Agenda – Council – February 23, 2011

Report – Standing Policy Committee on Infrastructure Renewal and Public Works – February 14, 2011

Item No. 2 South End Water Pollution Control Center Design Criteria

STANDING COMMITTEE RECOMMENDATION:

On February 16, 2011, the Executive Policy Committee concurred in the recommendation of the Standing Policy Committee on Infrastructure Renewal and Public Works and submits the following to Council:

1. That the South End Water Pollution Control Centre (SEWPCC) be designed:

   A. For a future projected population of 270,000 people;
   B. To provide treatment removals based on a 30 day rolling or monthly average rather than on never-to-exceed daily limit;
   C. To include reduction of nitrogen in addition to ammonia.

2. That chemical reduction of phosphorus be considered an allowable process in the design.

3. The Proper Officers of the City be authorized to do all things necessary to implement the intent of the foregoing.

Report – Standing Policy Committee on Infrastructure Renewal and Public Works – February 14, 2011

DECISION MAKING HISTORY:

EXECUTIVE POLICY COMMITTEE RECOMMENDATION:

On February 16, 2011, the Executive Policy Committee concurred in the recommendation of the Standing Policy Committee on Infrastructure Renewal and Public Works and submitted the matter to Council.

STANDING COMMITTEE RECOMMENDATION:

On February 14, 2011, the Standing Policy Committee on Infrastructure Renewal and Public Works concurred in the recommendation of the Winnipeg Public Service and submitted the matter to the Executive Policy Committee and Council.

ADMINISTRATIVE REPORT

Title: **SOUTH END WATER POLLUTION CONTROL CENTER (SEWPCC) DESIGN CRITERIA**

Critical Path: **Standing Policy Committee on Infrastructure Renewal and Public Works – EPC – Council**

AUTHORIZATION

Author	Department Head	CFO	CAO
M. A. Shkolny, P. Eng. Manager of Engineering	B. D. MacBride, P. Eng Director of Water and Waste	M Geer A/CFO	M Ruta A/CAO

RECOMMENDATIONS

1) That the South End Water Pollution Control Centre (SEWPCC) be designed:

   a) For a future projected population of 270,000 people;
   b) To provide treatment removals based on a 30-day rolling or monthly average rather than on never-to-exceed daily limit;
   c) To include reduction of nitrogen in addition to ammonia.

2) That chemical reduction of phosphorus be considered an allowable process in the design.

REASON FOR THE REPORT

The Environment Act Licence for the SEWPCC that has been issued by the Province of Manitoba contains a number of compliance requirements. A few of the compliance requirements as discussed below under “Implications” specify a higher level of treatment on a daily basis which provides little additional benefit to the environment at a significant cost premium. It would be relatively unusual and costly to design a plant to meet these requirements. With the recommended design on a monthly average basis, there is a risk of enforcement action if the daily limits in the licence are exceeded.

Manitoba Conservation (the regulator) is well aware of our concerns with the limits and they are considering our arguments. However, the deadline for completion of upgrades

at the SEWPCC to achieve reductions in nitrogen and phosphorous is December 31, 2012. A final decision on these design parameters is required now so as to not delay further design and construction of the works required at the SEWPCC. For example, in absence of a final determination, treatment options for the SEWPCC are being developed based on the recommended design parameters. If we don't get approval to proceed on some basis, the work will just have to be stopped. There will be a significant loss of momentum and costs to demobilize and then remobilize once a decision is made. A lack of a decision will also impact the schedule further. We believe the above recommendations form a reasonable approach to moving forward.

IMPLICATIONS OF THE RECOMMENDATIONS

Design Population for Plant Expansion – 270,000

The selection of an appropriate design population for plant expansions is a major factor influencing size requirements, and associated capital and operating costs. A twenty-year design horizon is considered appropriate as the basis for the upgrades, and coincides with the year of 2031. A twenty year horizon balances the goal not to build in advance of utilization against the negative impact of too frequent construction on operations. Of course there is uncertainty in the timing to reach the design population. If growth occurs more rapidly than expected, the capacity of the facility will be exceeded sooner than 2031, and the plant will require expansion earlier than planned. Conversely, if growth does not materialize as quickly as forecast, there will be capital investment in a facility that is underutilized for more years than planned.

