



GVRD Regional Utility Planning

**Standardized ICI Water Audit
Process Final Report**

Prepared by:

Stantec Consulting Ltd.
1007, 7445 – 132nd Street
Surrey, BC V3W 1J8

Contact:

Raymond Chin, P.Eng.
Tel: 604.597.0422
rchin@stantec.com

May 2006

111700191



Stantec

This report was prepared by Stantec Consulting Ltd. for the Greater Vancouver Regional District. The material in it reflects our best judgment in light of the information available to us at the time of preparation. Any use which a third party makes of this report, or any release of or decisions made based on it, are the responsibilities of such third parties. Stantec Consulting accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.



Greater Vancouver Regional District Standardized ICI Water Audit Process

Consulting Team Contacts

Larry Sawchyn lsawchyn@stantec.com

Raymond Chin rchin@stantec.com

Mary O'Brien maobrien@stantec.com

GVRD Water Utilities Planning Contacts

Stan Woods stan.woods@gvr.bc.ca

Lisa Mirfatahi lisa.mirfatahi@gvr.bc.ca



Executive Summary

The cost of potable water within the GVRD is rising significantly due to increasing water treatment costs and new infrastructure costs to service increasing water demands. The GVRD desires to defer capital expenditures by encouraging water conservation.

Industrial Commercial and Institutional (ICI) customers use large volumes per site in comparison to residential users. The GVRD commissioned Stantec Consulting to study the effectiveness of utilizing a standardized water audit template for demand management among ICI customers. The tasks taken were to develop a standardized water audit template, refine the template in consultation with the GVRD, complete four complementary pilot audits and prepare a report to the GVRD on the results of the program. In addition, detailed reports are submitted in confidence to the ICI customers who participated in the pilot study.

Water audits are classified into level 1, 2, or 3 depending on the degree of detail. The classification system comes from energy auditing industry norms and the work of Natural Resources Canada. This assignment deals with level 1 audits (walk-through scoping level).

Successful water auditing requires an audit team that has a suitable level of experience and competency. The report discusses the technical knowledge and skills required in the audit team. A blank audit is appended to the report. The report provides instruction on the use of the audit template. The audit process steps are discussed from pre-audit checklist through to the final report to the ICI customer.

The time required to conduct the audits was tracked. The cost of the pilot audits typically ranged from \$3,500 to \$5,000. The cost data collected from the pilot audits fall within the range expected based on Stantec's previous experience in energy and water audits.

The report also discusses the lessons learned from the pilot audits. In summary, the standard audit process is an effective tool in identifying water conservation opportunities among ICI customer facilities. ICI facilities that already have an established program of water use monitoring may be more interested in proceeding to a more detailed level of audit. Further study is required to determine what, in general, is the expected value of level 1 audits throughout ICI facilities in the GVRD.

The final section of the report discusses 'next steps' to consider in pursuing water conservation among ICI customers. It recommends an 'Integrated Demand Side Management' approach. Water auditing is one component of Integrated Demand Side Management.



Table of Contents

1.0	INTRODUCTION.....	1
2.0	WATER AUDIT PROTOCOL.....	3
2.1	THREE LEVELS OF AUDIT DETAIL	3
2.2	WATER AUDIT TEMPLATE	4
3.0	WATER AUDIT TEAM QUALIFICATIONS	5
4.0	USE OF A STANDARD WATER AUDIT TEMPLATE.....	6
5.0	PILOT TESTING OF A STANDARD WATER AUDIT TEMPLATE.....	9
5.1	WATER AUDIT TIME & COST REQUIREMENTS FROM PILOT AUDITS	10
5.2	WATER AUDIT COSTING DATA FROM PAST EXPERIENCE	11
5.3	LESSONS LEARNED FROM PILOT WATER AUDITS	12
5.3.1	Usefulness of Standardized Audit Template	12
5.3.2	Value of Level 1 Audits to ICI Facilities Pilot Tested	12
5.3.3	Limited Awareness of Water Rate Increases	13
5.3.4	Utilize Expertise of Staff at Audit Facilities	14
5.3.5	Incentives to Reduce Water Consumption	14
5.3.6	Alternate Sources of Process Water	14
5.3.7	Sewer Charges.....	15
5.3.8	Domestic Plumbing Fixtures.....	15
5.3.9	Water Cooling Systems	15
5.3.10	Standardized Water Utility Records.....	16
5.3.11	Opportunities for Water Conservation by ICI Customers	16
5.3.12	Confidentiality.....	16
6.0	NEXT STEPS.....	17
6.1	VALUE OF AUDITS	17
6.2	RECOMMENDATIONS TO THE GVRD	19
Appendix A Standard Level 1 Water Audit Template		

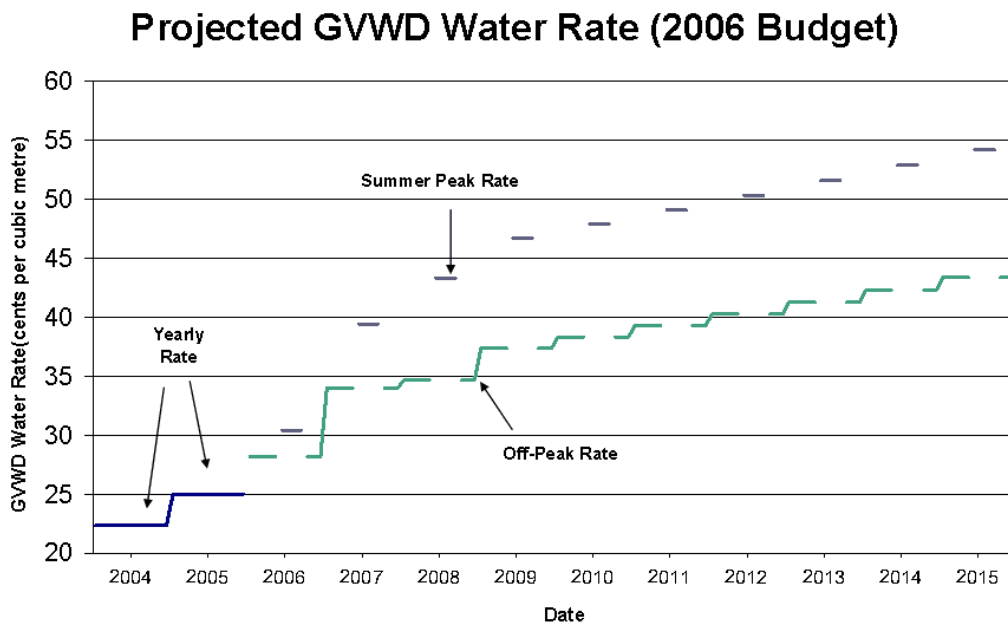


1.0 Introduction

Water rates within the GVRD are currently among the lowest in North America. However, the costs of constructing and operating the Seymour-Capilano Water Filtration Plant will push up these rates significantly over the next decade. The filtration plant is needed to meet new Canadian Drinking Water Guidelines and will improve the quality of the region's drinking water.

In 2005, an average single family home in Greater Vancouver paid \$240 in drinking water. Of this, about \$110 covered the cost of municipalities purchasing water from the GVRD. The rest, about \$130, covered the municipal costs of providing water services. For single family homes, the average amount spent each year on drinking water is expected to rise from the current \$240 to about \$298 by 2008 (a 24% increase relative to 2005) and to about \$335 by 2014 (a 40% increase relative to 2005). Businesses and other water consumers are also expected to face similar increases over the same period, with increases of about 24% by 2008 and about 40% by 2014 relative to 2005 costs. Figure 1 shows the GVRD's projected water rate increases over the next ten years.

