reative Particle Sizes (Koch, 2004)

Please note – micron scale is a log scale

Rotorua WWTPP – MBR
4 micron pore size (approx location)