The city-wide population for Winnipeg was estimated at 652,000 in the year 2005 when the conceptual planning studies for the SEWPCC were first initiated. The current 2009 population for Winnipeg is estimated at 675,000 people based on 2007 Conference Board of Canada (CB) values and estimates provided by the City's Economist. The recent 2007 CB population growth forecast raised the city-wide population estimate from 754,000 to 855,000 people in the year 2031. The 2009 service area population for the SEWPCC was estimated at 190,000 people. The projected service area population for 2031 for the SEWPCC was revised based on the more recent 2007 CB population projections and now estimated to range between 260,000 to 280,000 people. Based on past, current, and projected housing starts in the SEWPCC service area, a population forecast of 270,000 is recommended for the 2031 SEWPCC expansion design.

A capital cost estimate of $203 Million was previously established in 2008 for the project based on conceptual level engineering for a 2031 population of 230,000 people. The estimated cost is based on August 2008 construction costs, and includes allowances for engineering (15%), contingencies (10%), estimating uncertainty (15%) and construction escalation (15%). Since 2008, the escalation related to a buoyant construction market has levelled and a 15% allowance may no longer be appropriate. A new capital cost for

enlargement of the SEWPCC expansion including nutrient removal will be prepared soon. Several treatment options are currently being reviewed for the SEWPCC and whole-life costs are being considered in that review. It is expected that as engineering proceeds further, a more accurate cost estimate will be available in late January or early February.

Use 30 day average for design rather than never-to-exceed daily limit

The operating licence issued for the SEWPCC by Manitoba Conservation contains compliance limits for ammonia (NH_3) and 5-day carbonaceous Biochemical Oxygen Demand ($cBOD_5$) in the effluent. The licence includes these limits as never-to-exceed values which are measured daily. This is more restrictive than in other jurisdictions where the limits are averaged over a month. The never-to-exceed daily limits for both of these parameters impose a higher level of treatment. Never-to-exceed daily limits impose both design and operation challenges as the plant must produce effluent of this quality every day under a wide range of flow conditions. The Department argued that plant performance in meeting the compliance limits should be determined based on a 30-day rolling or monthly average. Manitoba Conservation is still considering this request.

Reduction of $cBOD_5$ is required to protect the dissolved oxygen levels in the river to maintain a healthy environment for aquatic life under low river flow conditions. Previous river water quality investigations determined that the local rivers have robust assimilative capacity under low flow conditions and that reducing the load for either ammonia or $cBOD_5$ beyond a 30-day rolling or monthly average provides no measurable environmental benefit. More recent simulation modeling for 2031 conditions found that the $cBOD_5$ limit would only be exceeded on seven (7) occasions annually. Six (6) of these events were predicted to occur in the spring when the Red River is typically flooding and has its greatest assimilative capacity. For the majority of the time, effluent from the expanded SEWPCC will be better than that required in the licence.

It has been estimated that the cost to enlarge the SEWPCC facility expansion to comply with a “never-to-exceed” $cBOD_5$ limit would add approximately $60 million to the cost. Since the never-to-exceed $cBOD_5$ requirement provides no additional environmental benefit and will incur a $60 million cost premium, it is recommended that the 2031 SEWPCC design be based on meeting a 30-day rolling or monthly average for $cBOD_5$. The capital cost estimate of $203 Million previously developed assumed that performance would be based on a 30-day rolling or monthly average basis. On-going assessment of treatment options has assumed that the 30-day rolling or monthly average will be utilized.

