Integrated System Planning to serve growth in Western Sydney

Objectives
- Serve rapid population growth.
- Configure the wastewater system to be efficient and resilient to changing growth patterns and regulatory requirements.
- Leverage value of existing assets.
- Manage nutrient loads to the Hawkesbury Nepean River.
- Recover water, energy and nutrients.
- Provide water for liveability (urban greening, industry and residential recycling).

Challenges
- 20% increase in plant load over the past 3 years.
- Sharp increase in growth forecast triggered by high density rezoning along the rail corridor (150,000 EP).
- Treatment capacity is at its limit.
- Limited lead time for planning.
- Decentralised system that limits efficiency and resource recovery opportunities.
- Tightening discharge compliance.
- Assessing three catchments resulted in large number of potential options with different staging implications.

Method
- Setting clear objectives and wide study boundary.
- Solve system configuration question 1st ie – interconnect and consolidate or not.
- Assess preferred treatment solution 2nd ie – conventional technology vs intensification.

Solution
The preferred solution was to interconnect systems to:
- Balance load across systems to leverage latent system capacity at Riverstone.
- Stage treatment amplifications to smooth investment and maximise planning time.
- Improve system resilience by allowing intersystem redundancy.
- Consolidate biosolids treatment for efficient resource recovery and to prevent taking up more land in Rouse Hill.

Achievements
This solution will allow about $500 million investment to be spread over 10-15 years instead of the 5-10 years if the systems had been amplified in isolation.

Consolidating biosolids treatment at Riverstone will:
- Accelerate energy generation so we achieve our targets 10 years earlier than planned.
- Protect critical community land and habitat for threatened flora and fauna from being used to amplify our assets.
INTEGRATED SYSTEM PLANNING TO SERVE GROWTH, SYDNEY, AUSTRALIA

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KEYWORDS
Wastewater, Integration, Biosolids Consolidation, Growth Servicing, Options, System Resilience, Process Intensification

EXECUTIVE SUMMARY
Western Sydney is experiencing rapid population growth through urban sprawl and high-density infill. In the north west, Castle Hill and Rouse Hill treatment plants require urgent amplification to accommodate this growth. An integrated system planning study was undertaken to determine an immediate amplification option to meet Sydney Water’s long term (30 year) servicing objectives in the region. The preferred solution was an integrated wastewater servicing approach across the three catchments. Key features include: inter-catchment transfer of sewage to leverage latent system capacity, stage treatment amplifications and improve system resilience; biosolids consolidation and resource recovery via inter-catchment transfer of liquid sludge. This solution will allow about $500 million investment to be spread over 10-15 years instead of the 5-10 years if the systems had been amplified in isolation. Setting correct boundaries to the analysis was the critical factor in identifying opportunity for system integration.

INTRODUCTION
Rapid urban development, spurred by land rezoning along the North-West Rail Link corridor has led to a rapid increase in the amount of wastewater generated in the North West of Sydney, Australia. The catchments of Castle Hill and Rouse Hill, through which the Rail Link is being constructed, have faced rapid population increases, and are projected to experience continued growth into the future. In addition, the adjacent catchment of Riverstone is expanding due to land being released for development, with the Riverstone Wastewater Treatment Plant (WWTP) currently in construction.

In 2017 Sydney Water Corporation engaged ENSure (a joint venture of GHD and Jacobs) to undertake an options study to identify the preferred approach to service the projected wastewater flows and loads. The options study objectives were:

- Stage investment to match growth.
- Leverage capacity and value of existing assets (treatment and network).
- Align short term investment with longer term strategic objectives including:
  - nutrient management in the Hawkesbury Nepean River
  - recovery of energy and nutrients
  - providing water for liveability (urban greening and residential recycling)
- Look for compatibility of land use, particularly biosolids processing.
- Assess innovative technology options, particularly for biological treatment

The project scope included the three wastewater systems of Castle Hill, Rouse Hill and Riverstone.

METHOD
The first task was to develop a Basis of Design document that described the key inputs to the project, including the population projections to be adopted for the study, design criteria to be used for sizing of treatment processes and the evaluation criteria to be adopted for comparing options.

