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| **IN THE MATTER OF** | of the Resource Management Act 1991 |
| **AND** | |
| **IN THE MATTER OF** | of Resource Consents and Notices of Requirement for the Central Interceptor main project works under the Auckland Council District Plan (Auckland City Isthmus and Manukau Sections), the Auckland Council Regional Plans: Air, Land and Water; Sediment Control; and Coastal, and the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health |

**STATEMENT OF EVIDENCE IN REPLY OF CLINTON JAMES CANTRELL ON BEHALF OF WATERCARE SERVICES LIMITED**

## 1. INTRODUCTION

**Qualifications and experience**

1.1 My name is Clinton James Cantrell. My qualifications and experience are set out in my primary statement of evidence dated 12 July 2013.

1.2 I confirm that I have reviewed, and agree to comply with, the Code of Conduct for Expert Witnesses set out in the Environment Court's Practice Note (2011).

**Scope of this supplementary evidence**

1.3 The purpose of this reply evidence is to respond to issues raised on:

(a) the alternatives assessed for, and the extent of works required at, the Lyon Avenue site;

(b) the need for the Kiwi Esplanade site and the air treatment facilities proposed for that site;

(c) the contribution of the Central Interceptor to growth related flows to the Mangere Wastewater Treatment Plant ("**WWTP**");

(d) the alternatives to the EPR discharge put forward by the Manukau Harbour Restoration Society;

(e) the existing wastewater overflows into the Manukau Harbour;

(f) growth projection impacts on the existing wastewater network and the Central Interceptor Scheme;

(g) the capacity of the Central Interceptor Scheme to reduce targeted overflows; and

(h) the impact of the Central Interceptor main tunnel on the existing Mangere WWTP consents.

1.4 I address each of these in turn below.

## 2. LYON AVENUE - EXTENT OF WORKS AND ALTERNATIVES

2.1 The construction works and permanent features at the proposed Lyon Avenue site are shown on pages 61 and 62 of the Hearing Drawing Set.

2.2 The existing combined sewer overflow ("**CSO**") at this location discharges into the Meola Creek almost every time it rains. It is the largest overflow (by volume) in the Auckland regional wastewater system.

2.3 The works at this site are required to make a connection between the existing overflow and the main tunnel. Making this connection will reduce the volume and associated pollution load of the existing overflow which impacts the areas adjacent to the St Lukes Gardens Apartments, Mount Albert Grammar School ("**MAGS**"), the Meola Creek and the Waitemata Harbour where the stream discharges, including Point Chevalier Beach. As discussed in Mr Munro's evidence, and my primary evidence, the significant reduction in overflow volumes will result in significant benefits to the local community and environment.

2.4 This site is defined as a "secondary construction site" simply because it is not one of the three "primary construction sites". The only structures proposed at this site are the ones required to connect the existing overflow to the main tunnel. This includes a connection / control chamber on the existing outfall, a drop shaft to lower the flows to the same elevation as the main tunnel, and an access shaft to connect the drop shaft to the main tunnel via a de-aeration pipe. At other secondary construction sites, additional structures are required for purposes other than connection of an overflow (e.g. connection of a link sewer and / or a CSO collector sewer). However, neither of these are required at this site and I can confirm that, contrary to what the St Lukes Gardens Apartments' submission suggested, the works at this site are simply what is required to connect the existing overflow to the main tunnel. The residents of the St Lukes Gardens Apartments are important beneficiaries of this work occurring next to them.

2.5 In order to connect the existing overflow to the main tunnel, works must occur in the vicinity of the spillway. As the concept design has evolved, the works footprint has reduced, particularly through the elimination of any need for a grit removal chamber, and it is now possible for all construction works to occur in the vicinity of the spillway. This enables the construction site to have a relatively small footprint, concentrated around the areas where at least some of the works must occur. Watercare's proposed site has the smallest footprint practicable at this stage of concept design in order to undertake the proposed works, and is as close as possible to the required location for the connection works. This is the most appropriate approach from a technical and effects perspective.

2.6 Once it became possible for all works to occur in the vicinity of the spillway, this became the preferred site. A borehole was then drilled at this location to conduct required geotechnical testing. While other alternative sites have been assessed and are technically feasible (but not without some complications), locating some of the construction works in these other areas would still mean that works in the vicinity of the spillway would be required. Locating some of the works in an alternative location would, quite obviously, expand the overall size and effects of the construction area. I explain this further in later paragraphs of this reply evidence.