Reduction of ammonia is required to protect aquatic life from chronic toxicity from prolonged exposure to ammonia in the treated effluent discharged to the river at low flows. The ammonia limits contained in the SEWPCC licence are derived by Manitoba

Conservation using a complex methodology developed by the United States Environmental Protection Agency (US EPA). The Department considers that the Province has inappropriately applied the US EPA scientific methodology resulting in overly stringent ammonia load limits in the Licences issued to Winnipeg. Manitoba Conservation took the monthly limit and divided by the days in the month and said that we must meet this on a daily limit. In reality, the aquatic life would not be impacted by a daily excursion within limits providing the monthly requirement was met. The misapplication of the EPA protocol by the Province results in an artificially low and overly protective criterion to protect aquatic life, which requires a larger design for the nitrification process to reduce ammonia concentrations with associated increased capital and operating costs.

The development of appropriate ammonia limits has been discussed at length with Manitoba Conservation but the licence limits have not been adjusted to address the City's concerns. The Department has also appealed the ammonia licence limits specified to the Minister of Conservation but has not received a response to this appeal. In the absence of favourable adjustment to the licence limits, it is recommended that the Department's interpretation of the US EPA scientific methodology be applied to the SEWPCC design which would consider limits specified to be monthly averages as opposed to "never-to-exceed".

Remove nitrogen to enhance ammonia removal

Certain prominent scientists have expressed that nitrogen removal from Winnipeg's wastewater treatment plants will have no benefit to quality of Lake Winnipeg and potentially could promote the growth of undesirable blue-green algae. The department agrees with this assessment. However, in this case, the reduction of nitrogen from the SEWPCC is estimated to be only about 360 tonnes per year, or less than 0.4% to the total nitrogen load to the lake, and does not make a significant difference to total quantity of nitrogen received by Lake Winnipeg.

Notwithstanding the limited benefit to the lake, previous analyses have estimated that beyond a certain level of ammonia removal, that is, greater than about 60%, in concert with phosphorus removal, it becomes more cost-effective from a whole-life cost standpoint to implement a full biological nutrient reduction (BNR) process that reduces nitrogen as well because of the benefit associated with alkalinity and oxygen recovery through the denitrification process. If full BNR was not provided, additional air blower capacity and chemical addition to adjust alkalinity would be required resulting in more expensive capital, and operating and maintenance costs. Based on the assimilative capacity of the Red River at the point of discharge from the SEWPCC, about 66% of the total ammonia load needs to be removed to protect aquatic life from chronic toxicity under low river flow conditions to achieve compliance. In this case, economics favour that full BNR (that is including nitrogen reduction) be incorporated for the design of the SEWPCC expansion. Although, as stated above, there is some concern in general that removing nitrogen could promote the growth of undesirable blue-green algae, given the

very small amount in this case; the fact that the environmental licence requires nitrogen removal; the need to move on with construction; and the economics, it is recommended that the nutrient removal process design for the SEWPCC allow the incidental removal of nitrogen to permit the most cost-effective approach to achieve compliance with ammonia and phosphorus license limits.

The situation at the North End Water Pollution Control Centre (NEWPCC) is very different and nitrogen removal at that facility will significantly increase the cost of treatment. With the addition of Centrate treatment at the NEWPCC in 2008, the effluent for the NEWPCC has met prescribed ammonia limits during the most restrictive months in both 2009 and 2010. Therefore nitrogen reduction is not required at the NEWPCC for ammonia compliance. A separate report will be developed on NEWPCC design criteria.

Chemical Reduction of Phosphorus

There is general agreement that phosphorus removal from Winnipeg's wastewater treatment plants will positively benefit Lake Winnipeg. Compliance with the phosphorus limits contained in the Licenses for all three of Winnipeg's wastewater treatment plants would reduce the annual phosphorus load to Lake Winnipeg by about 4% or 300 tonnes per year. The reduction of phosphorus from the SEWPCC is estimated to be about 70 tonnes per year, or about 1% of the total phosphorus load to the lake. Scientific studies on freshwater lakes found that reduction in phosphorus loading to the lake limited the growth of algae, especially undesirable blue-green algae when nitrogen is in short supply in the water. As such, to protect Lake Winnipeg from undesirable blue-green algae phosphorus should be removed.