Figure 1: Projected GVRD Retail Water Rates to Member Municipalities



In an effort to defer construction expenditures for new infrastructure and help keep potable water costs low for all users, the GVWD is assessing opportunities to reduce water demand. There are a number of demand-side management initiatives being pursued, one of which is water auditing.

Water audits are an effective way of determining the water uses and efficiency of Industrial, Commercial, and Institutional (ICI) facilities. Audit data collected from operations records can



Greater Vancouver Regional District Standardized ICI Water Audit Process

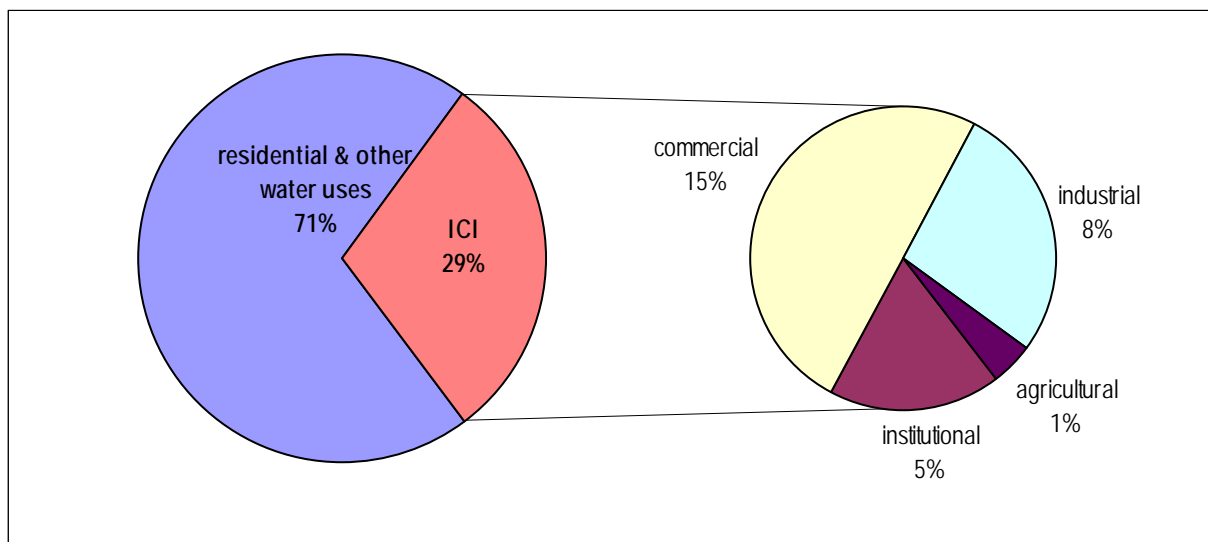
provide relatively accurate information of the facility's water-efficiency performance to develop a facility-specific water budget over the course of the year. The custom water budget acts as a baseline for the water user from which conservation opportunities can be calculated and savings measured.

Within the GVWD serviced municipalities, ICI customers in the sector represent roughly 29% of the total billed urban water demand (see Figure 2). Given the large water volumes consumed per site in comparison to residential customers, there are potential opportunities for considerable water savings. For ICI customers with large facilities or water intensive processes, water efficiency measures can yield significant water and sewer utility savings, often with the added benefit of energy and process chemical savings.

The GVRD commissioned Stantec to develop a water auditing protocol for the ICI sector and evaluate the usefulness of a standardized audit for water conservation by pilot testing the audit process on four ICI facilities. This report describes the standardized water audit template, provides information about the use of the tool, reports on lessons learned and cost data from pilot audits. The final sections of the report reflect on the lessons learned and the value of water auditing as a component within a regional water demand-side management program.

Due to confidentiality agreements with the GVRD and ICI customers, the completed audits are provided to the ICI customers only, and not included in this report.

Figure 2: Reported 2001 Water Use in the GVRD System ¹



¹ Source: GVRD Policy and Planning Department Report: Water, GVWD and Municipal Water Demand by Sector, March 2005



2.0 Water Audit Protocol

A water audit is a systematic approach to collecting information about water flows coming into the facility, the water uses and processes within the facility, and wastewater outputs. Audits can be classified as level 1, level 2 or level 3. Each increasing level represents increased detail. This classification system comes from Energy Auditing industry norms, which have evolved from work by Natural Resources Canada and consultants across Canada.

2.1 THREE LEVELS OF AUDIT DETAIL

Level 1: Scoping

A level 1 water audit is a walk-through type audit in which the audit team completes a systems analysis of the facility water consumption and develops a rough baseline of water uses and requirements in terms of quality, quantity, and seasonal variation. The level 1 audit is designed to act as an efficient and effective tool to identify and prioritize water conservation opportunities. The level 1 water audit report provides sufficient documentation to proceed with an in-house water conservation program and/or identify areas where more detailed investigation is required.

The following table provides an example of the content and depth of a level 1 investigation.

Table 1: Example of Depth Provided in a Water Conservation Measure from a Level 1 Audit Report

Water Conservation Measure	Water Conservation Measure Description
Leak Repair	Fix leak in 2-inch overhead water supply pipe in kiln room which was noted during the site visit to leak continuously.

Level 2: Scoping with In-depth Assessment in Some Areas

The level 2 water audit is somewhat of a custom audit with the scope defined by the client and the audit team. A level 2 audit consists of a level 1 audit for the whole facility and a level 3 (see below) depth audit for specified items.

The level 2 Water Audit is recommended for facilities with an existing water conservation program where plant managers have already identified problem areas that the audit team is directed to focus their expertise upon.

This might occur, for example, when a facility manager has implemented an aggressive water fixture upgrade and leak detection program, but is aware of an extremely high demand and low water efficiency in a once-through cooling system. The facility manager might want to complete



a detailed assessment on a cooling system upgrade in addition to the scoping assessment of conservation opportunities for the whole facility.

Level 3: In-depth Assessment in All Areas

A level 3 water audit provides the client with an in-depth report summary of all water consumption with engineering calculations documenting feasible water conservation opportunities. Level 3 auditing is typically performed when the facility manager has the desire and budget to obtain a complete evaluation of facility water use and a detailed evaluation of payback associated with conservation measures. The following table provides an example of the content and depth of a level 3 investigation.

Table 2: Example of Depth Provided in a Water Conservation Measure from a Level 3 Audit Report

Water Conservation Measure Description				Annual Utility Savings				Capital Cost (\$)	Payback Period (yrs)
	Water Savings	Sewage Savings	Energy Savings	water (\$/yr)	sewer (\$/yr)	energy (\$/yr)	Total (\$/yr)		
	(m ³ /yr)	(m ³ /yr)	kWh or GJ						
Recycle spent cooling water for wire washing	10,000	10,000	n/a	\$3,000	\$6,000	\$0.00	\$9,000	\$20,000	2.2

2.2 WATER AUDIT TEMPLATE

The audit team, in consultation with GVRD staff, developed a water audit template for the Industrial, Commercial, and Institutional sector. The audit team used the audit template as a field tool during the onsite audit investigations.

The template acts as a checklist to guide the user to collect the information appropriate to the level of audit being carried out. In general, a standardized audit template is most useful for a level 1 walk-through scoping study. Where level 2 or 3 audits are required, a higher level of customization of data collection will be required than can be provided completely with a standardized template. The specifics of the information required will depend on the system(s) under detailed review. For illustrative purposes, the standard template (see Appendix A) includes examples of information that may be required for higher-level audits.

Use of the water audit template assumes that professionals with the appropriate working knowledge of water systems, water management, and water conservation measures will complete the audit. Recommendations on audit team qualifications are discussed in the next section.



3.0 Water Audit Team Qualifications

The use of the water audit template requires a suitable level of experience and competency by the audit team. The team must have sufficient understanding and field experience to collect the data and to make and prioritize recommendations for water savings measures. For higher-level audits, the team requires expertise to determine the economic and practical feasibility of proposed recommendations. This includes engineering calculations and preliminary design work in order to develop a business case for the proposed water savings measures.

