Assessing the Need to Treat Winnipeg’s Water Supply

Presented to
Standing Policy Committee on
Public Works
October 31, 2000
Why Do We Need Water Treatment?

- Water treatment is about protecting Public Health

- “The rationale for construction of a water treatment plant is based primarily on health concerns” …. Dr. Margaret Fast

- “Providing water that is safe and healthy to drink” received the highest priority …. March 1999 Customer Survey
Why Is Water Treatment Being Considered Now?

- To reduce the risk of waterborne disease outbreaks caused by chlorine-resistant microorganisms
- To reduce the existing levels of chlorinated disinfection by-products
Since 1919, Winnipeg has enjoyed a high quality reliable water supply from Shoal Lake
- minimal treatment (chlorine for disinfection prior to 1937, and fluoride for dental protection since 1956)

In 1993 Council
- Accepted the recommendation to undertake water treatment within a ten year time frame
- And established a Water Treatment Reserve

Between 1995 and 1999 a comprehensive program of monitoring, pilot testing and engineering studies was undertaken
Public Consultation

• “Should Winnipeg Build a Water Treatment Plant?” …an eight page brochure was widely circulated

• Special Meetings of Executive Policy Committee (EPC) were held October 21 and 28, 1999

• The public provided 32 written and oral submittals at the EPC Special Meetings
  - 20 “In Support”
  - 6 “In Opposition”
  - 6 “For Information”
The rationale for construction of a water treatment plant is based primarily on health concerns and it is for this reason that I offer my support for this request.” — Dr. Margaret Fast

“The Medical Officer of Health for Environmental Health agrees with the City of Winnipeg plan to construct a water treatment plant.” — Dr. Jim Popplow
International Specialists

- Dr. J. Rose - University of Florida
- Dr. E. Nieminski - State of Utah
- Dr. G. Finch - University of Alberta
- Dr. B. Bellamy - CH2M Hill, Denver, Colorado

Manitoba Public Health Representatives

- Dr. Guilfoyle - Manitoba Medical Officer of Health
- Dr. J. Blanchard - Provincial Epidemiologist
- D. Rocan - Manitoba Environment

City of Winnipeg Public Health Representatives

- Dr. M. Fast - City of Winnipeg Medical Officer of Health
- Dr. S. Harlos - Deputy Medical Officer of Health
Workshop Conclusions

- LOW RISK

- HIGH CONSEQUENCE

The Experts’ Opinion:

- “The implementation of comprehensive water treatment for the Shoal Lake water supply system is considered to be justified from the public health perspective”
High Consequence

- Public confidence in municipal tap water is a valuable asset (and easily lost)

- Significant consequences result from a waterborne disease outbreak:
  - illness and loss of life
  - liability
  - loss of public confidence
Shoal Lake

**AQUEDUCT**

- slime
- zebra mussels
- taste & odour

**Chlorine:**
- disinfection
- taste & odour

**Shoal Lake**

**INTAKE & AQUEDUCT**

- long contact time for chlorine
- good for disinfection
- formation of disinfection by-products

**DEACON RESERVOIR**

- open reservoir
- staging area in fall for waterfowl

**Chlorine:**
- disinfection
- taste & odour

**Source**

- large isolated lake
- 500 people live nearby
- about 1200 cottages
- high in natural organic matter

**DISTRIBUTION SYSTEM**

- formation of disinfection by-products

**3 REGIONAL DISTRIBUTION RESERVOIRS & PUMPING STATIONS**

- disinfection
- taste & odour

**Customers**
Drinking Water Quality Regulation

• Unlike the USA, Canada sets guidelines rather than standards

• Provinces are responsible for regulation of drinking water

• Manitoba regulates under The Public Health Act
  – Minister issues certificates
  – Canadian guidelines used as reference for quality requirements
Regulatory Trends

• In USA, water quality is regulated nationally under the *Safe Drinking Water Act*

• Trend in the USA is for increasing stringency in water quality standards and guidelines to protect public health

• Canada is following this trend, ie. new Ontario Regulations
Waterborne Pathogens

- Chlorine is effective against bacteria and viruses

- Chlorine is relatively ineffective against *Giardia* and requires high doses and long contact times

- Chlorine is not effective against *Cryptosporidium*
Disinfection By-Products (DBPs)