2.7 Options evaluated for this site included locations on the MAGS playing fields, at Kerr Taylor Park and in the vicinity of the proposed site. Engineers and technical experts were instructed to evaluate technical requirements and to consider all effects of options on surrounding properties including on the St Lukes Gardens Apartments and MAGS properties. The options considered are indicated in Part B of the Central Interceptor Main Project Works Assessment of Effects on the Environment

("**AEE**") submitted to the Council, dated August 2012, page 68, and in the comparative summary assessment table included as Appendix H of Ms Petersen's primary statement of evidence. Variations of those options were also considered as part of the assessment process, but drawings were not prepared for all variations.

2.8 It is important to note that all alternative site locations still require works at the spillway, and construction access to the spillway, in order to connect the existing overflow to the main tunnel.

2.9 The evidence presented by Ms Walker on behalf of the St Lukes Environmental Protection Society suggested an alternative at the rear of 2 Wagener Place (referred to by Ms Walker as the "Phillips Building"). The car park in this location can be seen on pages 61 and 62 of the Hearing Drawing Set. This is one of the many variations which were previously considered.

2.10 2 Wagener Place is in private ownership, and the building is occupied by a number of tenants operating commercial businesses. At the rear of the site the established car park extends into the adjacent Crown-owned land. Fencing has been established around the perimeter of the car park. Access is via a service lane on the southern boundary. The service lane provides access to the businesses that operate from 2 Wagener Place, and there is angle parking adjacent to the building and extending down the lane.

2.11 Around half of the existing car park is located on Crown-owned land. Land ownership boundaries are clearly identified on a marked up copy of page 62 in **Appendix C**. I have been advised by Watercare that there is no formal arrangement for this occupation of the Crown land.

2.12 To make use of the 2 Wagener Place car park, the following construction issues would need to be considered:

(a) A 100m long, 2700mm diameter pipe connection back to the spillway would have to be constructed. The length and extent of basalt for a trench would require more extensive tree removal than the proposed site and would increase impacts associated with blasting and / or rock breakage.

(b) This would suggest a pipejacked solution at a level below the basalt (approximately 10m – 12m deep). However, pipejacking will require an enlarged chamber adjacent to the spillway to receive the pipejack and accommodate an additional vortex drop structure down to the connecting pipe 10m – 12m below. Excavation of basalt would be needed to construct this larger chamber, which is considerably deeper than the current arrangement. Permanent vehicle access would be needed to this structure.

(c) A similar depth pipejack shaft would be required at the Phillips Building site although detail design may allow this to be incorporated into the vortex drop shaft at this end.

(d) The longer connection by pipejack, the larger and more complex chamber at the spillway and the potential additional pipejacking shaft would add to the costs (in excess of $1 million).

(e) There are additional traffic and access issues which will be addressed in the reply evidence of Mr Hills. Access to the Phillips Building car park is of restricted width, currently services commercial units and is used for car parking. Long-term operations and maintenance would be more difficult for the overflow connection chamber and the vortex drop shafts given the depths that the hydraulic control structures would need to be placed at.

2.13 This alternative site is not preferred for a number of reasons, some of which I discuss below:

(a) As noted above, all of the alternative site locations that have been considered in this vicinity require works at the spillway next to St Lukes Gardens Apartments to connect the overflow to the main tunnel. These works would still require some access via Morning Star Place to the connection point and for the associated work at that location, unless an alternative access was used. There would still be very significant impacts on the Roy Clements Treeway and Meola Creek. If a connection to 2 Wagener Place is made by trenching this would involve use of the service lane as well as construction noise and vibration associated with excavation of the basalt, and a greater level of disturbance to vegetation in the Roy

Clements Treeway than occurs with the proposed Lyon Avenue site. If the connection is made via tunnelling, a construction shaft is required somewhere adjacent to the spillway, with construction noise, vibration and traffic effects at this location being similar to those described for the proposed Lyon Avenue site, and still requiring vegetation removal to facilitate shaft construction.

(b) The temporary effects associated with constructing the drop shaft and access shaft at the 2 Wagener Place site would extend to that property as well as surrounding land, including adjacent residential development at 3 Wagener Place. These effects would include construction noise, vibration and traffic. The latter will be discussed by Mr Hills.