The areas of knowledge required to undertake audits could vary significantly depending on the business of the audit customer. For example, the water uses and operational requirements vary widely between schools, hospitals, greenhouses, or heavy industry/manufacturing facilities.

In general, the audit team needs to have technical knowledge about systems and unit processes along with knowledge of industry best practices in order to evaluate the water use efficiency. The team will also require the skill and experience to gather a thorough understanding of the facility's infrastructure, operation, philosophy and future plans. The audit team should also have knowledge of and experience with the following subjects:

- Process engineering optimization
- HVAC systems efficiency measures
- High efficiency plumbing fixtures
- Greywater systems
- Rain or storm water capture and reuse systems
- Decentralized and alternative wastewater treatment systems
- Heat pumping for waste heat extraction / cooling
- Water efficiency programs targeting behavioral change through education and awareness.
- Local regulations and codes governing water use, water using equipment, and water discharges.
- Funding opportunities or incentive programs such as green building grants, city-specific rate adjustments for onsite water reuse or wastewater treatment, or water and energy inter-related retrofit assistance programs.



4.0 Use of A Standard Water Audit Template

The standard water audit template provides a logical progression to obtain the information required to complete a water systems analysis for ICI facilities. The following paragraphs provide an overview of the steps associated with the audit process using the template.

Step 1: Pre-Audit Information Collection

After obtaining written agreement to work with the audit client, the audit team will gather background information on the facility including:

- water and sewer consumption/flows & billing history
- water and sewer rate structures
- facility/process drawings, schematics, reference materials
- confirm on-site contact to assist audit team during site visit

Step 2: Initial Onsite Discussion

Once arriving onsite, the auditor typically spends some time with the facility manager or appointed personnel to review the activities onsite, operating schedules, and general corporate philosophy on water management. During this time, the audit team will collect general information on the following:

- overview of facility activities, processes, and schedules
- philosophy on water management
- past and current measures in water conservation and monitoring programs

Step 3: Water Systems Analysis

The auditing template guides the user during the walk-through of the facility to provide identification and analysis of the water systems including:

- domestic water uses
- HVAC water consumption
- process water uses
- exterior water uses



The audit template will encourage the auditor to draw out information from site review and discussion with knowledgeable/technical plant staff on:

- water quality requirements
- inefficiencies and leaks
- excessive water pressure
- alternative onsite water sources
- seasonal variations
- opportunity for water treatment and reuse or direct reuse
- need for education and behaviour-oriented conservation initiatives

Step 4: Annual Water Balance

With the data collected, the team can generate a water balance for the facility and site quantifying all sources and releases of water and flows through various fixtures, equipment, and processes. In addition, an analysis of the water quality required for each use will be noted. The following table illustrates an example of what a water budget might look like for a manufacturing facility with some office spaces.

Table 1: Sample Water Budget for a Manufacturing Facility

Water Use Area	Quantity	Quality Required
	Level 1 Audit (m ³ /yr or % of total)	(potable vs. non-potable)
Domestic (faucets, toilets, showers)	20%	potable and non-potable water
Process Water Use	20%	non-potable water
HVAC Systems	35%	potable water
Once-through Cooling	10%	potable or non-potable water
Kitchenette Dishwasher	1%	potable water
General Cleaning	2%	potable water
Drip irrigation system	7%	non-potable water
Leaks	5%	n/a
Total Facility (Indoor & Outdoor)	100%	



Greater Vancouver Regional District Standardized ICI Water Audit Process

Step 5: Brainstorm of Water Conservation Opportunities

The audit template will lead the user to identify measures to conserve potable water use as described above. Once a list of conservation measures is generated, it is beneficial for the audit team to review and discuss these ideas with the facility manager or appropriate staff during the site visit. This discussion is invaluable to provide feedback on the viability of the concepts, determine whether any of these ideas have been attempted before and draw out any additional site-specific considerations.

Step 6: Water Audit Report

The audit consultant will complete and submit to the client a report summarizing the information collected during the audit and water conservation measures proposed. The depth of analysis provided in the audit report will depend upon the level of audit undertaken, as described previously (level 1 to 3).



5.0 Pilot Testing of A Standard Water Audit Template

In order to test and refine the water auditing process, the consulting team conducted four complementary water audits in the following municipalities served by the Greater Vancouver Water District:

- District of Maple Ridge
- City of Surrey
- City of Coquitlam
- Township of Langley

In consultation with the GVRD and member municipalities, the specific audit clients were selected based on the following criteria:

- Listed among of the highest water users within each member municipality
- Diversity in water use (i.e. Variety of ICI client water usage)
- Willingness to participate

The selected facilities included a metal manufacturing plant, a chemical manufacturing plant, a public aquatic centre, and a horticultural nursery.

The developed audit template was tested for its effectiveness as an auditing tool in leading the auditor to collect specific information required to assess and quantify conservation opportunities at various facilities. Due to time and budget constraints on this project, Stantec, in consultation with the GVRD, limited the pilot audits to level 1 audits.

The time required to conduct the audits and costs associated with that was tracked and reported in a section 5.1. Section 5.2 provides cost data extrapolated from Stantec's past experience with energy and water auditing. Section 5.3 discusses lessons learned from the pilot trials. The completed audit forms are the confidential property of the ICI audit clients and are therefore not included in this report.



5.1 WATER AUDIT TIME & COST REQUIREMENTS FROM PILOT AUDITS

The level of effort required and approximate cost for each of the pilot trials of the standard audit template are presented below in table 4.

Table 4: Pilot Level 1 Water Audit Time Requirements and Cost Data¹

	Level 1 Water Audit Person Hour Requirements				
	Pre-Audit	Onsite Auditing	Research & Audit Report Completion	Total	Approximate Cost
Pilot Audit #1 Chemical Manufacturing Plant	3	8	17	28	\$3,600
Pilot Audit #2 Metal Manufacturing Plant	4	8	24	38	\$4,950
Pilot Audit #3 Aquatic Centre	1	8	17	26	\$3,400
Pilot Audit #4 Horticultural Nursery	2.5	8	24.5	35	\$4,600

The hours reported do not include development and training costs associated with creating and refining the audit template and also do not include disbursement costs for travel associated with conducting the audits.

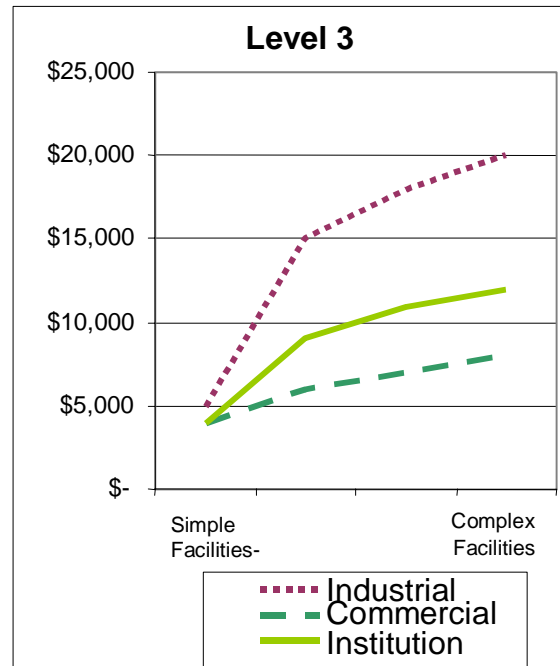
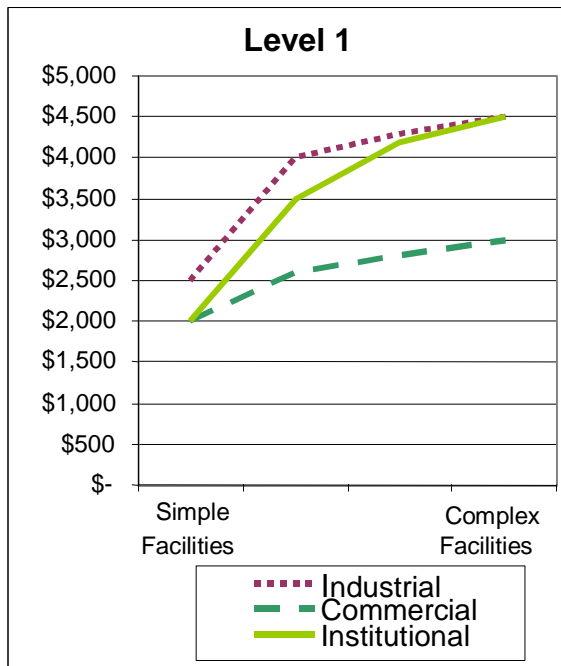
¹ Any reliance, which a third party makes of the costs estimated in this report, are the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of the decisions made or actions based on these cost estimates.