- Formed as a reaction between chlorine and natural organic matter in the water

- Objectives for DBPs and waterborne pathogen control are in conflict
  - more disinfection, better pathogen kill
  - more disinfection, higher DBPs

- Research has identified an association between DBPs and illness

- The DBP guidelines in Canada have become much more stringent; the US continues to lower allowable concentration levels
Taste, Odour and Appearance

- Public confidence in tap water is strongly influenced by taste and odour

- Unpleasant taste and odour from algae are a frequent summer occurrence

- 41% of customers are not satisfied with how their water looks and tastes
Process Selection

- Goals and criteria for potable water in Winnipeg were developed

- A flexible evaluation model for evaluating alternative treatment technologies was developed

- Comprehensive testing program was conducted over 18 months

- Most cost effective approach to achieving water quality goals was selected

- A conceptual design for the preferred (base-line) “state-of-the-art” water treatment plant was completed
Chlorine:
- disinfection
- slime
- zebra mussels
- taste & odour

Customers

• removes and inactivates pathogens
• lower DBPs
• provides protection for contingency events
• improves taste & odour

The Addition of Treatment Facilities Reduces Health Risk
Water and Waste Department

City of Winnipeg
Water Treatment Plant
(Conceptual Design)
RECOMMENDED TREATMENT PROCESS

1. RAW WATER STORAGE TANK
2. MIXING / FLOCCULATION TANKS
3. DISSOLVED OXIDATION TANKS
4. OZONE CONTACTORS
5. BIOLOGICAL ACTIVATED CARBON FILTERS
6. DISINFECTION FLUORIDATION CORROSION CONTROL
7. TREATED WATER STORAGE
## Water Quality Targets Using the Recommended Treatment Process

<table>
<thead>
<tr>
<th>Treatment Goal</th>
<th>Specific Parameter</th>
<th>Typical Winnipeg Drinking Water Quality</th>
<th>Canadian Guidelines</th>
<th>Water Quality Goals</th>
<th>Pilot Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear water</td>
<td>Turbidity (NTU)</td>
<td>0.3 – 2.6</td>
<td>&lt; 1.0</td>
<td>&lt;0.1</td>
<td>0.04 - 0.08</td>
</tr>
<tr>
<td>DBP control</td>
<td>TTHMs (µg/L)</td>
<td>112</td>
<td>100</td>
<td>100 (40)</td>
<td>&lt;100 without GAC, &lt;30 with GAC</td>
</tr>
<tr>
<td></td>
<td>THAAs (µg/L)</td>
<td>86</td>
<td>NG</td>
<td>NG (30)</td>
<td>&lt;30 with BAC</td>
</tr>
<tr>
<td>Taste and odour control</td>
<td>TON (threshold odour number)</td>
<td>10 - &gt;200</td>
<td>Aesthetic</td>
<td>&lt;10</td>
<td>TON &lt;10 (year-round)</td>
</tr>
</tbody>
</table>
New Technologies being Considered

• Ultraviolet Light Disinfection
  - may be an effective alternate for control of *Giardia* and *Cryptosporidium* for unfiltered surface water
  - potential to reduce capital and operating costs

• Membrane Filtration
  - proven as an effective barrier to *Giardia* and *Cryptosporidium*
  - membranes are becoming more cost competitive
## What is the Construction Cost?

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction costs (2000 $)</td>
<td>$149.0 Million</td>
</tr>
<tr>
<td>Contingency</td>
<td>$ 14.9</td>
</tr>
<tr>
<td>Inflation allowance</td>
<td>$ 11.0</td>
</tr>
<tr>
<td>Engineering - Design &amp; Contract Admin. - spent to-date</td>
<td>$ 22.6</td>
</tr>
<tr>
<td>Finance and Administration</td>
<td>$ 3.0</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
</tr>
<tr>
<td>- Alternate Service Delivery Study, Risk Assessment, Environmental</td>
<td></td>
</tr>
<tr>
<td>Hearings/Approvals</td>
<td>$ 1.0</td>
</tr>
<tr>
<td><strong>Total Estimated Cost</strong></td>
<td><strong>$204 Million</strong></td>
</tr>
</tbody>
</table>
What is the Operating Cost?

- Power/Natural Gas: $1.5 Million
- Chemicals/Consumables: $4.0
- Operating Staff: $0.7
- Residuals Management: $0.6
- Plant Maintenance: $1.4
- Inflation Allowance: $1.8
- Taxes: $2.0

**Total Annual Estimated**

$12 Million (2006)
Financial Plan

- In 1993, Council approved a 10-year plan to finance and construct a water treatment plant.
- The 10-year plan provides capital and operating cost for water treatment.
- Water treatment will not cause rates to increase beyond current levels.
## Water and Waste Department

### Water Treatment Reserve Fund

#### Capital Expenditure and Financing Plan

<table>
<thead>
<tr>
<th>Year</th>
<th>CAPITAL EXPENDITURE</th>
<th>BLOCK 1 WATER RATE (per hcf)</th>
<th>FINANCING</th>
<th>BALANCE, END OF YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reserve Fund</td>
<td>Debt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rate per hcf</td>
<td>Annual Contribution</td>
</tr>
<tr>
<td>1994</td>
<td>0</td>
<td>$1.55</td>
<td>$0.07</td>
<td>1,503</td>
</tr>
<tr>
<td>1995</td>
<td>240</td>
<td>$1.70</td>
<td>$0.13</td>
<td>3,435</td>
</tr>
<tr>
<td>1996</td>
<td>977</td>
<td>$1.89</td>
<td>$0.02</td>
<td>1,287</td>
</tr>
<tr>
<td>1997</td>
<td>533</td>
<td>$2.10</td>
<td>$0.02</td>
<td>904</td>
</tr>
<tr>
<td>1998</td>
<td>362</td>
<td>$2.32</td>
<td>$0.40</td>
<td>9,640</td>
</tr>
<tr>
<td>1999</td>
<td>261</td>
<td>$2.54</td>
<td>$0.42</td>
<td>12,024</td>
</tr>
<tr>
<td>2000</td>
<td>2,500</td>
<td>$2.70</td>
<td>$0.44</td>
<td>11,318</td>
</tr>
<tr>
<td>2001</td>
<td>3,000</td>
<td>$2.75</td>
<td>$0.44</td>
<td>11,477</td>
</tr>
<tr>
<td>2002</td>
<td>6,127</td>
<td>$2.75</td>
<td>$0.46</td>
<td>11,986</td>
</tr>
<tr>
<td>2003</td>
<td>26,000</td>
<td>$2.78</td>
<td>$0.59</td>
<td>15,157</td>
</tr>
<tr>
<td>2004</td>
<td>84,000</td>
<td>$2.82</td>
<td>$0.47</td>
<td>12,530</td>
</tr>
<tr>
<td>2005</td>
<td>80,000</td>
<td>$2.83</td>
<td>$0.44</td>
<td>10,739</td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>204,000</strong></td>
<td></td>
<td><strong>102,000</strong></td>
<td><strong>102,000</strong></td>
</tr>
</tbody>
</table>
Rate Adjustments Without Treatment

• If Council decides not to proceed with treatment:
  
  - decrease in the combined water and sewer rate of about 18% from 1999 rates spread over the next 4 to 6 years
Proposed Water Treatment Program Schedule

- **2000:**
  - Decision to proceed
- **2000-2003:**
  - Consider new treatment technologies
  - Alternative services delivery study
  - Environmental/regulatory approval studies
  - Risk assessment/cost reviews
  - Facility design
  - Tendering process
- **2004-2006:**
  - Construction
- **late 2006:**
  - Commissioning/Operation
Conclusion

- The risk of a waterborne disease outbreak is low but the consequences are high

- Long-term exposure to disinfection by-products are associated with cancer

- The present system does not meet all water quality guidelines

- Treatment plant will cost about $204 M to build and $12 M/yr to operate (2006 dollars)
Recommendations

1. The City proceed with treatment of the water supply as described in the report

2. Design and construction activities be undertaken so that the water treatment plant be operational in the year 2006

3. The water treatment process, as identified through the pilot testing, be adopted as a baseline process for comparison to alternatives and new technologies
Recommendations cont’d

4. The Administration:
   – Investigate and report on new technologies such as ultraviolet disinfection and membranes
   – Investigate and report on alternative project delivery strategies
   – Prepare documents in support of any application by Council for Federal and Provincial funding
What Would Water Treatment Do For Winnipeg?

- Helps protect against outbreaks from parasites such as *Cryptosporidium* and *Giardia*
- Allows us to reduce the amount of chlorine added to the water supply
- Allows us to meet evolving *Guidelines for Canadian Drinking Water Quality*
- Supports the long-term health and well-being of our community