(c) The introduction of a deep connection from the spillway to a drop structure 100m away introduces operational and maintenance safety concerns for Watercare. An additional vortex drop structure would have to be introduced at the spillway requiring inspection and maintenance down to about 12m deep. It also means that the main drop shaft vortex enters the drop shaft at a similar depth, well below ground level. This would require additional provisions for entry to inspect the vortex from below ground. The current design allows visual and remote instrument inspection of the single vortex from ground level and without personnel entry, which is much safer for the personnel concerned. This would also be a consideration for a pipe-jack connection to the MAGS site.

(d) Additional truck movements would be required to remove the spoil from either the pipejack or open trench works due to the increased length of the connection.

2.14 A further alternative location has been proposed by Mr Maddren for the St Lukes Gardens Apartments Body Corporate and St Lukes Gardens Apartments Progressive Society Incorporated (see drawing No. 32218/SK02 "Indicative Layout Alternative 1" attached to his evidence). This alternative location occupies a part of the MAGS playing fields and extends into the land adjacent to the Meola Creek.

2.15 The construction issues and concerns discussed above for 2 Wagener Place would also apply to this MAGS site. In addition to those issues:

(a) some modifications of the stream bank would be required to provide sufficient level working space; and

(b) access would be through MAGS off Alberton Avenue. The traffic and pedestrian safety of this access have been discussed in the primary and reply evidence of Mr Hills. It is worth noting that access through this route would result in construction trucks passing within a few metres of the MAGS boarding students' residences.

2.16 In my opinion, while technically feasible, the alternative options previously considered by Watercare and other options put forward by the submitters are inferior to Watercare's proposed Lyon Avenue site.

## 3. KIWI ESPLANADE - NEED AND ODOUR

3.1 As discussed in my primary evidence, a site is required in the vicinity of Kiwi Esplanade for the following reasons:

(a) the connection of Link Sewer 4 to the main tunnel;

(b) a construction shaft to check the tunnel alignment and inspect the tunnel boring machine prior to it crossing the Manukau Harbour;

(c) a permanent access shaft to facilitate required inspections and maintenance; and

(d) the installation of a pressure relief vent to release air from the tunnel during large infrequent storm events.

3.2 It is this last feature which seems to be of greatest concern to submitters but is essential for the safe operation of the tunnel system.

3.3 As illustrated by the animation presented with my primary evidence, an air pressure vent is required to release potential air pockets that may form within the main tunnel directly underneath the Kiwi Esplanade area (see visual in **Appendix D**). A similar vent is proposed at the Pump Station 23 site. The analysis that was conducted to determine the need for these vents included the use of a sophisticated hydraulic surge model, which is similar to the Limnotech SHAFT model discussed in evidence presented by the Mangere Bridge Residents and Ratepayers Association.

3.4 The air pressure vent is predicted to discharge approximately only twice in 5 years based on the analysis completed with the surge model. Air pockets are only predicted to form within the tunnel for very large storm events which exceed a one in two year return period.

3.5 Activation of the pressure relief air vent will be very infrequent (around twice in 5 years as noted above), and when this does occur the air will be expelled within a short period of time (estimated to be approximately 10 minutes in duration based on surge model predictions). Prior to activation of the vent the majority of air within the tunnel will have been ventilated and treated by the Air Treatment Facilities located at the proposed Mangere Pump Station and Pump Station 23.

3.6 Activation of the pressure relief air vent is not expected to create odour nuisance to residents on Kiwi Esplanade due to the following reasons:

(a) activations will be very infrequent and for a very short duration;

(b) wastewater in the tunnel will be highly diluted with stormwater when activations occur; and

(c) activations will only occur in large infrequent storm events associated with higher wind conditions that would dissipate expelled air quickly as shown in the images previously presented (and **attached** in **Appendix E**).

3.7 Given the short duration, low frequency of occurrence, and estimated peak air flow rates it is also not practical nor necessary to treat the air from pressure relief air vents.