5.2 WATER AUDIT COSTING DATA FROM PAST EXPERIENCE

Stantec has a collection of data from past energy and water audits on facilities of varying sizes and complexity. This data was extracted and tabulated into the following charts for reference and comparison purposes. It is important to note that the pricing ranges illustrated in each of the following charts reflects average facility sizes and may not necessarily mark maximum upper range, especially for large complex industrial facilities.

Table 5: Water Audit and Cost Data Extrapolated from Stantec Past Energy and Water Audits²



The pricing range for a level 2 water audit is custom defined between the client and the consultant and will range between level 1 and level 3 audit costs.

The cost data collected for the four pilot audits generally conform with the data from Stantec's past energy and water auditing experience.

² Any reliance, which a third party makes of the costs estimated in this report, are the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of the decisions made or actions based on these cost estimates.



5.3 LESSONS LEARNED FROM PILOT WATER AUDITS

Numerous lessons have been gathered from the pilot audits conducted as well as from the process of working with the member municipalities to find suitable audit clients. These lessons are reported below.

5.3.1 Usefulness of Standardized Audit Template

Four teams of auditors tested the standardized audit template. By using a variety of auditors, Stantec was able to gather pilot testing results and feedback from several viewpoints.

Stantec auditors who were not involved in template development found that it took a bit of time to become familiar with the audit template, as with any new tool. The template acted as the checklist, ensuring that the audit team did not miss critical pieces of information while onsite. As auditors became more familiar with the audit template layout and information requirements, it became an effective tool in facilitating level 1 audits. In addition to the template form, notes taken on separate paper were helpful for elaborating on details and making sketches.

Initially, the template only covered information for a level 1 audit. After some discussion with GVRD staff, Stantec added some portions that illustrated level 2 and 3 audit information. This was meant as a guide only to help define the scope of a level 1 audit, not as an actual complete template for level 2 or 3 audits. Development and testing of level 2 and 3 templates suitable for the wide range of ICI clients would require much further work and testing and is beyond the scope of this study.

5.3.2 Value of Level 1 Audits to ICI Facilities Pilot Tested

The level of awareness of water use, costs and water conservation varies among ICI clients. Among the four facilities audited, two industrial clients already had a high level of knowledge about water costs and good records of water usage in various areas of their facility. Both industrial facilities have process engineers who track production inputs, including potable water, on a monthly basis. One commercial facility had a fairly good level of understanding around water consumption onsite and conservation opportunities; while the other commercial facility had a relatively poor understanding.

At the first industrial facility there are still significant opportunities for further water use reduction and the client was keen to explore and implement the changes. This client had marginal interest in an external level 1 audit but was more interested generating detailed design and implementation plans. This client had already performed a mental level 1 audit. In the end, the value of the external level 1 audit was to confirm and supplement his judgments and to prioritize the opportunities.

The second industrial client had achieved impressive levels of water cost reduction over the last 10 years from in-house changes. He also had marginal interest in a level 1 audit as he believed that there was little financial incentive for further water conservation measures. Although opportunities exist, he viewed the potential return as relatively small compared to other day-to-



Greater Vancouver Regional District Standardized ICI Water Audit Process

day tasks required at the facility. The inconvenience of implementation was a barrier to further action. The audit process, however, did serve to bring awareness about pending water rate increases and prompt further thought about a topic that had been set aside.

The third facility audited, a large horticultural nursery, had well documented records of when and where potable water was used and had identified some opportunities to displace potable water use for irrigation. The audit team identified a comprehensive set of alternative water supply options in addition to process and HVAC equipment water efficiency measures. For this client, the implementation of conservation measures is hindered by the low cost of potable water. The water quality requirements are very stringent making alternate sources expensive.

The fourth facility audited, a public aquatic centre, had a relatively non-existent water management program in place. The facility had no sub-meters to help identify where water is used in the facility, or if make-up water consumption is excessive. With little data on water consumption throughout the facility, the facility managers, found it challenging to determine if various systems were operating efficiently or not. The audit team was able to identify several areas in which improved monitoring, alternative operation practices, and new fixtures or HVAC equipment could provide water savings. Without a level 3 audit, it was difficult to predict the magnitude of conservation measures in this context.

On the other end of the spectrum, there was a potential audit candidate who initially declined a complementary audit. This facility is one of the highest water users in the particular municipality, but the plant manager was not aware that water use was at all significant in the facility. Upon later discussions with the facility manager, it was revealed that water usage had been overlooked because water was used in a once-through cooling system and not in the manufacturing process. It is expected that this particular water user could eliminate the majority of onsite water use by replacing the cooling system with a very low payback period. Water users in similar situations stand to benefit greatly from level 1 audits.

We conclude from our experience that level 1 scoping audits are most beneficial for clients without an established water system monitoring and management program in place. For facilities with a well-established water management program, a detailed (level 2 or 3) water audit may be the most appropriate starting place if they anticipate conservation opportunities and are eager to take the next step towards implementing changes.

5.3.3 Limited Awareness of Water Rate Increases

The pilot audits reveal that ICI facilities were generally somewhat aware of water as a utility cost, but were not generally aware of the significant increases expected for the near future. The reference point for decision-making around water conservation is typically based on existing or past water rates.

In the case of the audited industrial facility discussed previously, that was reluctant to implement further water conservation measures, the opinion was based on previous investigation (from many years ago) indicating a lengthy payback period. With future projected water rates, it is possible that the economic analysis may lead to a different conclusion.



Greater Vancouver Regional District Standardized ICI Water Audit Process

Based on the pilot audits conducted, general discussions with ICI facilities during the facility selection process, there appears to be a lack of awareness of water rate increases. This presents a significant opportunity for the GVRD to raise interest in water conservation by providing pending water rate increases education on water conservation measures.

5.3.4 Utilize Expertise of Staff at Audit Facilities

It is important for the audit team to connect with key facility personnel to gain access to their knowledge of facility history, operational and technical expertise and ideas for conservation in the audit process. By talking to as many knowledgeable staff as possible and drawing on their ideas and useful site-specific information, an auditor can get much more accomplished in a shorter time.

Brainstorming and discussion of the potential measures that come to mind during the site visit may reveal measures that have already been explored, in which case there may be a good reason why it was not implemented or ideas that an outside auditor might not have detected.

It is important to ensure that no one feels threatened by the auditor's presence. One step towards doing this is for the auditor to make clear his purpose and motivation in the audit process.

5.3.5 Incentives to Reduce Water Consumption

During one pilot audit, Stantec discovered that a facility was aware of their very high water consumption and had investigated some opportunities for water conservation. However, the payback period was over 15 years. Their threshold was 4 years; thus, they were not willing to implement the water conservation practices until they could achieve a more suitable payback period.