A second issue with phosphorus is its importance as a natural resource. Scientific studies suggest that readily available rock phosphorus (the raw material for phosphorous in fertilizers) is being depleted on global scale and will begin to negatively impact future food crop production and food supplies in as little as 30 years. Phosphorus is an essential element required for plant growth. Recovery of phosphorus from wastewater will become increasingly important. Technologies for recovery of phosphorus from wastewater are relatively new but are the subject of intense interest. An example of this recent technology development is a Canadian company *"Ostara Nutrient Recovery Technologies Inc."* that claims to have developed a process to recover phosphorus. Their website lists four commercial installations including one in Edmonton.

Phosphorus can be removed from wastewater by chemical means or by biological processes. Chemical treatment using metal (i.e. iron or aluminum) salts is by far the most used process throughout the world to precipitate phosphorus from wastewater. In fact, this process is being used now to reduce phosphorus on a side stream at the NEWPCC. However, phosphorus removed chemically is bonded with its metal counterpart and is no longer a bio-available source of phosphorus for plant growth – so

it cannot be used as a fertilizer. Phosphorus that is removed biologically can be transformed into a state that can be later reused as plant fertilizer using an add-on process like Ostara for example. There has been a preliminary indication from the Clean Environment Commission that they might recommend that only processes that recover phosphorus be permitted and Provincial officials have also expressed support for this approach.

We recommend that design options that include chemical removal of phosphorus be included for consideration at the SEWPCC because:

- It is not prohibited in the current licence issued by Manitoba Conservation;
- It allows the design team to consider a lower capital cost option for nitrogen removal than the process used at the WEWPCC;
- Even if we removed phosphorus biologically at the SEWPCC, the current biosolids treatment configuration at the NEWPCC results in it being chemically bound in any case; and
- Phosphorus recovery will be considered during the evaluation of design alternatives at the NEWPCC where a larger amount of phosphorus is available.

The description of the final treatment scheme selected will need to be submitted to the Province for review as a requirement of the regulatory licence.

HISTORY

- Licences have been issued by Manitoba Conservation that specify effluent limits for the City's three pollution control centres.

- In March 2009, The Manitoba Clean Environment Commission (CEC) released its report titled: *An investigation into nutrient reduction and ammonia treatment at the City of Winnipeg's wastewater treatment facilities.* The report recommended that nitrogen removal be required.

    - A letter to the CEC signed by 60 scientists urged the CEC to focus on phosphorus not nitrogen.
    - The Water and Waste Department had met with the CEC agreeing with scientists that phosphorous removal is key to reducing algal blooms.

- In response to the letter from the Mayor of Winnipeg of October 7, 2009 to the Minister of Conservation, a request has been made of the Clean Environment Commission to review this proposal regarding ammonia limits and nitrogen removal from wastewater and provide the Minister of Conservation with advice.

    - Accordingly the Department again met with the CEC from January to March 2010 to provide information to facilitate their deliberations.

    - If the City was not required to remove nitrogen and the ammonia limits were as requested by the City, the savings in capital cost would be in the order of $350 million at the North End plant.
    - The City is awaiting the results of the CEC review and a response from the Minister of Conservation.

- The process selection for the SEWPCC is in final stages of development.

FINANCIAL IMPACT

Financial Impact Statement **Date:** 26-Jan-11

Project Name:

SOUTH END WATER POLLUTION CONTROL CENTER (SEWPCC) DESIGN CRITERIA

COMMENTS:

There is no financial impact associated with these recommendations as these are the capital improvements included in the department's capital budget and ten year rate projections.

"original signed by Darlene Capp, C.G.A."
Darlene Capp, C.G.A.
Acting Manager of Finance and Administration

CONSULTATION

In preparing this report there was consultation with:

N/A

SUBMITTED BY

Water and Waste Department
Engineering Division
Prepared by: Nicholas T. Szoke, P. Eng
Date: January 26, 2011
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