3.8 However, approximately 6 to 8 times per year, air will be expelled from a smaller duct within the air vent when the tunnel is not able to operate with a negative air pressure. This is because the bottom end is full and the tunnel is in storage mode, meaning the tunnel will develop a positive pressure. In these storm events, any air expelled from the Kiwi Esplanade site will receive treatment through an activated carbon filter. Activated carbon has been successfully used to treat air from wastewater systems at other locations including some existing Watercare pump stations and wastewater tunnels overseas. There will be no odour expelled as a result of the treatment provided by the activated carbon system in the duct. As stated in my primary evidence, for approximately 98% of the time the tunnel will operate in a negative air pressure, which means that fresh air will be drawn into the Kiwi Esplanade permanent structure as opposed to being expelled. Approximately 6 - 8 times per year the tunnel will not be able to operate in a negative air pressure and air will be expelled from the air vent at this location, and at the air intakes at other locations. In those storm events, the air expelled at this location will be treated by an activated carbon filter.

3.9 On-going inspections and maintenance will require occasional access to the Kiwi Esplanade site. Normal inspections and maintenance will occur when the tunnel is operating in a negative air pressure mode. Inspections will not require removal of the entire top of the shaft, and can be conducted by opening much smaller hatch covers. Given the tunnel will be operating in a negative air pressure mode during these inspections, air will be drawn into the tunnel and will not expel out of it.

3.10 The tunnel has been designed to be self-cleansing, so Watercare is not anticipating any required cleaning of material or debris from this location. The only time that removal of the shaft top would be required is to conduct a more detailed structural inspection of the tunnel which may require placement of large safety equipment and vehicles into the tunnel. This would be very rare (estimated to be no more than once every 20 years) and would only be done when the tunnel is operating in a negative air pressure mode as it would not be safe to enter the tunnel when it is in a positive air pressure mode.

3.11 In summary:

(a) It is necessary to have access to the main tunnel at this location, for the reasons noted in paragraph 3.1 above.

(b) It is necessary to provide a pressure relief air vent to protect the main tunnel in very large storm events which exceed a one in two year return period.

(c) Air is expected to be expelled from the pressure relief air vent approximately twice every 5 years for an estimated duration of approximately 10 minutes, in large storm events when people would likely be indoors and where high winds would result in rapid dispersion.[1] When this occurs, it is not possible for the air to be treated.

(d) In other storm events, when the tunnel is operating in storage mode and the bottom end is full (6 - 8 times per year), air will be expelled. However, the air discharged in these events will receive treatment through an activated carbon filter and no odour will be expelled.

(e) Normal inspections and maintenance will only occur when the main tunnel is operating under negative air pressure and, as a result, no odour issues are expected to arise.

## 4. THE CONTRIBUTION OF THE CENTRAL INTERCEPTOR TO GROWTH RELATED FLOWS TO THE MANGERE WASTEWATER TREATMENT PLANT

4.1 Watercare anticipates that by the time the existing consents for Mangere WWTP expire, growth in Auckland will have resulted in the need to expand the Mangere WWTP from the current permitted average annual flow of 390 ML/day to 450 ML/day. This has previously been indicated to various parties, including the Mangere Bridge Residents and Ratepayers Association.[2] Analysis conducted as part of this project shows that planned growth will not result in the existing average annual flow limit being exceeded prior to expiration of the existing consent.

4.2 The existing limit of 390 ML/day and the predicted future limit of 450 ML/day are average daily flow limits. This is determined by taking the total volume which goes through the Mangere WWTP each year and dividing that volume by 365. It is important to note that the existing interceptor system (i.e. without the new Central Interceptor) already has sufficient capacity to deliver an annual volume which would equal an average daily flow of 450 ML/day. However, overflows are predicted to occur along sections of the existing interceptors during peak dry weather flows if the Central Interceptor scheme is not implemented.

4.3 As stated in my primary evidence, the Central Interceptor does not expand the area serviced by the Mangere WWTP and will not result in conveyance

[1] See primary evidence of Mr Kirkby.
[2] For example, refer Attachment 11 of 27 May 2013 Section 92 response.

from any new wastewater service areas to the Mangere WWTP. It simply re-routes existing wastewater service areas which are already delivered to Mangere WWTP via the existing Western and Eastern Interceptors, and captures targeted overflows which will contribute approximately 2% more volume on an annual average basis. As stated above, flows of up to 450 ML/day could already occur with the existing interceptor sewers and reaching this limit is not reliant on implementation of the Central Interceptor.

4.4 As explained in the primary evidence of Mr Munro, the Central Interceptor is part of a wider programme of works. Watercare's current regional wastewater strategy includes implementation of the proposed Northern Interceptor which will progressively divert wastewater to the Rosedale WWTP which would otherwise have gone to the Mangere WWTP. The expected timeframes for, and capacity of, the Northern Interceptor are detailed in Mr Munro's primary evidence.