In a case like this, where the water usage is very large, it may be strategic for the GVRD and member municipalities to collaborate and offer financial incentives to reduce potable water usage. The incentive provided would be offset by deferred capital expenditure for municipal infrastructure upgrades.

5.3.6 Alternate Sources of Process Water

In industrial facilities, there are often significant opportunities to substitute non-potable water or recycle water where potable city water is currently being used. The pilot audits revealed examples of this including use of non-potable well water for cooling water as well as storm water collection and treatment for use as process water.

Water auditors may use examples of water conservation practices at some facilities to illustrate the effectiveness of employing alternate non-potable water source and water recycling to ICI facilities that do not employ these conservation practices.



The audit team found that among the facilities using alternate water sources, there were some further opportunities to increase the practice of using alternate and recycled water in place of potable water.

5.3.7 Sewer Charges

The impact of non-potable water usage on sewer charges is an item that requires consideration by the facility, the outside audit team and the municipality and/or regional district. The structure of sewer rates will vary by municipality and by the agreement made between the facility and the municipality or the GVRD.

The GVRD and member municipalities should establish Sewer rate structures in a way that provides incentive for the facility to conserve water and to use alternate water sources instead of potable water, where possible. The facilities audited typically had a charge structure where the sewer charge is based on the net potable water consumption for domestic uses (sewer flow calculated from total potable water demand, less non-sewered quantities).

Where non-potable water is used for cooling and does not become contaminated, it can be discharge to nearby watercourses, where available, provided that there are no negative environmental impacts. This reduces unnecessary hydraulic loading to the sanitary sewer system. An example of this was seen at one industrial facility that used well water for process cooling.

5.3.8 Domestic Plumbing Fixtures

The two industrial facilities audited showed little domestic demand relative to process water. This situation is most likely representative among heavy industrial facilities. In such operations, the impact of high efficiency domestic plumbing fixtures is relatively insignificant on total water consumption. Such facilities are unlikely to upgrade domestic fixtures solely for the purpose of saving water. A fixture upgrade would likely only be contemplated if there were another reason for renovating.

However, in commercial and institutional facilities, the domestic plumbing water demands may be the majority of the water demand. In such instances, the incorporation of high efficiency plumbing fixtures can provide significant returns. For example, a swimming pool facility that was pilot audited stood to reduce water consumption substantially through the use of low flow showers. In addition, the domestic hot water energy savings helped make a good business case for a domestic fixture retrofit program.

5.3.9 Water Cooling Systems

At one audit facility, the audit team found high water usage in a once through water-cooled air conditioning unit. The cooling water flow was set by the air conditioner equipment supplier at the highest rate required based on the highest seasonal load condition. While the seasonal cooling load is lower for most of the year, the water flow rate continues at the set value. The air conditioning equipment supplier had no interest in saving water; his interest was in ensuring that



Greater Vancouver Regional District Standardized ICI Water Audit Process

the equipment performed under the worst load conditions. Water use savings could be obtained by installing control equipment to match the cooling water flow to the required load.

5.3.10 Standardized Water Utility Records

There is a large discrepancy between the billing, tracking, measurement, and reporting systems across the GVRD member municipalities. The audit team found that some member municipalities have poor systems for tracking water consumption records of water users and needed to switch between several data bases in order to generate a complete reference list providing water users, meter numbers, facility address, business type. In addition, some of the information was found to be inconsistent across the various systems.

A standardized system used by all member municipalities could offer better economies for water utility billing services and allow more pro-active demand side management practices by water customers, municipalities and water auditors.

5.3.11 Opportunities for Water Conservation by ICI Customers

The pilot audits completed by Stantec identified opportunities for potable water conservation in all the facilities audited. The payback period sought by facilities may vary depending on industry and management priorities. The industrial facilities audited tended to have shorter targets, in the range of 1 to 3 years. Commercial and Institutional facilities may accept longer payback periods in the range of 3 to 6 years, or longer where there is a philosophical motivation.

The pilot audits found some opportunities that offered a strong business case to implement (1 to 3 year payback range). There were also opportunities that had moderate payback periods (in the range of 3 to 6 years). Some opportunities had extremely long paybacks, (exceeding 10 years) and were not strong candidate opportunities for immediate implementation. We expect that the experience of the pilot audits is representative of the opportunities throughout the ICI sector.

5.3.12 Confidentiality

Among the privately owned industrial and commercial facilities that produced a product for market, confidentiality was an essential factor in their willingness to participate in the complementary pilot water audits. These customers are extremely concerned about an outside audit party reporting findings that may be viewed by their competitors or in one case, even by their customers.



6.0 Next Steps

6.1 VALUE OF AUDITS

The use of water auditing can play a role in encouraging water potable conservation within the ICI sector. Water auditing can reveal areas of inefficient water usage, prioritize the water conservation opportunities and identify areas for further review and evaluation.

Water audits can be classified by level of detail (level 1-3). Level 1 audits are the first step in the process of reviewing water conservation opportunities and will likely lead to level 2 or 3 audits. The recommendations that come out of detailed audits will require further action such as education, changes in procedure, or system changes/upgrades that involve design and construction costs. Water auditing is a step along the path towards the goal of water conservation. Auditing alone cannot achieve the goal but is a necessary step to achieving the goal.

The standard water audit template investigated in this study deals mainly with facilitating level 1 audits. The standard audit template provides a checklist to guide the audit team through collecting the required information in an efficient manner and provides a reminder of areas to be reviewed.

Based on the pilot studies, we conclude that level 1 water audits are most valuable for facilities that do not have a well-established water management program. Facilities that are proactive in water management are generally already partly or fully aware of the issues that would be revealed by a level 1 audit. In some cases, a level 1 audit may still have benefit to the facility. In other cases, the facility may be better served by going straight into a detailed audit, which provides financial justification for water conservation measures.

From the small sample size of the pilot audits, it is difficult to gauge the general level of benefit that ICI water customers across the GVRD would receive from standardized level 1 audits. This is an interesting question, along with the question of how much willingness the facilities would have to pay for conducting level 1 standardized audits. This could be the topic of a further study, as discussed in the section 6.2.



Greater Vancouver Regional District Standardized ICI Water Audit Process

Water auditing also offers the potential for the following:

- Baseline water consumption by sector
- Develop case studies of best practices for water conservation
- Reduce peak and total demand upon municipal infrastructure
- Exploit alternative water sources
- Gain acceptance and experience in treatment and reuse systems
- Provide customers with a shopping list of water conservation measures, prioritized by high, moderate and low potential for financial return.

Water auditing within the GVRD is at its infancy. Some of the reasons limiting its widespread practice are listed below:

- Limited local awareness of benefits and conservation measures
- Low water costs
- Absence of incentives or funding for conservation measures

Back during the energy crisis of the 1970's interest developed in energy audits. This interest has continued to increase. Today ICI energy audits are a tool used widely by local utility companies to manage consumption, and drive down peak demand and by facilities to reduce costs. The Canadian federal government encourages energy efficiency through funding of audits and the implementation of efficiency measures.

Water and energy are both resources that are experiencing increasing demand, supply restrictions and increasing cost. By extrapolation of the lessons from energy audits, we believe water audits to be a valuable tool, which will grow in use as water becomes more expensive.



6.2 RECOMMENDATIONS TO THE GVRD

While standard template level 1 water audits can identify water conservation opportunities, audits alone may not guarantee maximum gains in water conservation.

We suggest implementation of an integrated demand-side management program for the ICI sector. An integrated approach uses many facets to help customers develop awareness in water conservation, conduct audits, and implement conservation programs. In order to maximize the potential benefits from ICI water audits we recommended that the GVRD also evaluate the following services and program(s) and strategically implement those determined to yield the highest return.