The options for each plant were identified at a high level:

- Amplification of treatment plant capacity with conventional technology.
- Amplification of treatment plant capacity with alternate (high-rate) technology.
• Transfer sewage flows and loads in excess of the current capacity to a neighbouring catchment.
• Conversion from a raw sewage treatment facility to a settled sewage facility with additional treatment capacity.
• Consolidate biosolids treatment by transfer of sludge to a single treatment facility.

With three treatment plants to consider and several possible amplification stages over the 30-year project timeframe, there was an impractical number of feasible options. Hence the team focused on key questions that the project needed to answer.
• Is it better to amplify Castle Hill Water Recycling Pant (WRP) or limit inflow and transfer excess sewage flows and loads to the Rouse Hill catchment?
• Is it better to delay amplification of Rouse Hill WRP by temporary transfer of excess sewage flows and loads to the Riverstone catchment?
• What is the best way to amplify Rouse Hill WRP:
  o Conventional technology?
  o Alternate technology (high-rate)?
  o Conversion to a settled sewage facility?
• If Rouse Hill WRP is converted to a settled sewage facility, is it preferable to construct anaerobic digesters at Rouse Hill or consolidate biosolids treatment at Riverstone WWTP?

A short list of five options was developed, each of which was investigated in sufficient detail to allow comparison of the options against the evaluation criteria. This enabled the shortlisted options to be compared against each other on a range of quantitative and qualitative criteria, over the 30-year project timeframe.

RESULTS AND DISCUSSION
The preferred option included the following components:
• Transfer of sewage in excess of the capacity of the Castle Hill WRP to the Rouse Hill catchment via the existing sewer system. This allows time for credible results from the implementation of alternative treatment technology (InDense) trial at Castle Hill to be confirmed. It provides flexibility for various long-term strategies to be implemented, including amplification or decommissioning and consolidation with Rouse Hill.
• Temporary transfer of sewage from Rouse Hill WRP to the Riverstone catchment via a new (1.7km) rising main to connect to the existing sewer system. This makes best use of the treatment capacity that is currently being constructed at Riverstone, and delays capital investment at Rouse Hill WRP.
• The rising main used for the temporary transfer of excess sewage from Rouse Hill to Riverstone would be extended in the future as a dedicated sludge pipeline, directly connecting the two plants (10km). This facilitates the consolidation of biosolids treatment at Riverstone for the three plants. The current practice of transferring sludge from Castle Hill to Rouse Hill, via the existing sewer system, would be retained.
• The short-term amplification of Rouse Hill WRP would be based on conversion of Rouse Hill to a settled sewage facility. This requires the construction of primary treatment at Rouse Hill WRP, along with expanded tertiary treatment facilities. The raw sludge generated would be transferred to the biosolids treatment facility at Riverstone WWTP.
• The long-term amplification of Rouse Hill WRP could adopt either conventional or alternate technologies. Technologies that intensify the treatment capacity of the existing biological treatment processes, such as membranes, are preferred. Intensification will allow the plant to be amplified with minimal increase in footprint, avoiding expansion into an area of threatened ecological communities.

The preferred option provides many benefits, including reduced upfront capital investment and increased flexibility for the future. Providing a system that allows sewage to be transferred from one plant to another significantly increases the resilience of the entire system. The amount of sewage that is transferred can be changed to reflect the on-ground situation. For example, if a bioreactor at Castle Hill needs to be taken offline for replacement of the aeration diffusers, the amount of sewage that is transferred to Rouse Hill can be increased. This approach reduces the capital costs associated with providing treatment redundancy, compared to providing that redundancy at both plants.

Consolidating the biosolids treatment at one location reduces the need for providing redundancy at each of the three plants, reduces trucking and odour impacts and provides the economy of scale for technologies including cogeneration, thermal hydrolysis, and co-digestion. Advanced processing allows production of high grade products, renewable energy generation and in the case of co-digestion a new service offering and revenue stream.
CONCLUSION
The project identified several benefits of integrated system planning. The traditional servicing approach is to look at each catchment in isolation and to amplify each treatment plant based on growth within each catchment. An integrated approach can deliver benefits including improved system resilience, better use of latent system capacity, and more efficient system configuration. All of these outcomes translate to better customer outcomes, primarily through reduced bill pressure. This project is estimated to reduce investment over the next 20 years by about $20 million when compared to alternative options. The preferred option carries further opportunity for capital deferral due to the built-in flexibility for servicing growth across the catchments.