4.5 As noted by a number of submitters during the hearing, the Three Waters Strategic Plan 2008 ("**Three Waters Plan**") estimated that the Mangere WWTP would reach the currently consented capacity of 390 ML/day by 2027. This assumed the Northern Interceptor had not been constructed as, at that time, the likely timing of that project was not confirmed. The diversion of flows from the Mangere WWTP to the Rosedale WWTP via the Northern Interceptor will enable Watercare to manage network capacity within the limits of the existing discharge consent until it expires in 2032.

4.6 Beyond the Central Interceptor service area, Auckland Council is planning for significant growth in the southern area of Auckland. As part of the Unitary Plan, Council is proposing to establish the southern Rural Urban Boundary to provide for approximately 55,000 additional dwellings. Watercare has started to evaluate options for the expansion of existing non-metropolitan wastewater treatment plants or for new treatments plants in the southern area to service this growth which would otherwise have to go to the Mangere WWTP. However, the need for continued operation and upgrading of the Mangere WWTP in the foreseeable future will not change given the very large areas of Auckland it currently services and the intensification proposed under the new Unitary Plan zonings in these areas.

4.7 The Northern Interceptor is planned to cater for growth in the north-western area of Auckland, and an evaluation is underway for the southern area. The Central Interceptor is simply re-routing wastewater that is already delivered to the Mangere WWTP. Regardless of what happens in the north and south, the need for continued operation and upgrading of the Mangere WWTP in the foreseeable future will not change given the growth forecast in the draft Unitary Plan.

## 5. EMERGENCY PRESSURE RELIEF

5.1 As presented in my primary evidence, various options were considered for the emergency pressure relief ("**EPR**") structure which is required to ensure safe hydraulic operation of the main tunnel. The preferred location adjacent to the proposed Mangere Pump Station was selected as the only feasible site to meet the operational requirements for emergency relief in a pump station failure situation.

5.2 The probability of a discharge from the EPR has been estimated at no more than once every 50 years. Details of the estimates of probability were provided to Auckland Council in Watercare's Section 92 response letter dated 27 May 2013 (pages 2 through 4). A copy of this letter is provided in **Appendix F**.

5.3 As noted in **Appendix F**, activation of the EPR requires failure of the proposed Mangere Pump Station for an extended period of time (12 to 48 hours depending on associated weather conditions, during which period the tunnel provides adequate storage). Activation does not occur solely due to storm events. As discussed with the Commissioners during the presentation of my primary evidence, if failure occurs due to power outage, Watercare has backup generator services on standby, and based on current operational performance, the time taken to return power supply to the proposed Pump Station using backup generators is expected to be within four hours. As such, in these circumstances, the generators would also need to fail for some reason for an additional eight hours before the EPR would activate. It is worth noting that the Hobson Tunnel pump station has similar sized pumps as proposed for the Mangere Pump Station, and Watercare has run a number of site generator trials which confirm the appropriateness of the assumed response times.

5.4 **Appendix F** also clarifies that the probability of an EPR discharge during a 10-year storm is estimated at no more than 1 event every 250 years. The hydraulic model predicts an estimated peak discharge flow for a 10-year storm at 20 $m^3$/s. The probability of 1 event every 50 years is associated with a 1-year storm which is estimated to result in a much lower peak discharge flow of 3 $m^3$/s. To provide some context, 3 $m^3$/s is approximately the peak discharge flow rate from the existing Lyon Avenue overflow discharging into the Meola Creek. It is also worth noting that model predictions of EPR discharge events assume that it is raining everywhere across the entire Mangere WWTP catchment area, which is a conservative assumption.

5.5 Some questions have been raised regarding the estimated volume and associated effects of discharge from the EPR. The following provides estimates of EPR discharge volumes of heavily diluted wastewater (ie not just raw wastewater) based on hydraulic modelling results:

(a) Major malfunction + 10 year storm (1 event every 250 years): estimated EPR volume (over a [x] hour period) = 511,000 $m^3$.

(b) Major malfunction + 1 year storm (1 event every 50 years): estimated EPR volume (over a [x] hour period) = 90,000 $m^3$.