- Develop an awareness campaign to educate ICI water users of the potential benefits from water auditing and water conservation. Potential avenues for promoting awareness include mail-outs with water bills, the GVRD web site, and advertising through local trade associations.
- Consider developing a program to further study water auditing by provide rebates for completed water audits with information disclosed to the GVRD for performance tracking and ICI customer education purposes. Allow facilities to protect their identity in any public disclosure of information.
- Consider developing a program to provide incentives to implement water conservation measures and document measured water reduction. Evaluate the cost of this expenditure against savings on deferred capital expenditure for water supply infrastructure. This may be done in partnership with member municipalities.
- Create an online reference centre of case studies documenting water audit findings, water conservation measures, utility savings, and financial returns for efficiency measures. This could be linked to the “Smartsteps” webpages on the GVRD website. Allow facilities to protect their identity in any public disclosure of information.
- Provide online or printed resources on specific water efficiency and conservation measures for ICI facility managers. For example, standardized water audit template for in-house use, fact sheets on topics such as air conditioning, rainwater harvesting, greywater, best management practices, etc.
- Work with member municipalities to provide standardized and accurate reporting formats for water consumption. Assign outreach staff to review records and look for and work with ICI consumers with large opportunities to reduce consumption.



**Greater Vancouver Regional District
Standardized ICI Water Audit Process**

APPENDIX A Standard Level 1 Water Audit Template

A. Audit Instructions

Water Auditing is a means of evaluating water use efficiency within a facility and identifying and prioritizing conservation opportunities. The level 1 water audit involves a walk through scoping level assessment. The standardized level 1 water audit is a tool that is intended to help promote water conservation by identifying opportunities for further investigation and for implementation of water conservation measures

The following document provides a water auditing template for the Industrial, Commercial, and Institutional (ICI) sector. The template provides a logical summary of the process necessary to complete a water systems analysis and prioritize conservation opportunities. The template is intended for Level 1 audits (walk through assessment). Examples of increased detail as required for level 2 and 3 audits are provided for reference. However, detailed audits will typically require custom forms depending on the type of facility and water uses present.

Audit Team Skill Level:

The template assumes a certain level of experience and competency of the auditing team. It is expected that the team will have understanding and field experience to collect the data and further expertise in order to complete the proper engineering calculations to estimate the feasibility, water savings, and costs associated with water conservation measures to be provided in a formal audit report to the client.

STEP 1: Pre-Audit Information Collection

After agreement to work with the audit client, the consulting team will gather background information on the facility including:

- water and sewer consumption/flows & billing history
- water and sewer rate structures
- facility/process drawings, schematics, reference materials
- confirm onsite contact to assist audit team during site visit

STEP 2: Initial On-site Discussion

The audit team will collect general information on the following:

- overview of facility activities, processes, and schedules
- philosophy on water management
- water conservation and monitoring programs

STEP 3: Water Systems Analysis

The auditing template guides the user through a systems analysis of the water systems including:

- domestic water uses
- HVAC water consumption
- exterior water uses
- process water uses

The audit template will encourage the user to draw out information on:

- water quality requirements
- inefficiencies and leaks
- alternative onsite water sources
- seasonal variations
- opportunity for water treatment and reuse or direct reuse, need for education and behaviour-oriented conservation initiatives.

STEP 4: Annual Water Balance

With the data collected the team can generate a water balance for the facility and site quantifying all sources and releases of water and flows through various fixtures, equipment, and processes. In addition, an analysis of the water quality required for each use will be noted.

STEP 5: Brainstorm of Water Conservation Opportunities

The audit template will lead the user to identify measures to conserve potable water use as described above. It is expected that as these are identified they be further reviewed with the client during the site visit to draw out any additional site specific considerations.

1. Pre-Audit Information

Audit Site Information

Facility Name _____
 Facility Address _____

 Primary Contact Person / Title: _____
 Tel No., Fax, _____
 Email _____

 Secondary Contact Person / Title: _____
 Tel No., Fax, _____
 Email _____

 Type of Business _____
 By Sector Classification Classification (BSC) _____
 or NAICS code (see below) _____

Pre-Audit Check list

Date of Audit _____
 Site Audit Completed By: _____
 Contact Info _____
 Obtain signed letter of permission from audit client _____

 Obtain water billing records and sewer billing structure _____
 Request client to gather facility and process drawings, schematics & records
 General plant layout
 Process flow digaram
 Plumbing diagrams
 Landscape/irrigation plans
 Are drawings up to date?

 Confirm availability of facility operations personnel to accompany audit team
 Designated Person / Title: _____
 Tel No., Fax, _____
 Email _____

 Facility orientation req'd ? _____
 Camera (confirm photos are allowed) _____
 Personal protective equipment? _____
 check website for corporate vision items pertaining to sustainability, water usage _____

Use	BSC #	Use	NAICS #
Single family residential	0	Agriculture, Forestry, Fishing, and Hunting	11
Agriculture	1	Mining	21
Business & office	2	Utilities	22
Construction	3	Construction	23
Dairy and Meat product	4	Manufacturing	31
Education	5	Wholesale Trade	42
Forest Products	6	Retail Trade	44-45
General Food Products	7	Transportation and Warehousing	48-49
Grain and Vegetable Products	8	Information	51
Hospitality	9	Finance and Insurance	52
Industries	10	Real Estate and Rental and Leasing	53
Medical and Health	11	Professional, Scientific and Technical Services	54
Petroleum and Allied	12	Management of Companies and Enterprises	55
Recreation	13	Administrative and Support and Waste Management and Remediation Services	56
Religious & cultural	14	Educational Services	61
Restaurants	15	Health Care and Social Assistance	62
Retail shopping & stores	16	Arts, Entertainment and Recreation	71
Service stations	17	Accommodation and Food Services	72
Transportation	18	Other Services (except Public Administration)	81
Warehouses	19	Public Administration	92
Utilities & miscellaneous	20		
Municipal Family Residential	21	The North American Industry Classification System (NAICS) is a joint U.S., Canada and Mexico classification system. BSC is a local classification system.	

2. Initial Meeting/Discussions

Facility/Plant Manager

LEVEL 1 & LEVEL 2/3 AUDIT

Facility Overview

description of facility(ies)

--

Facility activities / products made

general activity type(s)

--

Important personnel to talk with re: plant operations, water usage

processes, HVAC, cleaning, kitchenettes, landscaping, other?

--

Operation Schedule

Monday - Friday

hours of day

--

Saturday

hours of day

--

Sunday

hours of day

--

Holidays

hours of day

--

shifts

--

Any Seasonal Changes?

description

--

Notes on Occupancy: (ie. part shifts, details on seasonal changes)

--

Philosophy on Water Management

Philosophy towards facility operation and water management

water management program?

--

water tracking & monitoring?
efficiency upgrades?

--

leak detection program & repair activities?

--

What pay back period does client require to implement system upgrades?

simple payback or return on investment

--

Discuss rising cost of water in GVRD

proactive vs. reactive to rising water costs

--

Water Monitoring & Measurement

Monitoring system for facility and process performance	what aspects are monitored? why?	
	how is monitoring carried out?	
	persons responsible?	
	feedback- reporting, maintenance, repairs, etc.	

Water Management Activities

Previous water studies	description, copy obtained?	
Past water reduction strategies	description, degree of success, etc.	
Ideas for water conservation	description, why not implemented?	
Key personel to talk to	re: facility/plant operations, water usage, environmental management systems, etc.	

**CITY WATER
Main Meter**

		<i>Main Meter</i>
Site Location		
Meter #	(Billing #)	
Brand		
Size		
Type	(instantaneous vs. Totalizer)	
condition	(operating, not operating, suspect needs calibration)	

**CITY WATER
Sub-Meter(s)**

		<i>sub-meter 1</i>	<i>sub-meter 2</i>	<i>sub-meter 3</i>
Site Location				
Meter #	internal #			
Brand				
Size				
Type	(instantaneous vs. Totalizer)			
condition	(operating, not operating, suspect needs calibration)			

3. Initial walk about - Level 1 Audit

3. Initial walk about- Level 2/3 Audit

For a LEVEL 1 Water Audit complete left hand side of page. For a LEVEL 2/3 Water Audit complete left hand and right hand sides of page.

May be with plant manager or with operations staff or with engineering staff. Gather variety of viewpoints

Major Water Use Areas

		LEVEL 1 AUDIT	
Water Pressure	Indicate building or facility water pressure		Indicate minimum water pressure required?
Major Water Use Areas	List major water use areas		
Major Water Use Processes	List major process water uses	(refer to list of process water uses in part 4. for assistance)	

Major Water Use Areas

		LEVEL 2/3 AUDIT
Additional details on water pressure		
Additional details		
Additional details		

Water System(s) Components

Water Treatment Systems

		LEVEL 1 AUDIT
Description		
Water source		
Type of treatment		
Treated water end use		
Leaks? Efficiency Opportunities?		

Major Water System(s) Components

Water Treatment Systems

		LEVEL 2/3 AUDIT
Conservation opportunities within system operation		
Quality and quantity of source water		
System make and model #		
Opportunity to treat additional non-potable water for use/reuse?		
Leaks? Efficiency Opportunities?		

Water Storage Systems

		LEVEL 1 AUDIT
Description		
Purpose / use		
Size of storage system		
Leaks? Efficiency Opportunities?		

Water Storage Systems

		LEVEL 2/3 AUDIT
Conservation opportunities?		
Quantity of water stored annually		
Expansion potential?		
Leaks? Efficiency Opportunities?		

Facility / Plant Operation Notes:

		LEVEL 1 AUDIT
Notes:		

Facility / Plant Operation Notes:

		LEVEL 2/3 AUDIT
Notes:		

3. Initial walk about - Level 1 Audit

3. Initial walk about- Level 2/3 Audit

For a LEVEL 1 Water Audit complete left hand side of page. For a LEVEL 2/3 Water Audit complete left hand and right hand sides of page.

Facility Description

		LEVEL 1 AUDIT		
		Building/Area 1	Building/Area 2	Building/Area 3
Building name	Indicate name & activities contained			
Building(s)	Total building square footage			
Site	Indicate total site area and total building footprint			
Building age				

Landscaping Irrigation & Outdoor Water Usage

Landscaping Irrigation

		LEVEL 1 AUDIT		
Estimated water usage (m ³ /yr)				
Irrigation system type (sprinkler vs. drip vs. manual hose sprinkling)				
Irrigation system controls (manual, timeclock, moisture sensors)				
What is sprinkling schedule used? Check if it complies with local by-laws				
Opportunities for native or drought resistant species?				

Outdoor Hose Bibs

		LEVEL 1 AUDIT		
Indicate usages (car wash, water fountains, street wash, equipment washing, other)				
Opportunity to encourage conservation through education & behaviour changes ?				
Ability to use non-potable water?				
Opportunities to recycle water?				
Other notes:				

3. Initial walk about - Level 1 Audit

Facility Description

		LEVEL 2/3 AUDIT		
		Building/Area 1	Building/Area 2	Building/Area 3
Any additional notes on building activities?				
Total roof area with potential for water				
Total site area with potential for water collection				
Any major building or site upgrades / renos				

Landscaping Irrigation & Outdoor Water Usage

Landscaping Irrigation

		LEVEL 2/3 AUDIT		
System use: days per year & hours per day				
Opportunity to upgrade system?				
Opportunities for soil moisture sensors or enhanced system controls?				
Ability to use non-potable water?				
Landscaping type (% annuals / % perennial flowers, % shrubs & % trees / % drought tolerant species?)				

Outdoor Hose Bibs

		LEVEL 2/3 AUDIT		
Quantify water use per year (flow rates x usage in litres/year)				
Initial staff suggestions & reaction to opportunities?				
Indicate quality of water required and where non-potable water use is possible				
Indicate quality of water required and where water recycling is possible				
Other notes:				

3. Initial walk about- Level 2/3 Audit

For a LEVEL 1 Water Audit complete left hand side of page. For a LEVEL 2/3 Water Audit complete left hand and right hand sides of page.

Stormwater management systems

LEVEL 1 AUDIT

Type(s): retention, detention, treatment, infiltration, reuse)	
System performance	
Opportunity for reuse?	
Notes:	

Alternate Water Sources

LEVEL 1 AUDIT

Ground Water

description of source(s)	
currently utilized?	
potential use?	
source seasonal? (if yes, indicate period)	
limitations?	

Rain Harvesting

description of source(s)	
currently utilized?	
potential use?	
source seasonal? (if yes, indicate period)	
limitations?	

Stormwater

description of source(s)	
currently utilized?	
potential use?	
source seasonal? (if yes, indicate period)	
limitations?	

Recycled, Treated, or Reused Process Water

description of source(s)	
currently utilized?	
potential use?	
source seasonal? (if yes, indicate period)	
limitations?	

Grey Water

description of source(s)	
currently utilized?	
potential use?	
source seasonal? (if yes, indicate period)	
limitations?	

Stormwater management systems

LEVEL 2/3 AUDIT

	system 1	system 2	system 3
Site area affected / used			
Total volume of stormwater managed / year			
Treated water quality			
Notes:			

Alternate Water Sources

LEVEL 2/3 AUDIT

Ground Water

	source 1	source 2	source 3
metered (y/n)			
utilized capacity			
rated capacity			
max capacity			
what is water quality?			

Rain Harvesting

	source 1	source 2	source 3
metered (y/n)			
utilized capacity			
rated capacity			
max capacity			
what is water quality?			

Stormwater

	source 1	source 2	source 3
metered (y/n)			
utilized capacity			
rated capacity			
max capacity			
what is water quality?			

Recycled, Treated, or

	source 1	source 2	source 3
metered (y/n)			
utilized capacity			
rated capacity			
max capacity			
what is water quality?			

Grey Water

	source 1	source 2	source 3
metered (y/n)			
utilized capacity			
rated capacity			
max capacity			
what is water quality?			

3. Domestic Fixtures & HVAC Systems - Level 1 Audit

3. Domestic Fixtures & HVAC Systems - Level 2/3 Audit

For a LEVEL 1 Water Audit complete left hand side of page. For a LEVEL 2/3 Water Audit complete left hand and right hand sides of page.