5.6 The approved Mangere WWTP bypass activates during wet weather conditions approximately 6 to 8 times per year on average. Observed flow monitoring data shows that approved bypass discharge volumes range from 3,000 $m^3$ for smaller storm events up to just over 600,000 $m^3$ for a 5-year storm event. Portions of this flow receive partial treatment in terms of screening, limited solids removal and UV disinfection. However concentration of typical wastewater pollutants such as suspended solids, BOD, ammonia, nitrogen and metals would be similar to that from the highly diluted EPR discharges which would be consistent with dilute CSO discharge. An assessment of effects of the approved bypass, including detailed harbour modelling to show the distribution of the flows, was completed as part of the existing Mangere WWTP consent application. Detailed monitoring of the Manukau Harbour required as part of Watercare's Mangere WWTP consents confirms that the approved bypass has not resulted in noticeable effects.

5.7 Furthermore, it is worth noting that Watercare proposes to implement a wet weather treatment system at the Mangere WWTP.[3] This system will provide additional treatment of approved bypass flows at the Mangere WWTP, resulting in a net reduction of total wet weather pollution loads into the Manukau Harbour. The proposed wet weather treatment system technology has been implemented at a number of overseas treatment plants similar to the Mangere WWTP, and has been shown to provide a significant reduction (greater than 90%) of such contaminants as suspended solids, phosphorous and heavy metals. Furthermore it ensures that peak wet weather flows, inclusive of overflows captured by the Central Interceptor Scheme, will receive a high degree of disinfection from the UV system. The wet weather treatment system will result in a significant reduction of wet weather related pollution loads into the Manukau Harbour. Over a 50 year period, the pollution loads removed by the wet weather treatment system will far exceed any new loads occurring from one EPR discharge event, resulting in likely continued net improvements to the Manukau Harbour which have been observed since the last upgrade of the Mangere WWTP.

5.8 Additional options presented by the Manukau Harbour Restoration Society for managing discharges from the EPR include a concept of storage in the Manukau Harbour. In order for this to work, large areas of the Manukau Harbour which were restored as part of the removal of the former oxidation ponds, as sought by the community, would have to be enclosed again and converted into impounded storage basins. These basins would have to be kept empty at all times to be available to take the EPR discharge whenever required and yet would only be utilised an estimated 1 time every 50 years. They would likely require structural repairs / rehabilitation between any such use and potentially over time even without use.

5.9 It is also worth noting again that the Central Interceptor main tunnel is already designed to act as a storage basin. In contrast to the option proposed by the Manukau Harbour Restoration Society, the main tunnel provides over 200,000 cubic metres of storage in an underground tunnel which results in significantly less environmental impact than what would occur by enclosing large areas of the Manukau Harbour.

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3 Refer paragraphs 7.24 and 7.25 of Mr Munro's evidence.

## 6. WASTEWATER OVERFLOWS INTO THE MANUKAU HARBOUR

6.1 As discussed in evidence presented by the Manukau Harbour Restoration Society there are overflows from the existing wastewater network which discharge into the Manukau Harbour. Watercare records indicate that there are 14 wastewater overflows from trunk pumping stations into the northeast part of the Manukau Harbour including the one associated with Pump Station 23 (the location for this overflow is along the Onehunga foreshore in the vicinity of the Manukau Boating Club). These overflows can occur, for example, as a result of flows exceeding the capacity of the wastewater pipe or the pump station. I understand the frequency of those existing network overflows into the Manukau Harbour are within the target limits of no more than two overflows per year as set out in the Auckland Council Regional Plan: Air, Land and Water. All of the sewer systems draining to these overflows are separate sanitary systems.

6.2 In contrast, the proposed EPR discharge would only occur in an extreme emergency situation and, as I have noted, is estimated to occur at a frequency of no more than around once every 50 years.

6.3 Watercare monitors the activity of existing network overflows through a real time telemetry system (SCADA). This system provides real time information to Watercare's operations team to indicate when any problems occur, and also when wastewater levels are unusually high potentially leading to an overflow.

6.4 The past 5 years of data from Watercare’s monitoring system for the 14 trunk pump station wastewater overflows discharging into the northeast end of the Manukau Harbour indicates the following:

(a) 7 of the overflows have not activated;

(b) 6 have activated less than 2 times per year on average, which is compliant with the Auckland Council Regional Plan: Air Land and Water targets for separated sewer system overflows; and

(c) The overflow associated with Pump Station 23 has activated 11 times in 5 years, or just over an average of 2 events per year.

6.5 In contrast to this there are over 200 active overflows which discharge into the Waitemata Harbour, many of which discharge more than 100 times per year. The total annual volume of wastewater overflow into the Manukau Harbour is estimated to be less than 3% of what is discharged each year into the Waitemata Harbour. As presented in my primary evidence the largest and most active of these are targeted by the Central Interceptor Scheme.

6.6 The overflow associated with Pump Station 23 will reduce in frequency to an average of less than 2 events per year as a result of the Central Interceptor main tunnel. This is because the pump station will be eliminated and the Onehunga branch sewer will be connected directly to the main tunnel. This will eliminate potential overflows associated with capacity exceedance of the pumping station and pump station failures. The overflow will remain in place due to capacity exceedance of the gravity sewer from excessive stormwater in the separated sewer system draining to the Onehunga branch sewer (because stormwater inflow and infiltration into separated sewer systems occurs from multiple sources including cracks, defects, unsealed joints and illicit connections).[4]

## 7. GROWTH PROJECTION IMPACTS ON THE EXISTING WASTEWATER NETWORK AND THE CENTRAL INTERCEPTOR SCHEME

7.1 The concept design of the Central Interceptor Scheme includes a component for additional wastewater associated with medium population forecasts to the year 2062. However the sizing of the main tunnel, link sewers and CSO collector sewers was primarily driven by peak flows associated with wet weather conditions. This included conservative assumptions regarding future stormwater inputs to the wastewater system, as well as predicted climate change effects. Also, the size of the main tunnel was driven by providing sufficient storage to reduce overflow

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4 Much of this occurs on private property including the piped connections from the house to the public sewer, which are extremely vulnerable to damage. The rates of stormwater inflow and infiltration in separate sewer systems varies widely from reasonably low amounts to higher amounts approaching what is observed in combined sewer systems. Throughout Auckland, the North Shore and locations overseas, the inflow and infiltration can result in overflows from the separate sewer systems, and it usually does not take a large amount of stormwater to trigger this, as separate sewer systems typically do not have much capacity to accommodate stormwater. In fact in Sydney Australia, a wastewater tunnel very similar to the Central Interceptor was built to reduce overflows from a separated system that were discharging into Olympic venue areas (cost of this tunnel was AUS$466M in 2003). More recently North Shore, which is also served by a separate sewer system, determined that $500M was required to reduce overflows to no more than 2 events per year. Reduction of inflow and infiltration requires comprehensive rehabilitations including expensive works on private property. The cost of private property repairs typically is in the range of $3,000 to $10,000 per property, and the public sewer repairs cost can approach values similar to full replacement cost. Many rehabilitation programmes have resulted in marginal benefits, particularly when parallel improvements to stormwater drainage are not addressed as well.

volumes by 80%, the minimum size required for construction purposes, and to ensure flows could be delivered to the Mangere WWTP within consented limits. As a result the capacity of the Central Interceptor Scheme is more than sufficient to cope with projected high population forecasts, and a sensitivity analysis using the calibrated hydraulic model was completed to confirm this.

7.2 To provide further context, wastewater flows associated with an additional 150,000 people would only occupy less than 2% of the available storage volume in the main tunnel. In addition, the consent application proposes a range of main tunnel diameters from 3.5 to 5 metres, which provides sufficient flexibility to confirm a final diameter in the detailed design stage which utilises the updated population forecast provided for by the draft Unitary Plan. The submitters who expressed concerns over future capacity, seem unaware of all of this.

7.3 With the Central Interceptor Scheme and other planned improvements in place (e.g. the Northern Interceptor), Watercare's trunk sewer system has sufficient capacity to cope with projected medium as well as high population forecasts. However, parts of the local sewer systems which drain to the trunk sewers do not have sufficient capacity to cope with planned areas of urban densification including portions of the Central Interceptor catchment. This has been the subject of most of the recent discussions between Watercare and Auckland Council in the context of the draft Unitary Plan. To address this, Watercare will evaluate options for upgrading the local networks (as it already does as a normal part of the management of the wastewater network) and work with Auckland Council to reduce stormwater inputs to the wastewater system where intensification will require new stormwater infrastructure. It is worth noting that the hydraulic model used to develop the concept design of the Central Interceptor Scheme included additional flows that would result from future local network upgrades required to address capacity issues.

## 8. CAPACITY OF THE CENTRAL INTERCEPTOR SCHEME TO REDUCE TARGETED OVERFLOWS

8.1 Evidence presented by the Manukau Harbour Restoration Society included questions about the capacity of the Central Interceptor main tunnel to reduce overflows to zero discharges.

8.2 As presented in my primary evidence, the Central Interceptor main tunnel has been sized to reduce annual overflow volumes by 80% on average. This control target is consistent with international best practice in the United Kingdom and North America. Wastewater tunnel systems implemented in cities similar to and larger than Auckland have been designed to reduce overflows, but not eliminate them. For example the largest wastewater reduction programme in the world, currently being implemented in London, has been designed to reduce overflows to 4 events per year at a total cost of £4.2 billion (2012 capital cost est.). This programme includes two large wastewater tunnels along the Thames River. The wastewater tunnel system implemented in Sydney, which is within a separated sewer system, has been designed to reduce separated sewer overflows to 2 events per year on average.

8.3 Complete elimination of overflows would require a substantial increase in the size of the main tunnel, link sewers, CSO collector sewers, shafts and associated cost. It is difficult to estimate the maximum required size as there could always be a storm event which is bigger than the design criteria. Detailed studies completed around the world, which include comprehensive environmental effects assessments, have determined that complete elimination of overflows is typically considered not practical, affordable, nor provides a reasonable return on benefits as a function of cost. This is further evidenced by regulatory standards in Europe and North America which set targets for combined sewer overflow reduction to between 4 and 12 events per year depending on where the overflows discharge.

## 9. IMPACT OF THE CENTRAL INTERCEPTOR MAIN TUNNEL ON THE MANGERE WWTP CONSENTS

9.1 Evidence presented by the Manukau Harbour Restoration Society suggests that connection of the Central Interceptor main tunnel to the Mangere WWTP will result in an increase of the interceptor conveyance capacity at the Mangere WWTP.

9.2 The opening legal submissions by Watercare's counsel (in paragraphs 7.2 – 7.9) addressed the legal aspects of the existing discharge consent. I will comment on the technical considerations.

9.3 As stated in my primary evidence, and at paragraph 4.3 of this evidence, the Central Interceptor Scheme is bringing dry weather wastewater flows to the Mangere WWTP that would otherwise get there via the Western or Eastern Interceptors and has also been designed to ensure that flow limits set within the existing consent are not exceeded. The existing consent includes three flow limit criteria as follows:

(a) The maximum daily flow shall not exceed 1,209,600 cubic metres per day. This equates to an average flow rate of 14 m3/s over a 24 hour period.

(b) A maximum design discharge rate of 25 m3/s.

(c) The mean daily flow of treated effluent discharged over any one year period shall not exceed 390,000 cubic metres per day.

9.4 As presented in my primary evidence, the concept design of the Central Interceptor main tunnel includes a pumping station at the Mangere WWTP to control how flow is delivered. The hydraulic model used to develop the concept design includes a control limit on the pumping station which prevents exceedance of a total peak flow into the Mangere WWTP above 14 $m^3$/s within the current consent period. This ensures that the consent's maximum limit of 1,209,600 cubic metres per day will not be exceeded. To achieve this, flows from the proposed Mangere Pump Station will be controlled variably within a range up to 6 $m^3$/s. The pump station will reduce flows into Mangere from the main tunnel such that the current maximum daily volume limit of 1,209,000 cubic meters is not excedeed. The maximum output from the pump station at 6 $m^3$/s would only occur when total flows from the existing interceptors are equal to or less than 8 $m^3$/s, and the tunnel is being emptied subsequent to a wet weather storage mode.

9.5 Furthermore, the hydraulic model demonstrates that the maximum hydraulic conveyance capacity of the existing interceptor system connected to the Mangere WWTP is approximately 14 $m^3$/s. This is consistent with the current consent limit of a maximum 24-hour average flow of 14 $m^3$/s. Given that the concept design limits discharge from the

Central Interceptor main tunnel such that total flows into the Mangere WWTP do not exceed 14 $m^3$/s through the period of the existing consent, it is compliant with existing consent limits on flows including the requirement that there be no increase to the interceptor hydraulic conveyance capacity.

**Clinton James Cantrell**

**13 August 2013**