May be with plant manager or with operations staff or with engineering staff. Gather variety of viewpoints

Domestic Water Fixtures & Appliances

LEVEL 1 AUDIT

	Indicate flow rate	Opportunity for conservation?	current (2005) better practice
Toilet (flow rates from volume on china inside tank, on seat, or valve model #)			6 LPF
Urinal (check flow rates by looking at china or valve model #)			1.0 LPF or 0.5 LPF
Bathroom sinks (check flow rates on aerator)			3.8 LPM (1.0 GPM)
Kitchen faucet (check flow rates on aerator)			7.57 LPM (2 GPM) or 5.67 LPM (1.5 GMP)
Shower (check flow rates on shower head)			9.5 LPM (2.5 GPM)
General Food Preparation Water Use Indicate extent of water use in employee self serve kitchenettes.			
General Washing, Sanitation, and Maintenance Summarize general employee space cleaning practices (i.e. washrooms & floor mopping)			

Heating Ventilation Air Conditioning (HVAC)

Once-through cooling systems
(Air Compressors & Pumps)

LEVEL 1 AUDIT

	UNIT #	UNIT #	UNIT #
Unit type & size			
Usage (area and frequency)			
Leaks / inefficiencies?			
Notes on operation:			

Domestic Water Fixtures & Appliances

LEVEL 2/3 AUDIT

	Type	# Units	Leaks?	Usage
Toilet Type (valve vs. tank) indicate valve model#				(indicate % of units with very low usage)
Urinal Type (flush control, sensor timed interval, etc)				(indicate % of units with very low usage)
Bathroom sinks Type (indicate type of use)				(indicate frequency of use and if hot water)
Kitchen faucet Type (indicate type of use)				(indicate frequency of use and if hot water)
Shower Type (indicate type of use)				(indicate % of units with very low usage)
General Food Preparation Water Use Indicate # and frequency of use for dishwashers, handwashing, etc.				
General Washing, Sanitation, and Maintenance Indicate water conservation opportunities within washing & maintenance practices				

Heating Ventilation Air Conditioning (HVAC)

Once-through cooling systems
(Air Compressors & Pumps)

LEVEL 2/3 AUDIT

	UNIT #	UNIT #	UNIT #
Unit type			
Model # (look up to get water use)			
Measured discharge to drain (LPM)			
Annual hours of operation			
Opportunity for shutdown / setback?			
Opportunity for water reuse?			

3. Domestic Fixtures & HVAC Systems - Level 1 Audit

3. Domestic Fixtures & HVAC Systems - Level 2/3 Audit

For a LEVEL 1 Water Audit complete left hand side of page. For a LEVEL 2/3 Water Audit complete left hand and right hand sides of page.

Heating Ventilation Air Conditioning (HVAC)

Cooling Towers

LEVEL 1 AUDIT

	UNIT #	UNIT #	UNIT #
Chiller size (nominal tons)			
# chillers serviced by cooling tower			
Unit age (yrs)			
Usage (area and frequency)			
Leaks / inefficiencies?			
Notes on operation:			

Boilers

LEVEL 1 AUDIT

steam vs hot water?

	UNIT #	UNIT #	UNIT #
Unit size			
Boiler Age (yrs)			
Usage (area and frequency)			
Opportunity for shutdown / setback?			
Leaks / inefficiencies?			
Notes on operation:			

Humidifiers

LEVEL 1 AUDIT

	UNIT #	UNIT #	UNIT #
Unit type & size			
Usage (area and frequency)			
Opportunity to reduce hours of operation?			
Leaks / inefficiencies?			
Notes on operation:			

Heating Ventilation Air Conditioning (HVAC)

Cooling Towers

LEVEL 2/3 AUDIT

	UNIT #	UNIT #	UNIT #
Model # (look up to get water use)			
Servicing capability (flow rate from chiller in LPM)			
Annual hours of operation			
Annual water treatment chemical costs (\$)			
Opportunity for shutdown / setback?			

Boilers

LEVEL 2/3 AUDIT

	UNIT #	UNIT #	UNIT #
Model #			
Incoming Water Temperature (deg.C)			
Outgoing Water Temperature (deg.C)			
Evaporation (kg/day)			
Daily Blowdown Practice (% or time duration)			
Proposed Daily Blowdown Practice (%)			
Boiler Use (days/yr)			
Steam Condensate Return (% of total)			
Condensate Tot. Dissolved Solids (ppm)			
Make-up Water Tot. Dissolved Solids (ppm)			
Required Boiler Conductivity (ppm)			

Humidifiers

LEVEL 2/3 AUDIT

	UNIT #	UNIT #	UNIT #
Model # (look up to get water use)			
Annual hours of operation			
Proposed hours of operation (hrs/yr if different than current)			
Average Water Use (LPM)			

4. Process Water Uses - Level 1 Audit

Review of water consumption in processes and process components (unit operations, equipment and uses):

For a LEVEL 1 Water Audit complete left hand side of page. For a LEVEL 2/3 Water Audit complete left hand and right hand sides of page.

Notes: Use as many sheets as required for complex facilities with multiple systems. Draw insights from plant operations, maintenance and technical staff.

- Process Water Uses :**
- o Commercial Kitchens & Restaurants
 - o Food & Drink Preparation
 - o Commercial Dishwashers
 - o Food & Garbage Disposers
 - o Icemakers
 - o Cooling Systems (especially water-cooled units)
 - o Laundries & Laundromats

Process # ____ - _____ (process name)

LEVEL 1 AUDIT

Description of production line	
Production/service rates (i.e. units/hr):	
Production Process Diagram - include water flows	(obtain copy or sketch system on separate sheet)
Description of production run changes	
Notes on production rate vs. water usage flows	

Process # ____ - _____ (process name)

LEVEL 1 AUDIT

Unit process, Equipment or System	equipment/system name
Required water flow rate (peak demand)	estimated max/avg/min ; what determines flow rate requirements?
Required water pressure	estimated max/avg/min ; what determines pressure requirements?
Required water quality for process, products, & equipment	high, moderate, or low ; what determines quality requirements?

4. Process Water Uses - Level 2/3 Audit

Notes: Use as many sheets as required for complex facilities with multiple systems. Draw insights from plant operations, maintenance and technical staff.

- Additional Process Water Uses:**
- o Swimming Pools & Ice Rinks
 - o Process Washing & Rinsing
 - o Process Materials Transfer
 - o Goods Processing
 - o Non-domestic Cleaning and Sanitization
 - o Golf Courses
 - o Commercial Nursery & Greenhouse Irrigation

Process # ____ - _____ (process name)

LEVEL 2/3 AUDIT

Additional Details	
Wash water required between runs?	
Qualify and quantify water flows through process	
Production run change frequency and wash water requirements between runs	
Notes:	

Process # ____ - _____ (process name)

LEVEL 2/3 AUDIT

Additional Details	
Specific water flow rate parameters (attach specifications)	maximum / average / minimum
Specific water pressure parameters (attach specifications)	maximum / average / minimum
Specific water quality parameters (attach specifications)	

4. Process Water Uses - Level 1 Audit

4. Process Water Uses - Level 2/3 Audit

For a LEVEL 1 Water Audit complete left hand side of page. For a LEVEL 2/3 Water Audit complete left hand and right hand sides of page.

<p>What are existing water conservation initiatives? Past lessons, projects, studies?</p>		<p>Retain details and reports on projects, performance achievements, water conserved, new opportunities.</p>	
<p>Age of Equipment / System</p>		<p>What components require replacement in the next 10 years, what is the projected replacement cost?</p>	
<p>Is equipment / system best available technology?</p>		<p>Indicate alternative technologies (make & model numbers)</p>	
<p>What is level of reliability & frequency of maintenance on existing equipment/systems?</p>		<p>Additional Details</p>	
<p>What equipment or control upgrades are possible to improve water efficiency? Other benefits?</p>		<p>Indicate details on known potential equipment and control upgrades (include studies if available)</p>	
<p>Process Operation Characteristics: shift clean-up, operator practices & process changeovers</p>		<p>Additional Details</p>	
<p>What operational changes are possible to improve water efficiency? (eg. pressure/flow reduction, leaks monitoring & repair, control of</p>		<p>Additional Details</p>	
<p>Is water treatment for reuse or direct reuse possible?</p>		<p>Details on opportunities for water treatment and reuse (location, flows, quality)</p>	
<p>Is an alternate source of water suitable in quality & quantity?</p>	<p>(review alternative sources identified in part 2. and current wastewater sources)</p>	<p>Details on opportunities for alternate water supply (location, flows, quality)</p>	
<p>Additional staff suggestions for changes</p>		<p>Additional Details</p>	

5. SKETCH OF FACILITY WATER BALANCE

Draw Facility water balance diagram showing major water usage areas

SAMPLE:

