ENVIRONMENT CANADA

WATER EFFICIENCY AUDIT
AT
CANADA CENTRE FOR INLAND WATERS

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Project EO 91122

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Dear Mr. Bien

Re Water Efficiency Audit at the Canada Centre for Inland Waters

We are pleased to enclose herewith ten (10) copies of the draft report on the water efficiency audit at the Canada Centre for Inland Waters. The report has been prepared following numerous visits to the centre over the last four months. Because of the approach taken, of informal discussions during the audit, much of the contents of the report will already be known.

We would like to express our appreciation to the staff at the centre for their valuable assistance during the course of the audit, and look forward to our meeting on Tuesday, October 1st, 1991, to discuss this report.

Yours very truly,

Proctor & Redfern Limited

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1.0 INTRODUCTION

1.1 Background

There is an increasing awareness of water conservation at all Government levels and in private industry. Across Ontario, a number of studies are currently taking place to establish standard procedures for completing water audits at a range of establishments. Implementation of sound water management practice will inevitably lead to reductions in water usage.

One of the objectives of the Federal Green Plan was to develop a water use plan by 1992, which would result in significant reduction in water usage by the year 2000. In an effort to establish water efficiency guidelines for Federal facilities, the Canada Centre for Inland Waters was selected to be used as a prototype. It would be the first Centre to be designated as a water efficiency facility.

The lessons learned during the audit, and the procedures established could then be applied to other facilities. Even those facilities with apparent average or low water usage would benefit from the knowledge gained about the system operation, and the good housekeeping water practices that would inevitably be developed. If water management is practiced in a methodical and organized way, and most importantly, if the good practices developed initially are continued, then reduction in water use at government establishments will be achieved.

1.2 CCIW Complex

The Canada Centre for Inland Waters is located in the northeast corner of Hamilton Harbour. The building was constructed in two phases. There are seven main sections which are shown on the site plan in Figure 1, and detailed below:

(i) Boiler Plant
(ii) Fisheries Laboratory
(iii) Hydraulics Laboratory
(iv) Research and Development
(v) Administration and Laboratory
(vi) Workshop and Warehouse
(vii) Wastewater Technology Centre

City water is supplied into the complex at two locations. The main building, which contains all sections except the Wastewater Technology Centre, has a city water supply and meter in the basement of the boiler house. The Wastewater Technology Centre is fed from a city water meter which is located in the service tunnel at the northeast corner of the Workshop and Warehouse.

Outflows from the Centre are collected into sanitary and storm systems. The main building and the Wastewater Technology Centre both have their own sanitary water collection chamber, each equipped with submersible pumps. Both sets of pumps deliver into a combined sanitary outflow pipe. The stormflow from the whole complex is also combined into a single storm drain.

The City water, sanitary and storm systems are all located to the east of the main building, at the front of the Complex.

1.3 Scope of Work

Proctor and Redfern Limited were retained to complete a water efficiency audit by Supply and Services Canada. The audit was based on the guidelines given; the Statement of Work, which is attached as Appendix "A" to this report; Proctor & Redfern's Proposal for Consultancy Services; and confirmation of work at the startup meeting.

The guidelines divided the audit into two areas; firstly, a water audit and secondly, a water efficiency program. The water audit consisted of three sections, namely, identification of system components, inventory of water use, and a water balance. The water efficiency program also contained three sections, namely, evaluation of water reduction alternatives, designing a water efficiency program, and implementation of the program.

As requested by Environment Canada, the work by Proctor & Redfern comprised of the full water audit, and the water efficiency program as far as evaluating water reduction alternatives. Recommendations are given, as part of the evaluation, for future action and implementation.

Proctor and Redfern's original proposal included for automatic recording of flows at the centre using data loggers. However, Environment Canada requested that the flow meters be manually read, and that the number of additional meters be reduced from four to two. Proctor & Redfern agreed to these changes and reduced the proposal fee accordingly.

At the startup meeting it was confirmed that a single schematic drawing of the cold water pipework was not required. At the meeting a cost estimate for additional work to measure the sanitary outflow was asked for, and it was later agreed to complete the work for a sum of $1,200. It was also confirmed that sewer sampling was not part of the audit.

1.4 Audit Methodology

The audit was completed generally as defined in the previous section of this report, the Scope of Works. The tasks were performed as detailed in the guidelines, but not in the order shown, and the manner indicated.

To begin with, the identification of system components was not completed on a physical area basis, floor by floor. The system was identified by hydraulic/process groups, based on the types of water use and operating pressures employed. Within these groups, however, the physical areas of use were indicated. It was felt that this method would give a better understanding of the use of water at the Centre, and would also facilitate identification of water reduction alternatives.

A water balance was completed next, and was based on the hydraulic/process groups using the existing and new flow meter readings. The water balance was made earlier than indicated in the guidelines, before the detailed inventory of water use. This approach enabled two key tasks to be accomplished at an early stage of the audit. Firstly, the magnitude of the unaccounted for / unmetered water use was quickly found. Secondly, areas of high water use both during the day and at night were identified.

These high water use areas were then targeted during the following inventory of water use stage. "Homing in" on the areas of high use during the inventory, greatly helped the process of identifying the water reduction alternatives that were available.

2.0 IDENTIFICATION OF SYSTEM COMPONENTS

2.1 Categories of Water Use

The main categories of water use at the Centre can be divided as follows:

Cooling

City water is used for cooling refrigeration equipment for large walk-in fridges and freezers. Cooling for the Computer Room air conditioning units is also provided by city water. The cooling process requires a continuous supply of cold running water. A large proportion of this water is discharged to the bay via the storm sewer system. However significant volumes of once through cooling water are also discharged to the sanitary sewer system.

Process/Plant

The two main areas of process/plant water use are the Fisheries Laboratory and the Hydraulics Laboratory. The Fisheries Laboratory uses city water on a continuous 24-hour, 7 days-a-week basis for the fish tanks, the majority of which is discharged to the bay, with only a small amount of contaminated water diverted to the sanitary sewer system.

The Hydraulics Laboratory, however, uses water on an intermittent basis. Much of the water in the Hydraulics Laboratory is re-used via an underground reservoir/trench system and large recirculating pumps. Periodically, particularly in the summer, water in the underground reservoir/trench is drained away, and replaced with city water. From time to time the flumes and tanks are also filled with city water. Discharge from the Hydraulics Laboratory is to the bay.

Domestic

Hot and cold water is used in the washrooms and the cafeteria, and is discharged to the sanitary sewer system.

Laboratories

The laboratories use city water and reverse osmosis water. Most of this water is utilized at the sinks, but there are also feeds to the fume hoods and enclosures, for use as required. A glass pipework system collects the discharged water and conveys it into the sanitary sewer.

Outdoor

When the lawns are watered in the summer bay water is mainly used. However, there are a number of hose bibbs connected to city water pipes around the buildings that can be utilized for lawn watering.

Fire System

For the main building the supply to the fire pump is taken off the incoming city water pipe before the main meter, and it is therefore unmetered. In the Wastewater Technology Centre it is believed that the fire main is also unmetered. In this case a pump is not required.

2.2 Overall Supply System

City water enters the centre at two locations, the boiler house of the main building and the Wastewater Technology Centre. At the boiler house a combination meter, which records high and low flow, is used to measure the chargeable city water. Similarly, a combination meter measures the chargeable city water entering the Wastewater Technology Centre.

The Schematic shown in Figure 2 demonstrates how the water is distributed and metered after these two meters. In the main building, it can be seen that all sub areas are metered, except for the water taken off in the boiler house. It can also be seen that the supply of water for the fire protection system is connected to the city water pipework before the main meters. This is to ensure that in the event of a fire, there are no restrictions to flow caused by the meter.

2.3 Hydraulic/Process Groups

A Schematic has been prepared for each of the sub metered hydraulic/process groups shown in Figure 2. They have been supplemented with three further schematics of the boiler plant, the hot water system and the water return to the bay. A description of each schematic will now be given.

2.3.1 Boiler Plant Water Supply Schematic

Once water has passed through the main flow meter, the boiler plant is the only area where supplies are drawn from the pipework and not further submetered before use.

With reference to Figure 3 it can be seen that the make-up water to the hot water heater is unmetered. The amount and frequency of make-up is reflected by the volume of hot water used in the main building, and generally follows the pattern of occupancy, with the greatest volumes being used during the working day from Monday to Friday.

There are two unmetered feed pipes into the boiler house itself, and the rate of use is intermittent for domestic purposes, and continuous where the water is used for cooling.

The remaining unmetered connection in the boiler house is for the ship bay, from which water is taken on an irregular basis, when there is a ship in dock.

2.3.2 Hydraulics Laboratory Water Supply Schematic

The incoming water into the Hydraulics Laboratory is metered, and it is then divided into plant and domestic cold water as shown in Figure 4. The plant water is the largest use in this area, and it is further submetered before the connections to the underground reservoirs, tanks and flumes. The domestic cold water is used to cool compressors, which are used intermittently. The outside watering connections are also fed from the domestic pipework system. The majority of the water is discharged into the storm system to the bay.

2.3.3 Fisheries Laboratory Water Supply Schematic

The Fisheries Laboratory receives carbon filtered water at three temperatures, namely ambient, cold and hot, as detailed in Figure 5. The ambient water is fed directly to the Laboratory after the carbon filters. The cold and hot water is supplied via chillers and steam heaters, which are located in the Research and Development Penthouse. The majority of the water is supplied without further metering, with only a small volume being sub metered in one corner of the laboratory. The water from this corner is discharged to the sanitary sewer system. All other discharges are to the bay via the storm system.

2.3.4 Research and Development Water Supply Schematic

The main cold water pipes for the Research and Development building are located in the Penthouse. A new meter, which was installed for the audit, is used to measure the supply which is divided between domestic cold water and low pressure domestic cold water, as shown in Figure 6. From the Penthouse, pipes from both pressure systems run down to the 1st and 2nd floors. The domestic cold water system then continues into the Workshop and Warehouse.

2.3.5 Administration and Laboratory Water Supply Schematic

The Administration and Laboratory building receives its water from the same supply pipe which feeds the Research and Development building. The cold water flow is measured by a newly installed flow meter. The main pipework system which supplies the whole building is located on the 3rd floor.

In this case there are three domestic cold water pressure systems, namely low pressure, domestic (city water pressure), and high pressure, as shown in Figure 7. At the time of the audit, the pressure reduction valve was by-passed, and the low pressure system was operating at domestic pressure. It can therefore be seen by reference to the schematic, that the 1st to the 5th floors are operating at domestic pressure; and that the 6th floor, 7th floor and penthouse are operating at high pressure.

From the pipework gallery on the 3rd floor, the schematic shows that numerous pipes feed water up and down the building along the full length of the 3rd floor.

2.3.6 Wastewater Technology Centre Water Supply Schematic

City water is supplied to the Wastewater Technology Centre through a combination meter which is located in the service tunnel from the main building. After the pipe enters the centre it rises to the Penthouse where it divides into domestic cold water and plant water, as shown in Figure 8.

The domestic cold water operates at a low pressure and provides water for the hot water heater make-up, and the reverse osmosis unit. The Laboratories, which are located on the 1st and 2nd floor, are also supplied for this system.

The plant water is supplied through a pressurized break tank. The plant water system also feeds the outside buildings.

2.3.7 Hot Water Supply Schematic

Both the main building and the Wastewater Technology Centre have their own hot water heaters, which use steam from the boiler plant to warm the water. Both buildings have a flow and return hot water system connected to the water heaters.

For the main building, a schematic of the flow and return system is detailed in Figure 9. It can be seen that all areas except the boiler plant have a return of hot water to the heater, which is kept circulating by a pump located next to the water heater.

The main distribution pipe run in the Research and Development building is located in the Penthouse. Pipework exists for two pressure systems, low and domestic, but at the time of the audit the pressure reduction valve was by-passed, and the whole building was operating on domestic pressure. Only domestic pressure hot water is returned to the water heater.

The Administrative and Laboratory building hot water flow and return main pipework runs are located on the 3rd floor. In this case pipework exists for three pressure systems, namely low, domestic and high. As in the Research and Development building, the low pressure system was operating at domestic pressure during the audit. Therefore, domestic hot water is supplied to the 1st to 5th floors, and high pressure domestic hot water is delivered to the 6th and 7th floors, via a pump which is located on the 3rd floor. Again only domestic pressure hot water is returned to the water heater.

2.3.8 Water Return to Bay Schematic

Water is returned to the bay, via a storm sewer system, from four areas of the main building as shown in the schematic detailed in Figure 10. A rebate on the sewer charge is obtained on the water bill for this volume of water.

For the Fisheries Laboratory, the majority of the water used in the fish tanks is returned to the bay. The volume is the difference between the main fisheries meter and the three hot, cold and ambient sub meters. This volume represents a continuous, significant amount of water used once, and then discharged. Similarly, in the Hydraulics Laboratory the majority of the water is returned to the bay, as measured by the plant water meter.

The meter for the reverse osmosis unit is located in the Administrative and Laboratory Penthouse, next to the unit, and approximately 45 percent of the metered water is returned to the bay. The other 55 percent is delivered to the laboratory sinks for use and discharge to the sanitary sewer system.

Finally, the largest volume of water returned to the bay is from the Administration and Laboratory, 4th to 7th floor. A continuous supply of city water is used to cool a large number of walk-in fridges and freezers. The flow is measured by the north and south meters, which are located on the 3rd floor of the building.

3.0 ADDITIONAL FLOW METERING INSTALLATION

Before the audit was completed, only approximately 50 percent of the city water flow was measured once it had passed through the CCIW main meter. It was therefore decided, as part of the audit, to install two additional flow meters. These meters were fitted in the 3rd floor pipe gallery of the main building. One was located to measure the flow into the Research and Development building, including the Workshop and Warehouse; and one to measure the flow into the Administration and Laboratory Building.

Both flow meters were installed on Saturday, July 27th, 1991, following extensive warning of water users at the Centre. In order to minimize the area of the building that would be without water, the domestic cold water pipes were frozen to install the necessary valves and tees. The new flow meters were fitted on by-pass pipework with appropriate isolating valves.

Once the flow meters were valved into operation, it quickly became apparent that they were to become extremely important for the audit. The flow meter for the Administration and Laboratory recorded approximately 45 percent of the total flow into the main building.

4.0 FLOW METER RECORDING

4.1 Manual Reading of Flow Meters

Twelve existing and two new flow meters were manually read over a three-week period commencing Monday 29th July, 1991. Readings were taken three times daily from Monday to Friday, at 8:30, 12:30 and 16:30 hrs. Over the weekend the meters were read at 8:30 and 16:30 hrs. A long weekend occurred at the end of the first week, with a statutory holiday on Monday, August 5th, 1991.

This frequency of manual meter reading enabled the morning and afternoon peak flows to be identified. The important night time base flow was also quantified.

The meter readings were entered into a spreadsheet as read, and converted to a common unit of cubic metres. In order to be able to compare flows, the readings for each period were calculated as a flow rate in cubic meters per day. The flow rates for the three week metering period are shown in the table in Figure 11.

A rebate on the sewage treatment charge is given by Burlington Hydro for the amount of storm water returned to the bay. This figure can be calculated from the existing flow meters. However, in order to make an estimate of the total flow discharged from the main building, site measurement of the sanitary pumped flow was completed during the three-week test period. Measurement of flow into and out of the building enabled a better understanding to be gained about the water use patterns.

4.2 Sanitary Flow Recording

Because of practical and financial considerations, it was decided with Environment Canada that the sanitary flow discharged would be measured indirectly rather than by the use of a flow measuring device installed directly inside the pipe.

Both the main building and the Wastewater Technology Centre have their own individual sewage chambers, which receive the wastewater flow. From these two chambers, submersible pumps are used to deliver the wastewater into the Burlington Hydro system. Because the Wastewater Technology Centre only accounted for 6 percent of the total complex flow, it was decided to complete the recording of sanitary discharge for the main building only.

The method of operation of the sanitary pumps is that when the level of wastewater in the chamber reaches a controlled level, a pump starts and runs until a defined lower level is reached in the chamber. The chamber is then allowed to fill until the upper level is reached to start the pump again.

The estimate of sanitary flow was made in two stages. Firstly, the pump discharge rate was calculated over a 90-minute period, from the average of pump and fill rates. Although this technique has its limitations, it was considered to be far more accurate than using the manufacturer's pump duty. Secondly, a clip on power meter and data logger was attached to the pump incoming power cable to record the frequency and duration that the pumps were in operation. From the pump rate and pumping time it was possible to make an estimate of the sanitary flow leaving the main building.

The test was completed over a 13-day period during the three-week test, and the results are tabulated in Figure 12. Two data loggers were used, and changed halfway through the test. The reason for the gap in data on August 14th and 15th is that the loggers store data for 6 to 7 days and write over the first data recorded when the memory is full.

5.0 WATER BALANCE - MAIN METER

5.1 Historical Water Use

In order to establish how representative was the volume of water used during the three-week recording period, the historical monthly metered amounts were examined. The twenty months between January, 1990 and August, 1991 were reviewed. The Burlington Hydro billed volumes for the main meter and the Wastewater Technology Centre are tabulated in Figure 13, and shown in graphical form in Figure 14.

Since January, 1990, the average total volume of water supplied into the centre has been 23,800 m^3 per month. Generally more water is used in the summer than in the winter. During the three-week audit period, 14,400 m^3 of water was measured, which is equivalent to an average of 20,600 m^3 for the month. Therefore, during the audit, the water used was approximately 13 percent below the twenty-month average.

5.2 Main Meter Balance

For the CCIW main meter the flow rates for the morning, afternoon and night intervals are shown graphically in Figure 15 for the three-week reading period. It can be seen that during the working day from Monday to Friday, that the rate of use is between 800 and 950 m^3 per day. Overnight and at the weekend the base flow is between 500 and 600 m^3 per day. This base figure is a continuous 24-hour flow.

Referring to Figure 16, which demonstrates the flow rate graph for the Wastewater Technology Centre, the volumes of water used are considerably smaller, but the variation in flow rates are larger. The daytime base flow is in the order of 35 to 40 m^3 per day, and the overnight and weekend flow is 20 m^3 per day. However, when plant water is used for pilot work, the rates increase considerably up to 150 m^3 per day as shown.

With reference to the overall water supply schematic shown in Figure 2, for the main building most water is further sub metered once it has passed through the main meter. The unmetered portion has been estimated by simply deducting the total of the five sub meters (No's. 2, 3, 12, 13, 14) from the main meter. It has been plotted graphically in Figure 17. A representative 10-day interval between August 6th and 16th is shown. The estimated unmetered flow must be treated with caution, because it has been derived from six flow meters, which have their own level of inaccuracy. By inspection, 5 percent inaccuracy in the main meter amounts to 25 percent of this estimated flow.

6.0 WATER BALANCE - INFLOW AND OUTFLOW

To further enhance the water balance, the inflow of city water and outflow of storm and sanitary water was derived for the main building. The inflow of city water has already been discussed and shown graphically in Figure 15. The storm and sanitary discharges will now be reviewed, followed by the inflow/outflow balance.

6.1 Storm Return to Bay

The components of the storm water returned to the bay are shown on the schematic in Figure 10. The largest volumes are the Fisheries, hot, cold and ambient water, and the storm water meter returns from the Administrative and Laboratory building. The graph given in Figure 18 indicates the variation storm return over the three-week recording period.

The daytime flow rate is generally between 400 and 500 m^3 per day, and the night time and and weekend base flow rate is between 300 m^3 and 400 m^3 per day. This base figure is a continuous 24-hour flow. The short term high flow rates are normally caused by the hydraulics laboratory plant water use.

6.2 Sanitary Pump Flow

The results of the sanitary flow recording for the main building have been tabulated in Figure 12, and are shown graphically in Figure 19. The daytime flow rates vary between 500 and 700 m^3 per day, at the night time and weekend base flow rate is between 200 and 300 m^3 per day. Again, this base flow is continuous for 24 hours.

6.3 Inflow and Outflow Balance

For the main meter, storm return and sanitary flow, the respective rates are shown individually in Figure 20. The inflow and outflow (storm and sanitary) are also plotted in Figure 21.

It can be seen that the outflow is at most times greater than the inflow of city water, by a rate of approximately 50 to 100 m^3 per day. This difference is caused by either error in flow meters and the sanitary pump test, or unmetered flows being discharged to sewer.

It is likely that the inflow and storm return values are more accurate than the sanitary discharge estimate. Firstly, the sanitary pumped flow was derived from pumping rate and duration of operation, which will contain inaccuracies. And secondly, the sanitary flow was estimated at the sewage chamber which is located away from the main building to the east of the front car park. The sewer pipes are laid in filled ground, probably below the water table, and there is likely to be infiltration into the pipe. Also, any water discharged from the ships bay would increase the unmetered sanitary flow.

It is therefore not surprising that the total storm and sanitary outflow is greater than the metered city water inflow. The magnitude of the difference may not be as shown because of the inaccuracies described. However, the pattern of day, night and weekend flow is valid.

7.0 WATER BALANCE - SUB AREAS

7.1 Hydraulics Laboratory

The schematic in Figure 4 demonstrates that the hydraulics laboratory water is divided between plant and domestic use. However, most of the water used is in the plant. The total flow variation over the three week recording period is shown in Figure 22.

Plant water is used in a random manner, and although when taken the flow rates are high, the volumes abstracted are relatively small when compared with the centre's total use.

7.2 Fisheries Laboratory

The total flow into the Fisheries Laboratory is shown in Figure 23. Most of the area is supplied by hot, cold and ambient water that is not further metered once it has passed through the carbon filters, as detailed in the schematic in Figure 5.

During the three week recording period, no flow was measured by the cold water meter, "2A". The rates of flow for the hot, "1A", and ambient, "3A", meters are shown in Figure 24. This water is contaminated, and is discharged to the sanitary sewer.

For the 10 day period between the 6th and 16th of August, the unmetered flow rate is given graphically in Figure 25. The base continuous 24 hour flow that is returned to the bay is approximately 135 m^3 per day.

7.3 Research and Development

The Research and Development Building, and the Workshop and Warehouse are detailed in the schematic in Figure 6, and are relatively small users of water. The flow rate variation over the three week period is demonstrated in Figure 26. The continuous 24 hour base flow is between 25 and 35 m^3 per day in the week, and falls to 20 m^3 per day at the weekend. The daytime use is predominantly for washrooms and laboratory sinks.

7.4 Administration and Laboratory

The Administration and Laboratory Building is the single largest consumer of water at the centre. The schematic in Figure 7 identifies the three domestic cold water pressure systems. Over the three week recording period, the variation in flow rate is shown in Figure 27. The normal daytime flow rate varies between 370 to 450 m^3 per day, and the continuous night time rate is 220 to 280 m^3 per day. At the weekend the base flow rate is 210 to 240 m^3 per day.

The major daytime users are divided between washrooms, the cafeteria and laboratory sinks. In order to investigate the components of the large base flow 24 hours a day, the summation of the two storm meters "B" and "C" is plotted against the inflow in Figure 28. It clearly shows that 180 to 220 m^3 per day is discharged to the bay. These two meters collect storm water from the 4th to 7th floor and penthouse only. Most of this water is used for once through cooling at the numerous fridges and freezers. It is estimated that the remaining 24 hour base flow, of approximately 50 m^3 per day, is also used for cooling, mainly at the cafeteria and 1st floor computer rooms.

An indication of the split between the two storm meter flows is given in Figure 29. The north meter receives almost exclusively 24 hour base load flow, whereas the south meter receives a combination of base load and daytime flow.

7.5 Wastewater Technology Centre

A hydraulic schematic of the centre is given in Figure 8, and the variation in flow rate is demonstrated in Figure 16. The rates of water use were discussed in the main meter balance section 5.2.

7.6 Softened Water

A water softener is located in the boiler plant. Softened water is used to supply the reverse osmosis unit in the Administration and Laboratory Penthouse and as make-up water for the boilers. Figure 30 shows the variation in softened water, and the volumes used by the reverse osmosis unit. The difference between the softened water and reverse osmosis water meter figures is the amount of make-up water delivered to the boiler. Figure 31 details this boiler make-up variation.

7.7 Boiler Plant

As discussed in Section 5.2 to estimated unmetered volume of water used in the boiler plant should be treated with caution. The derived daytime flow rate is around $200m^3$ per day, and the night base flow is about 80 m^3 per day, as demonstrated graphically in Figure 17.

As shown in the Figure 3 schematic, the two main water uses abstracted in the boiler plant are for make-up water to the hot water heater, and cooling water for the boiler plant.

8.0 INVENTORY OF WATER USE

8.1 Approach

The inventory of water use was completed for the sub areas described in Section 7.0. The approach for each sub area was to quantity the volume of water used by category. The four main categories of use were described in Section 2.1, and are cooling, process/plant, domestic and laboratories. During the audit there was a negligible amount of water used outdoors and for the fire system.

From the flow variations already described, it can be seen that the rate of use of the centre is divided into two types. Firstly, a continuous 24 hour, 7 days a week base flow, and secondly, an 8 hour Monday to Friday daytime flow, on top of the 24 hour base. This pattern and magnitude of flow rate, was well established during the three week audit period. Occasionally high flow rates occurred on weekdays, at the hydraulics laboratory in particular. If these occasional, short-term flows are screened out, then a clear pattern emerges. The flow rates at 9 representative weekdays (30, 31 July; 1, 7, 8, 9, 12, 15, 16 August) were used to establish a weekday 24 hour base flow, and an 8 hour daytime flow pattern. The base flow at the weekend was slightly less than the overnight flow between the weekdays. From Monday to Friday, the average base 24 hour volume of city water supplied for the whole complex was 562 m^3. This figure represents 85 percent of the total. Only 103 m^3, or 15 percent was supplied on top of this base flow for use during the working day from Monday to Friday.

The inventory by category of use was therefore further subdivided into 24 hour base flow and 8 hour daytime weekday flow. Also, it was identified if the discharge was to storm or sanitary sewer. This technique of categorizing and subdividing greatly enhanced the understanding of water use, and was an essential prerequisite to identifying water reduction opportunities.

For each sub area the inventory has been tabulated in Figure 32. A description will now follow of each sub area inventory.

8.2 Boiler Plant

Included in this inventory is the unmetered use in the boiler plant area, that was reviewed in Section 5.2, and the softened water. It can be seen that the main water use is to cool the steam making boilers, and this is a 24 hour base flow of 40 m^3 per day, which is discharged to the sanitary sewer. The other base flow is of softened water, of which 12 m^3 is for boiler make-up, and 8 m^3 for the reverse osmosis unit.

Generally, during the day 10 m^3 is supplied as make-up water to the hot water heater, and 3 m^3 for reverse osmosis water use in the laboratories.

From the inventory the unmetered boiler plant use is estimated at 50 m^3 per day in total, whereas the figure calculated from the difference in the main meter and sub meters was 102 m^3. It was explained in section 5.2 that the meter calculated figure should be treated with caution because of meter error. Therefore, the inventory value will be treated as more accurate for the boiler plant area.

8.3 Hydraulics Laboratory

Although large volumes of water are used in the Hydraulics Laboratory, normally only a small amount of city water is required daily. The extensive trench and reservoir system is used to recirculate water via the two sets of installed pumps.

City water is used on a 24 hour base for cooling at a cold room and filling/top up of tanks generally. This represents a base flow of 25 m^3 per day. The small amount of daily use, 9 m^3, is for domestic use and daytime process/tank filling.

8.4 Fisheries Laboratory

Nearly all of the flow to the Fisheries Laboratory is supplied on a continuous 24 hour basis. Of the 183 m^3 per day average, 174 m^3 is constantly delivered to the fish tanks , and only 9 m^3 used in the day to backwash the carbon filters and at the laboratory sinks. A constant flow of 133 m^3 per day is discharged from the fish tanks to the storm sewer, and 41 m^3 is discharged to the sanitary sewer. The 174 m^3 per day flow is the second largest single use in the complex, the largest being at the Administration and Laboratory Building.

8.5 Research and Development

The main area of use in the three storey building is at the computer rooms and photographic laboratory. Air conditioning units are utilized at each location. Cooling for these units is achieved by a continuous flow of 27 m^3 per day of city water, which is discharged to the sanitary sewer system. The daytime use of 7 m^3 is primarily at the washrooms, at the laboratory sinks and enclosures, and in the photographic laboratory, with discharge to the sanitary sewer.

8.6 Administration and Laboratory

The average 299 m^3 per day which is supplied to the Administration and Laboratory area represents approximately 45 percent of the total flow into the main building. The largest proportion of this flow, 251 m^3 per day, is used on a continuous 24 hour basis for once through cooling.

The main cooling load is for large walk in fridges and freezers which are located between the 4th and 7th floor of the building. Once used, an average of 200 m^3 per day of city water is collected in the 3rd floor pipe gallery, from where it is passed through two flow meters (south storm "C", north storm "B"), and then discharged back to the bay.

The other significant cooling load is at the computer area on the 1st floor, where two air conditioning units are operated. The majority of the remaining 51 m^3 per day of 24 hour cooling is used at this location. Small volumes of water are utilized to cool the cafeteria fridges and freezers. All cooling water on the 1st and 2nd floors is discharged to the sanitary sewer.

During the day, these are three main categories of use which account for 48 m^3. Firstly, the laboratory sinks utilize city water for experiments, cleaning and creating vacuum. Secondly, water is used for domestic purposes in the washrooms. The third area of use is in the cafeteria for meal preparation and dishwashing. All water used during the day is discharged to the sanitary sewer.

8.7 Wastewater Technology Centre

Although the average volume of water used is relatively small at 41 m^3 per day, large variations and increases take place when pilot plant work is ongoing. A base 24 hour flow of 24 m^3 per day is used for watering at the outside greenhouse, cold room cooling and at the pilot plant. During the daytime a large proportion of the 17 m^3 is utilized in the washrooms, and at the laboratory sinks. Small amounts are used by the reverse osmosis unit, outside buildings, pilot plant and domestic hot water make-up.

8.8 Category of Use Summary

A summary of the four main categories of use is shown in Figure 33. It can be seen that cooling represents 50 percent of water used, and process 36 percent. Domestic use and the laboratory account for a further 7 percent each.

It should be noted that the total of the city water inflow from the sub area inventory as shown is 665 m^3. This compares with the main meter total of 717 m^3. The 52 m^3 difference is the cumulative effect of flow meter inaccuracy, and at 7 percent is not unreasonable.

8.9 Typical Water Consumption Values

It is worth at this stage considering water consumption typical values, which are frequently quoted, but often variable in magnitude. The variation is commonly caused by a diversity of the components used to make-up the typical value.

Water consumption rates are usually expressed as litres per person per day. For the centre, if the total volume of water supplied, 717 m^3, is divided by the summer work force of approximately 700 people, then a rate of consumption of 1,025 litres per person per day is derived. Clearly this figure is unrealistic, because of the nature of water use at the complex.

At the other extreme, if the volume of water used domestically in the washrooms and cafeteria is taken, at 45 m^3, then the rate of consumption is 65 litres per person per day. At the centre the washrooms are equipped with flush valves which generally use less water than traditional toilet tanks. At Proctor & Redfern's head office, which employs approximately 350 staff, the domestic consumption rate is 85 litres per person per day. A typical office domestic consumption range is therefore between 60 and 100 litres per person per day.

However, other city water is used at the centre, and buildings in general, which is related to domestic occupation. In the summer city water is used to cool at the boilers which produce steam to heat water. In the winter the same boilers provide steam to heat the buildings. Local air conditioning units for several computer rooms and the photographic laboratory use city water for cooling. If these volume are added to the very base domestic figure, the typical water consumption rate increases to about 250 litres per person per day. This figure is specific to the Canada Centre for Inland Waters, and is related to the type of equipment used. It is hoped that this commentary has demonstrated that there is not a typical value for water consumption. Rates of use are specific to individual facilities according to the water using equipment and activities. However, a figure of 60 to 100 litres per person per day could be used as the very basic domestic consumption, and then other uses could be added for each specific facility.

9.0 WATER REDUCTION ALTERNATIVES

During the course of the audit potential areas of water reduction were identified. They will now be described, with the most viable option, of reducing once through cooling water, being reviewed first.

9.1 Cooling Water

By far the largest category of water use in the complex is cooling. City water is used for cooling compressors and motors in approximately 50 locations throughout the centre. In all cases the cooling process in "once through" with the warmed water flowing directly to drain. Approximately 60% of the cooling water is used in the 4th to 7th floors of the Administration and Laboratory building, and is piped back to the bay, so that at least the sewer charges can be saved. However, several larger users, including the computer centre, are still incurring water and sewer charges for their cooling water.

The main chillers in the boiler plant, however, are cooled using water pumped from the bay through an underground pipe. This circulation system is presently used only in the summer.

The cooling loads for the individual areas of the main building have been analyzed in terms of their average flow to identify water cost savings, and maximum flow for sizing and costing water reduction alternatives. The average city water used for cooling was 327 m^3 per day, with 127 m^3 per day attracting a sewer charge in addition to the water charge. Four options have been analyzed, and each option would be capable of supplying the combined cooling load in the Boiler House, the Hydraulics Laboratory, Research and Development, and Administration and Laboratory. The most practical, cost beneficial and attractive option is described first.

9.1.1 Bay Water Cooling

This system would require the lowest capital cost because only supply piping to the refrigeration equipment would be needed. Since this can still be considered as a "once through" system, the existing drains can be used. Furthermore, operating costs would be lower, since "cool" water is available all year round. If it is found that peak summer bay water temperatures are too high for cooling purposes, a small heat exchanger could be installed in the boiler room to pre-cool the incoming bay water, using chilled water. However our preliminary investigations have revealed that the existing equipment could accommodate cooling water temperatures as high as 80°F.

The proposed bay water cooling option is shown in Figures 34 and 35. Water will be taken from the existing bay water recirculation system in the boiler plant. The bay water will then be pumped, using two variable speed 20 HP pumps, to the refrigeration equipment. The main pipe run will be installed in the Administration and Laboratory 3rd floor, and the Research and Development Penthouse, with connections to the Boiler Plant and Hydraulics Laboratory en route. The main pipe run in the Administration and Laboratory Building will then rise vertically up to the Penthouse, to a 2,000 gallon storage tank. This tank will contain 15 minutes capacity for the Administration and Laboratory building cooling. From the tank, pipework will feed down and along the service corridors in the 4th to 7th floors. Control equipment will be installed to maintain the storage tank volume across the range of cooling loads.

It is understood that pipework from an old cooling tower system is still installed in the service corridors of the Administration and Laboratory 4th to 7th floors. If the pipework is in usable condition, and has the required capacity, the cost of the bay cooling option will be reduced. Therefore, two estimated costs have been prepared. The cost for the installation of this option is $101,000, which could be reduced to $73,000 if the old cooling tower pipework can be used in the 4th to 7th floors.

There may be an additional cost associated with winterization of the bay water intake, and also a further cost if a small heat exchanger is required.

The estimated cost savings, however, are significant. Based on a reduction of an average 327 m^3 per day of city water, and an additional saving of 127 m^3 per day of sewer charge, the annual combined water and sewer saving would be \$56,400. This is based on current Burlington Hydro rates of 32.10 cents per m^3 for water, and 39.54 cents per m^3 for sewer charge. These rates are likely to increase in the future. The operating cost for this option is estimated to be \$3,000 a year, hence the net saving will be \$53,400.

The pay back period for the \$101,000 scheme, with an annual net saving of \$53,400 is therefore 1.89 years. This period will be reduced to 1.37 years if the existing pipework can be utilized. Even allowing for potential additional costs associated with the bay water intake winterization, and a small heat exchanger, this option is very attractive. Future increases in water charges would reduce the pay back period, and make the option even more beneficial.

9.1.2 Modify Existing Chilled Water System

The existing closed loop chilled water system could be used to cool the refrigeration equipment. However, supply and return lines would have to be piped to all the units from the existing closed loop system. This would involve doubling of the required piping and substantial modifications. An investigation would need to be completed to confirm if the existing chillers have the spare capacity to handle the extra load. Furthermore, the chillers do not operate in the winter at present, and there would therefore be an additional operating cost for this option.

9.1.3 Installation of Cooling Tower System

This scenario would require similar piping modifications as the previous option. An additional capital cost for a cooling tower, pumps and chemical treatment would also be required. Operating costs would be slightly lower.

9.1.4 Air Cooled Refrigeration Units

Due to the large number and discrete location of the existing coolers and refrigeration units, the cost of replacing the the existing equipment would be prohibitive. Furthermore, if the heat were not properly removed from within the building shell (by extensive pipework modifications), the additional cooling load could most likely exceed the present capacity of the main chillers.

9.2 Fish Tank Water

After water used for cooling purposes, the second largest single use is for the fish tanks. The annual cost to provide a continuous flow of city water through the fish tanks is $20,400 for the incoming water, and $5,900 sewer charge for the contaminated portion of the flow; giving a total cost of $26,300. The question must therefore be asked, can this volume be reduced, or recycled in the Fisheries Laboratory? The answer to this question is not within the scope of the audit, because it is dependent on the fish biology. It should therefore be pursued by the staff at the centre.

9.3 Laboratory Sink Water

Water is used in the various laboratories for washing equipment, experiment cooling and creating vacuum. The recording of the sanitary discharge demonstrated that at the three break times during the working day, there is a noticeable reduction in flow. Therefore, the user habit/work practice needs to be further examined to establish if this break time reduction could be extended for longer periods.

It is likely to be uneconomic to provide a number of vacuum pumps to eliminate city water for producing vacuum. The operating costs are similar, before the capital cost of the equipment is taken into account.

9.4 Domestic Water

There are three main areas of domestic water use in the washrooms, at the cafeteria and hot water. The washrooms are fitted with flush valves at the toilets and urinals, so significant savings associated with flush tanks are not available. Generally, the volume of water used is a function of the time the valve is held down. The faucets in the washroom already have an aerator fitted, so again, significant reductions would be difficult to achieve.

In the cafeteria approximately half the flow is used by the dishwashers, and half at the sinks and steam tables. Because the total flows are relatively small, large savings are unavailable. However, maintaining full loads in the dishwashers, and conservative use of water should be maintained.

The amount of hot water used is also very small, and again significant savings cannot be achieved.

9.5 Water Wise Culture

At the centre it will be important to establish a water wise culture at the same time that water reduction schemes are being implemented. The level of awareness of the staff needs to be raised to demonstrate the volumes of water used, the associated costs, and the potential savings. The staff at the centre currently practice material conservation, and have moved from the three R's to the seven R's. They are therefore likely to be responsive to another important, and environmentally friendly conservation effort, that of water reduction.

10.0 RECOMMENDATIONS

It is recommended that a water efficiency program be devised and implemented. The program will contain a combination of physical system changes, and user education to encourage and develop a water conservation culture at the centre. It is clear from the audit that the most significant savings will be from physical system changes. The recommendations are as follows:

i) Design and install a bay water cooling system as described in Section 9.1.1, to replace the "once through" city water cooling at the refrigeration equipment. When implemented, this scheme will reduce the volume of city water used by up to 50%.

ii) Investigate the potential for water reduction or recycling in the Fisheries Laboratory. At 36%, the fish tanks use the second largest volume of city water.

iii) Investigate the potential to modify user habit in the laboratories in order to extend the periods in the day, at break times, when lower volumes of water are used.

iv) Because of the devices installed, there appears to be little potential to significantly reduce the amount of domestic water used by retrofitting. However, user habit change could produce small savings.

v) Establish a water wise culture at the centre.

vii) Use the existing flow meters to monitor the volumes of water supplied. This will be useful to confirm the magnitude of reduction once the water efficiency program is instigated, and also vital to ensure that reductions achieved are maintained in the future.

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Michael Martin, M.A. Sc., P.Eng.

APPENDIX A

STATEMENT OF WORK

APPENDIX "A"

STATEMENT OF WORK

WATER EFFICIENCY AUDIT OF THE CANADA CENTRE FOR INLAND WATERS BURLINGTON, ONTARIO

Background:

Efforts are currently underway to establish water efficiency guidelines for federal facilities. The **Canada Centre for Inland Waters (CCIW)** has been selected as the federal facility to be used in prototyping these guidelines and the first facility to be designated as a water efficient facility.

The development of water efficiency audit guidelines for CCIW and other federal facilities was undertaken by CH2M Hill Engineering Ltd. These guidelines (attached for reference) provide preliminary details on water use at CCIW and an overview of the necessary procedures for conducting the water audit.

The Canada Centre for Inland Waters is one of the world's leading water research centres and a major complex providing Environment Canada and the Department of Fisheries and Oceans with shared facilities for a wide range of environmental research, surveys, and marine research. Laboratories and offices of the following components are housed within the complex:

Environment

National Water Research Institute (NWRI)
Inland Waters Directorate, Ontario Region
Water Quality National Laboratory
Canadian Wildlife Service, Ontario Region
Wastewater Technology Centre

Fisheries and Oceans

Great Lakes Fisheries Research Branch
Bayfield Laboratory for Marine Science and Surveys

In addition to the normal institutional-type water uses at CCIW, the laboratories of the complex are major users of water. Among these can be noted in particular the Hydraulics Laboratory of NWRI, whose facilities include a huge 100-metre wind-wave flume and a large-scale cold room with water flumes, the Fisheries Wet Laboratory, and the Wastewater Technology Centre, which conducts its work in laboratories and stationary pilot plants in a separate building at CCIW.

Objective:

The purpose of this contract is to undertake a **water audit of the Canada Centre for Inland Waters complex** in order to document water uses and to determine if and where excess water is being used and to identify ways in which water use can be reduced or made more efficient. The water audit results will be used directly in the design of an appropriate program for the facility to use water as efficiently as possible. A successful water efficiency program can result in significant savings to the facility through reduced water supply and sewer charges.

Scope of Work:

1. The contractor shall undertake a water efficiency audit of the Canada Centre for Inland Waters (CCIW) by:

(i) defining the water distribution system infrastructure: (for example, identifying which areas of the facility have hot and cold water supplies; identifying measured and unmeasured water supplies; identifying all points in the system where water can be extracted; providing distribution system design details);

(ii) developing a detailed inventory of all of the water use operations at the facility, according to: category of water use; volume, rate and frequency of use (including seasonal use considerations); discharge locations; water lost or consumed;

(iii) installing additional metering or taking additional flow measurements, as required;

(iv) preparing a water balance for the facility by equating the volume of water supplied to the facility to the water used in each area of the facility; and,

(v) estimating discharge flows through the sewage lift station pump and storm drain.

2. The results of the water audit will be an account of the water volumes used by each operation summed up for the whole facility. Information on water quality required for each operation, as well as variations in water demand should be provided through the water audit. The contractor should, in addition, identify suitable locations for the sampling of water quality of water use discharges.

3. The contractor, on the basis of results of the water audit, shall provide recommendations, complete with cost-benefit analysis, on requirements and specific measures to be taken to reduce water use and improve water efficiency at the facility.

Project Information:

1. The Canada Centre for Inland Waters was completed in 1971 as a federal research facility. CCIW is located on the northeast edge of Hamilton Harbour, south of Burlington and north of Hamilton. The site covers over 40 hectares on which 47,700 m^2 of building facilities sit.

The CCIW complex consists of seven main sections. These are:

- Boiler Plant
- Hydraulics Laboratory
- Great Lakes Laboratory for Aquatic Sciences (GLLFAS) (Fisheries Wet Laboratory)
- Research & Development Building
- Administration & Laboratories Building
- Workshop - Warehouse
- Wastewater Technology Centre

Research is carried out in the Hydraulics Laboratory, Fisheries Laboratory, Administration & Laboratory Building, Research and Development Building and the Wastewater Technology Centre. The

Hydraulics Laboratory is equipped with a tow tank, a wind/wave flume, and various other hydraulic testing equipment. The Fisheries Laboratory, which undertakes toxicity testing of aquatic life, contains a series of hot, cold and ambient water tanks. The Administration & Laboratory Building houses numerous laboratories which support a variety of analytical research. And finally, the Wastewater Technology Centre contains a pilot plant and analytical labs, which support wastewater related research. The remaining sections of CCIW support the research arm of the facility. The Boiler Plant provides heating, cooling and other plant services to the facility. The Workshop-Warehouse contains a variety of shops (wood, machine) and storage. And finally, the A & L section houses offices, an auditorium and the cafeteria.

There are in excess of 300 individual water use points at CCIW, some of which are subject to seasonal use variations. Division of the complex into smaller, water-using sub-areas is possible to provide the advantage of using internal meters (of which there are nine) to provide flow information required for the water balance. The smaller sub-areas can be chosen to represent a logical area of water use, as well as management responsibility. For example, the Hydraulics Laboratory and the Fisheries Laboratory are beside each other, but each has separate meters and different management; thus, they can be divided for the purposes of the water balance. Large areas of office space with washrooms as the only water use can be grouped together, while the Cafeteria, with a distinct and specific water use, can be separated.

Further details are provided to the contractor in "**Guidelines for Conducting a Water Audit and Developing a Water Efficiency Program at the Canada Centre for Inland Waters**", prepared by CH2M Hill Engineering Ltd.

2. Access to the facilities will be arranged with CCIW (NWRI) Buildings and Property Services.

Deliverables and Control Procedures:

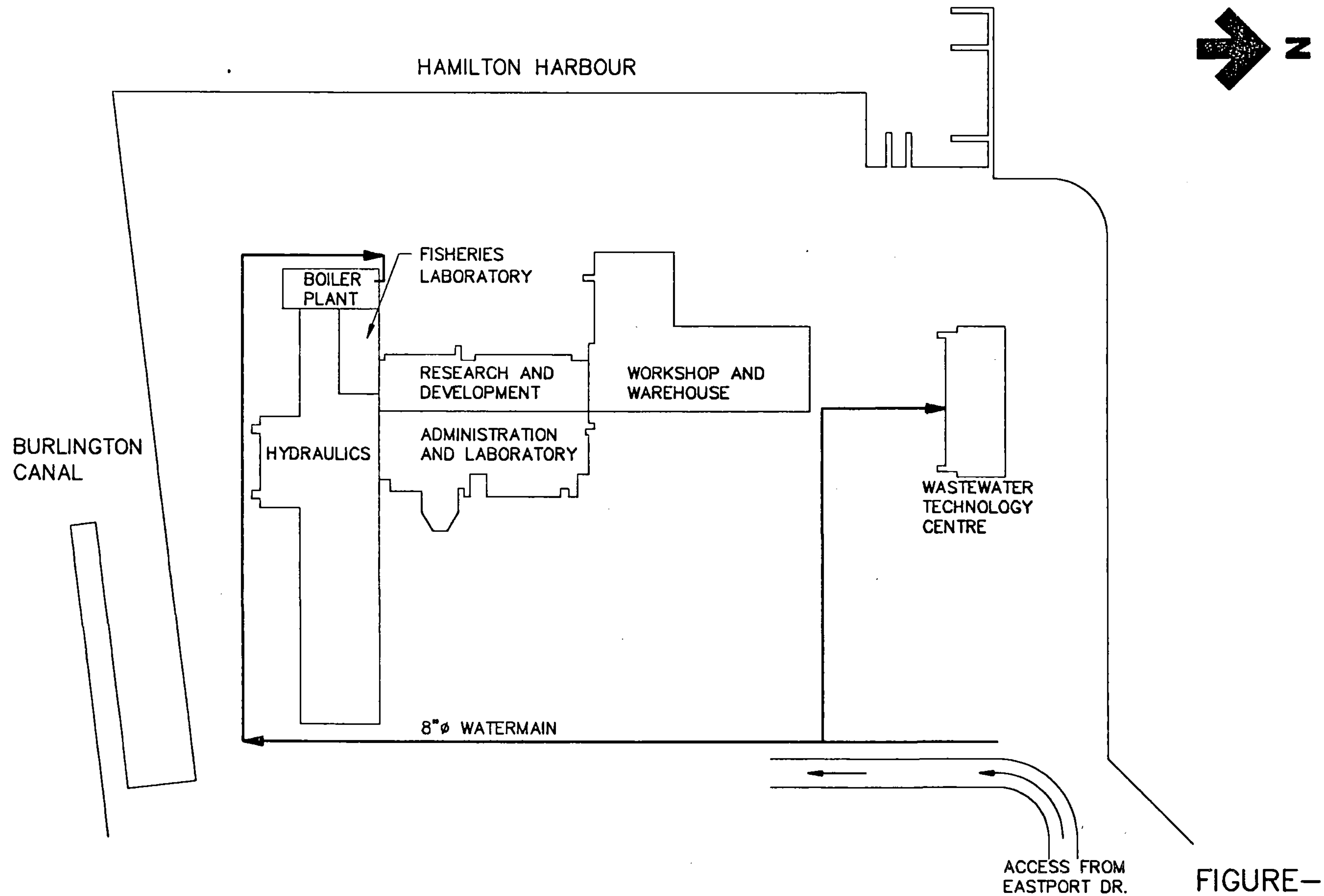
1. The contractor shall conduct and complete a comprehensive water audit of the CCIW complex and shall provide a written report fully documenting the audit process, analysis of findings and results, and recommendations on the implementation of water efficiency improvement measures.

2. Fifteen copies of the final, approved report shall be delivered to the Scientific Authority at the completion of the contract.

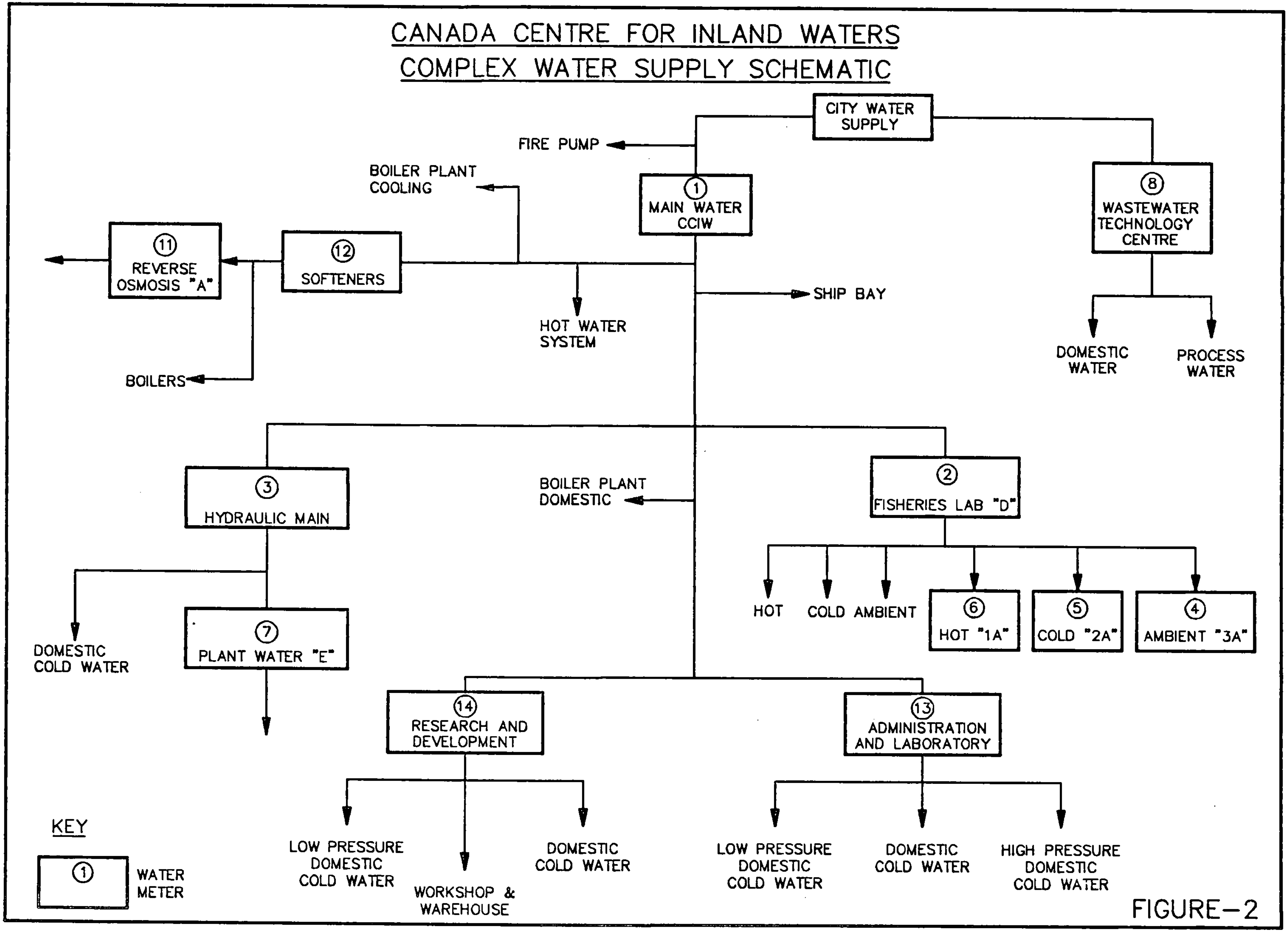
3. The contractor shall meet with the Scientific Authority and the CCIW Water Efficiency Designation Committee at the contract start-up, at least once during the term of the contract (or more frequently, as required) to report on the progress of work, and at the completion of the work, shall provide draft copies of the report for discussion of findings and recommendations, prior to report finalization.

CANADA CENTRE FOR INLAND WATERS

SITE PLAN



FIGURE–1


CANADA CENTRE FOR INLAND WATERS
COMPLEX WATER SUPPLY SCHEMATIC
CITY WATER SUPPLY
FIRE PUMP
BOILER PLANT COOLING
1 MAIN WATER CCIW
8 WASTEWATER TECHNOLOGY CENTRE
11 REVERSE OSMOSIS "A"
12 SOFTENERS
SHIP BAY
HOT WATER SYSTEM
BOILERS
DOMESTIC WATER
PROCESS WATER
3 HYDRAULIC MAIN
BOILER PLANT DOMESTIC
2 FISHERIES LAB "D"
HOT
COLD
AMBIENT
6 HOT "1A"
5 COLD "2A"
4 AMBIENT "3A"
DOMESTIC COLD WATER
7 PLANT WATER "E"
14 RESEARCH AND DEVELOPMENT
13 ADMINISTRATION AND LABORATORY
KEY
1 WATER METER
LOW PRESSURE DOMESTIC COLD WATER
WORKSHOP & WAREHOUSE
DOMESTIC COLD WATER
LOW PRESSURE DOMESTIC COLD WATER
DOMESTIC COLD WATER
HIGH PRESSURE DOMESTIC COLD WATER
FIGURE-2

CANADA CENTRE FOR INLAND WATERS
BOILER PLANT WATER SUPPLY SCHEMATIC

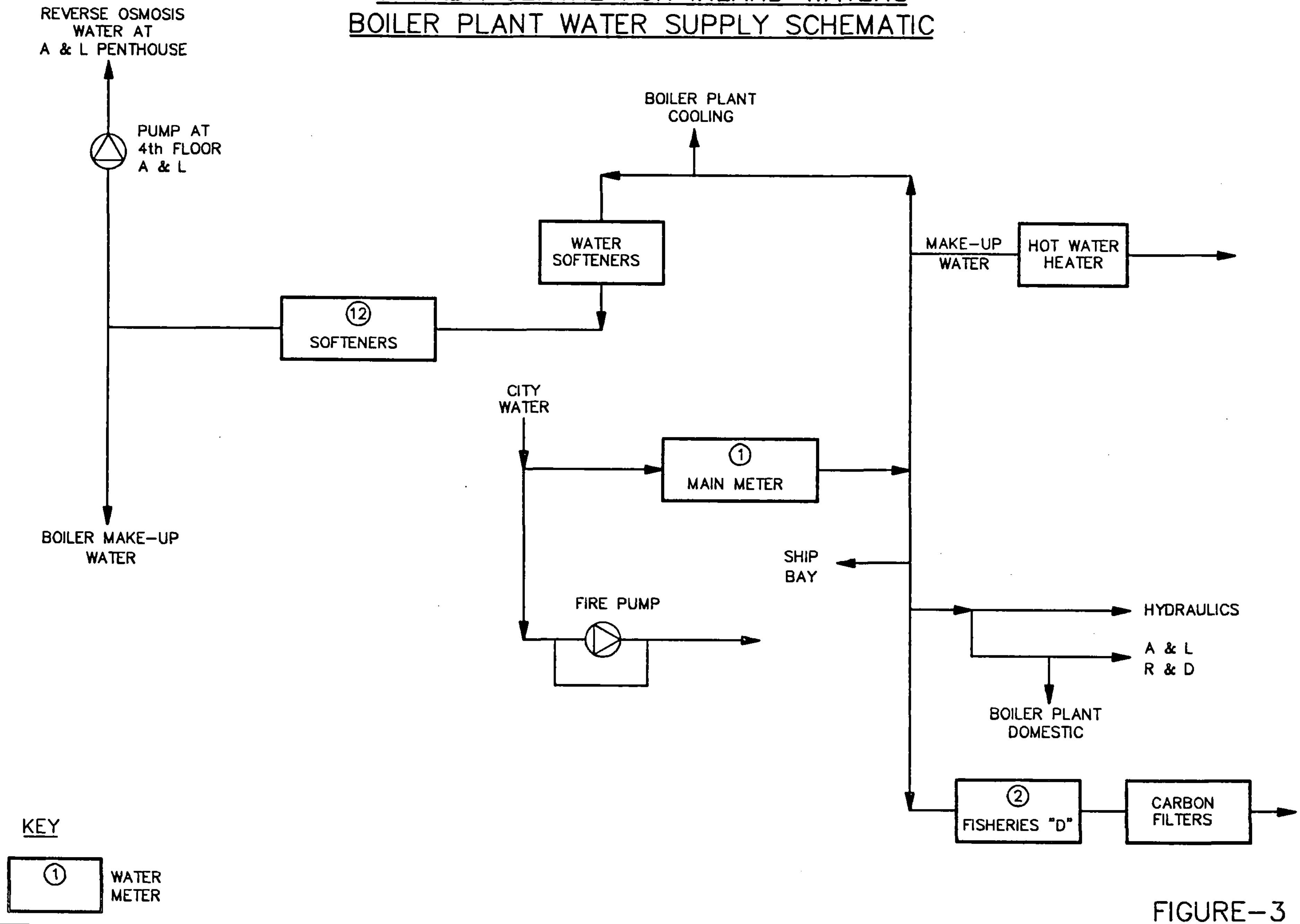
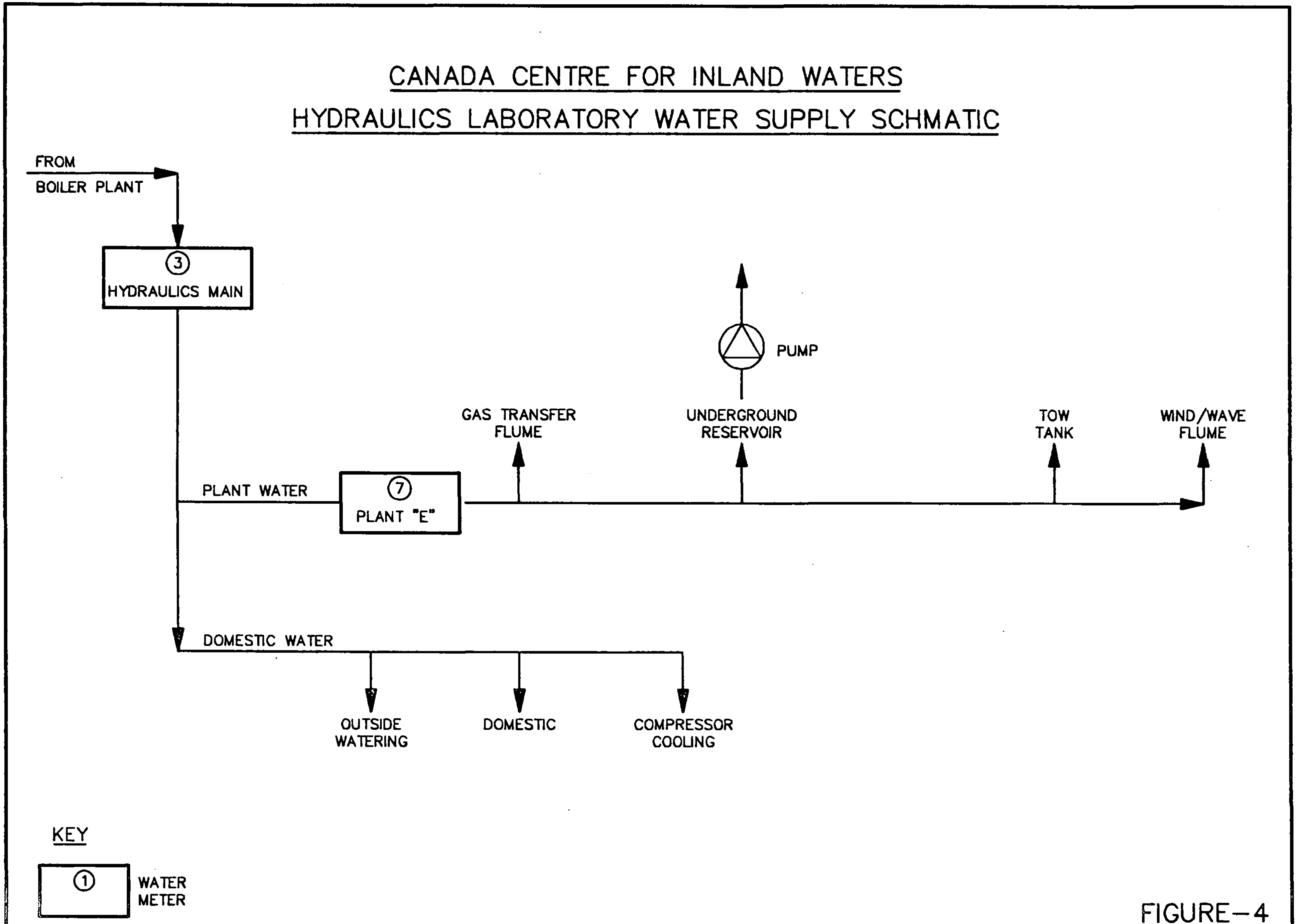


FIGURE-3



CANADA CENTRE FOR INLAND WATERS
HYDRAULICS LABORATORY WATER SUPPLY SCHMATIC
FROM
BOILER PLANT
3
HYDRAULICS MAIN
PUMP
GAS TRANSFER
FLUME
UNDERGROUND
RESERVOIR
TOW
TANK
WIND/WAVE
FLUME
PLANT WATER
7
PLANT "E"
DOMESTIC WATER
OUTSIDE
WATERING
DOMESTIC
COMPRESSOR
COOLING
KEY
1
WATER
METER

FIGURE-4

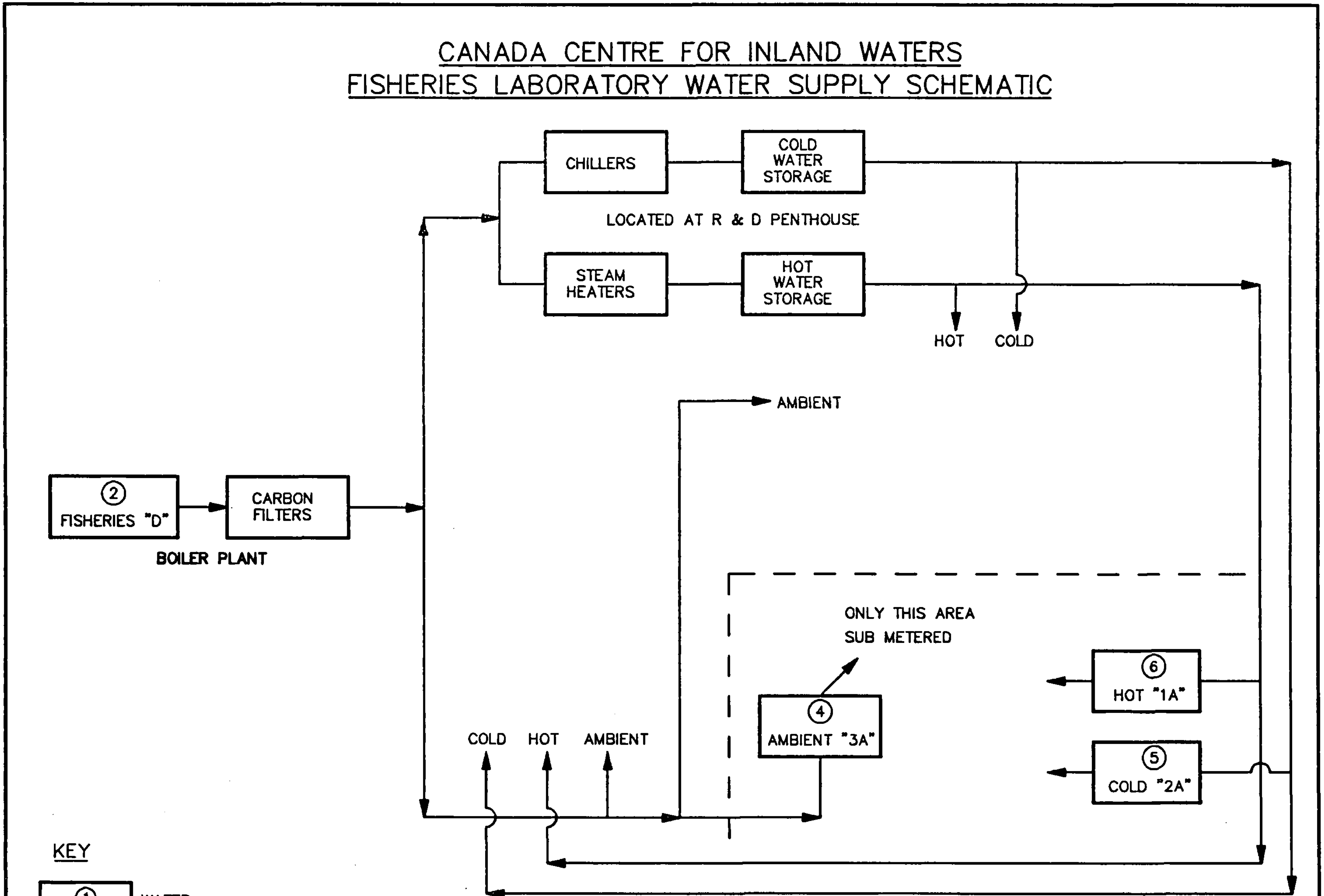

CANADA CENTRE FOR INLAND WATERS
FISHERIES LABORATORY WATER SUPPLY SCHEMATIC
CHILLERS
COLD WATER STORAGE
LOCATED AT R & D PENTHOUSE
STEAM HEATERS
HOT WATER STORAGE
HOT
COLD
AMBIENT
2
FISHERIES "D"
CARBON FILTERS
BOILER PLANT
ONLY THIS AREA SUB METERED
6
HOT "1A"
4
AMBIENT "3A"
5
COLD "2A"
COLD
HOT
AMBIENT
KEY
1
WATER METER

FIGURE-5

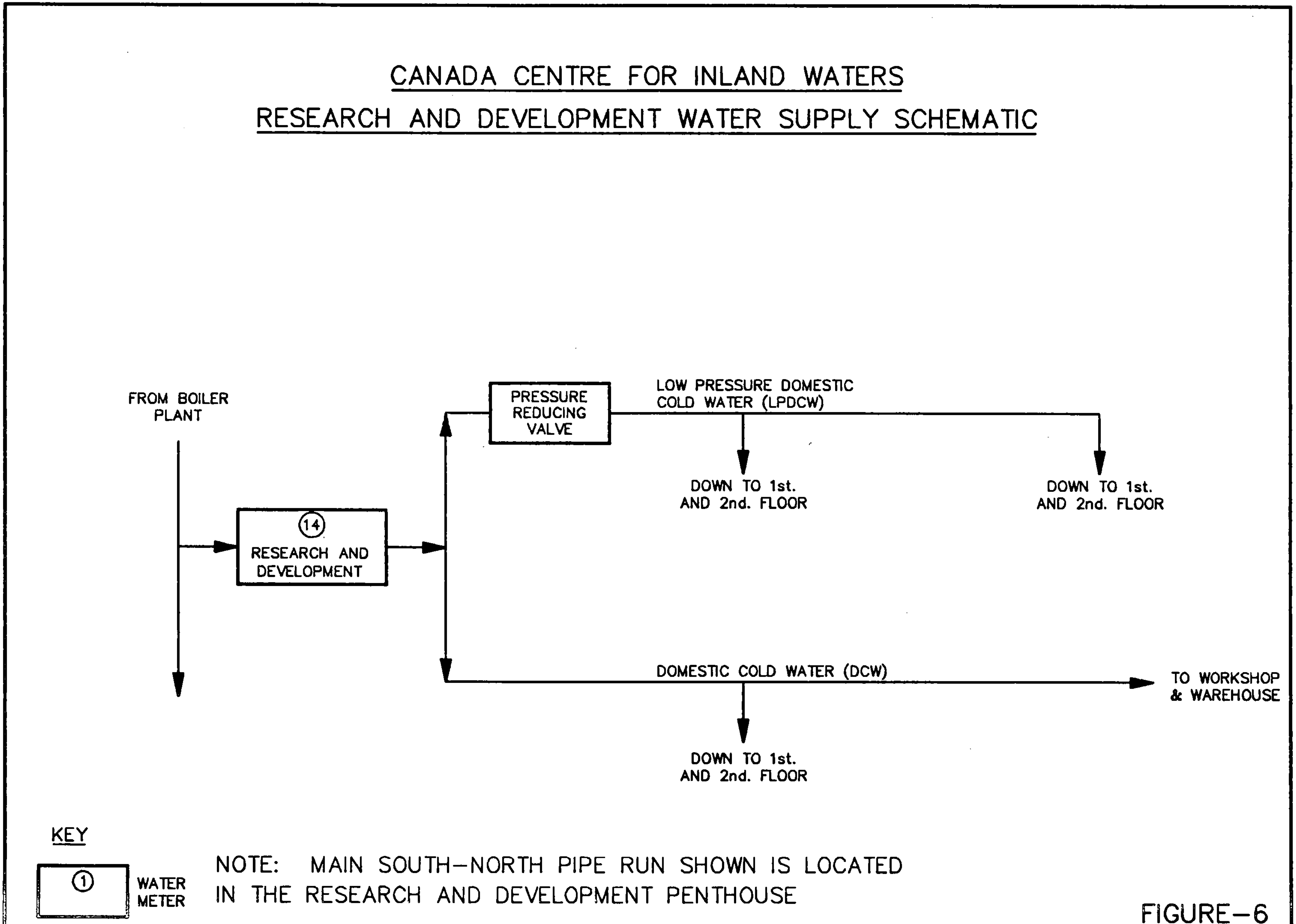
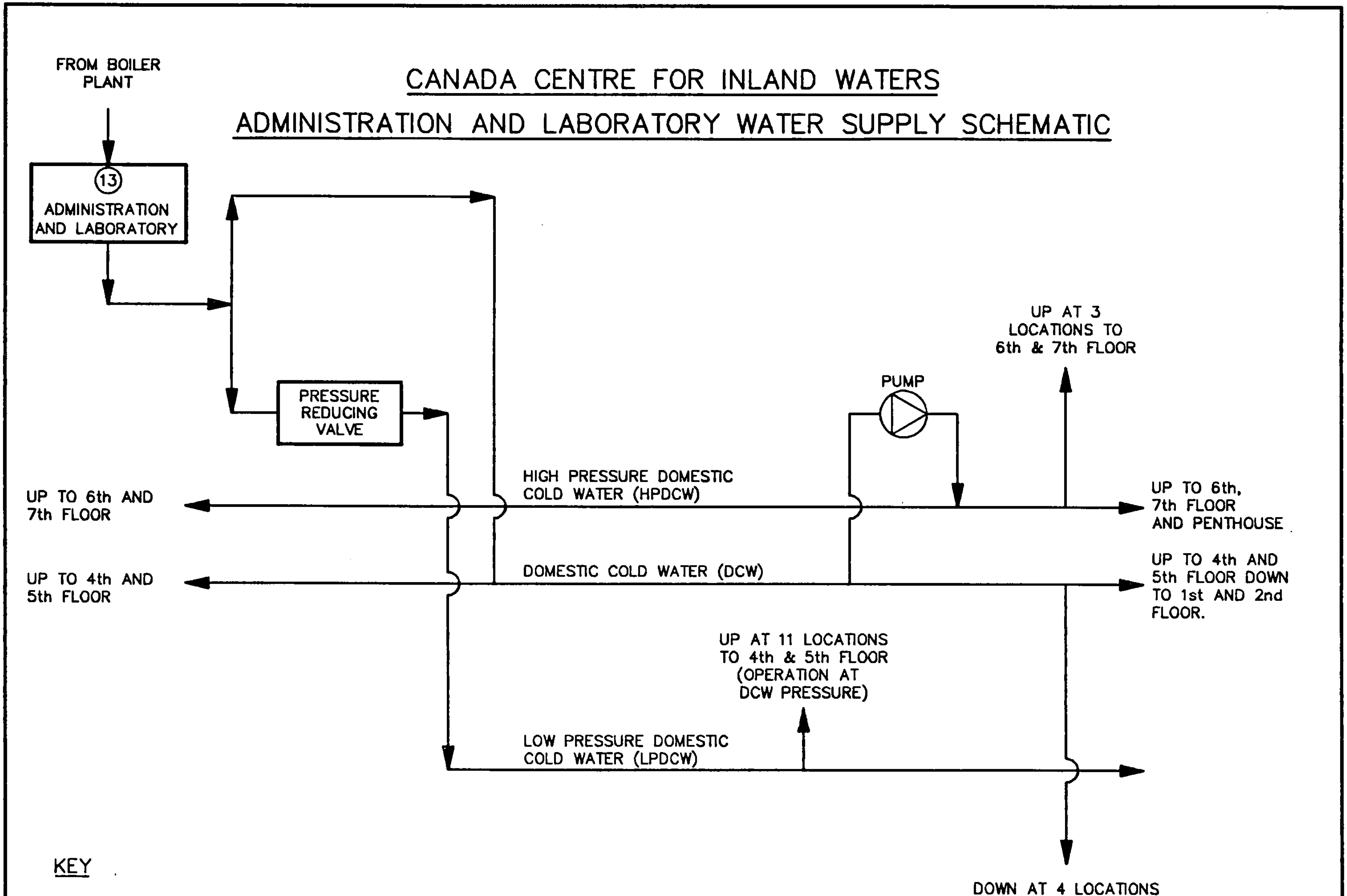
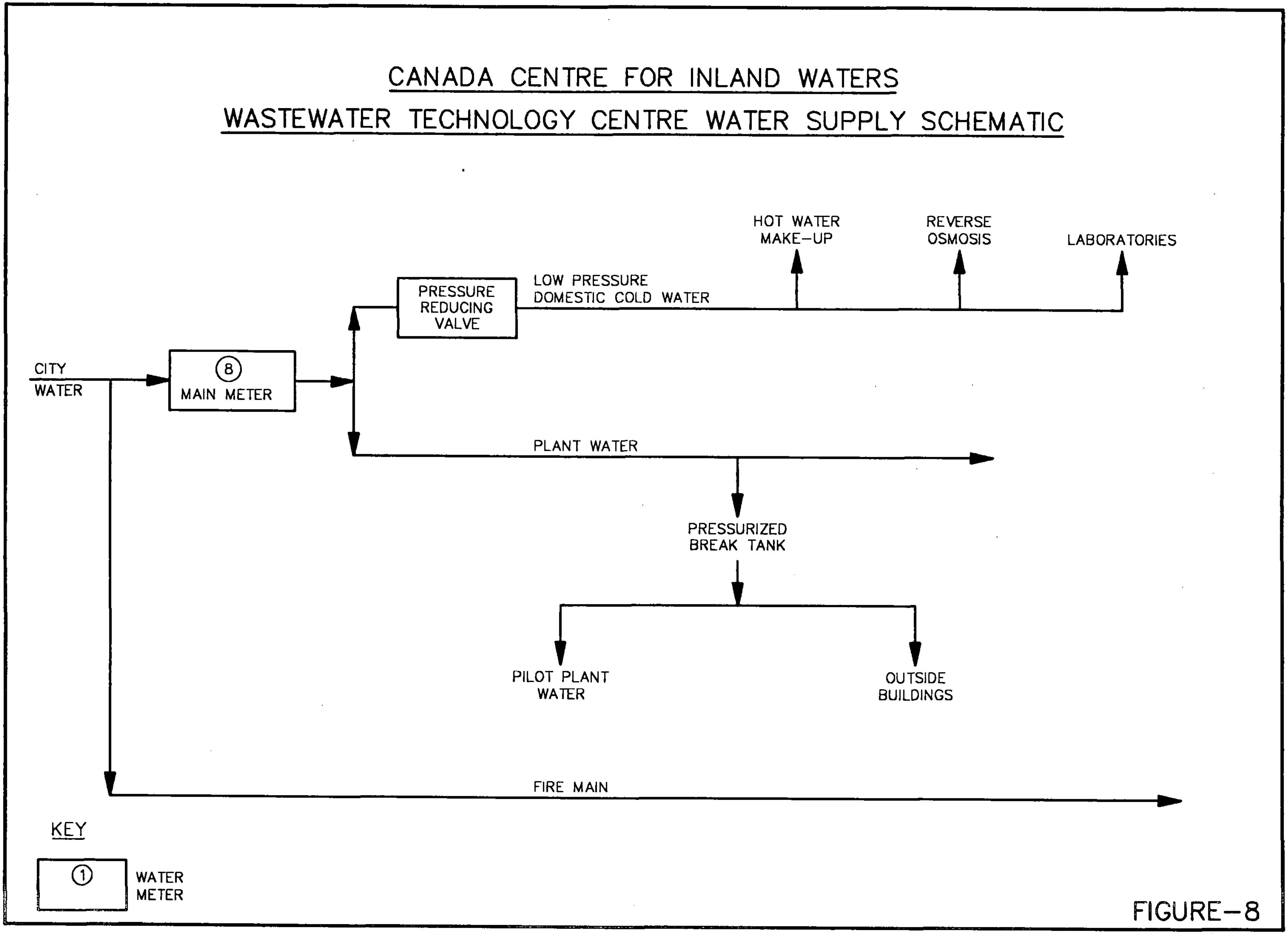

CANADA CENTRE FOR INLAND WATERS
RESEARCH AND DEVELOPMENT WATER SUPPLY SCHEMATIC
FROM BOILER PLANT
PRESSURE REDUCING VALVE
LOW PRESSURE DOMESTIC COLD WATER (LPDCW)
DOWN TO 1st. AND 2nd. FLOOR
DOWN TO 1st. AND 2nd. FLOOR
14
RESEARCH AND DEVELOPMENT
DOMESTIC COLD WATER (DCW)
TO WORKSHOP & WAREHOUSE
DOWN TO 1st. AND 2nd. FLOOR
KEY
1
WATER METER
NOTE: MAIN SOUTH-NORTH PIPE RUN SHOWN IS LOCATED IN THE RESEARCH AND DEVELOPMENT PENTHOUSE

FIGURE-6

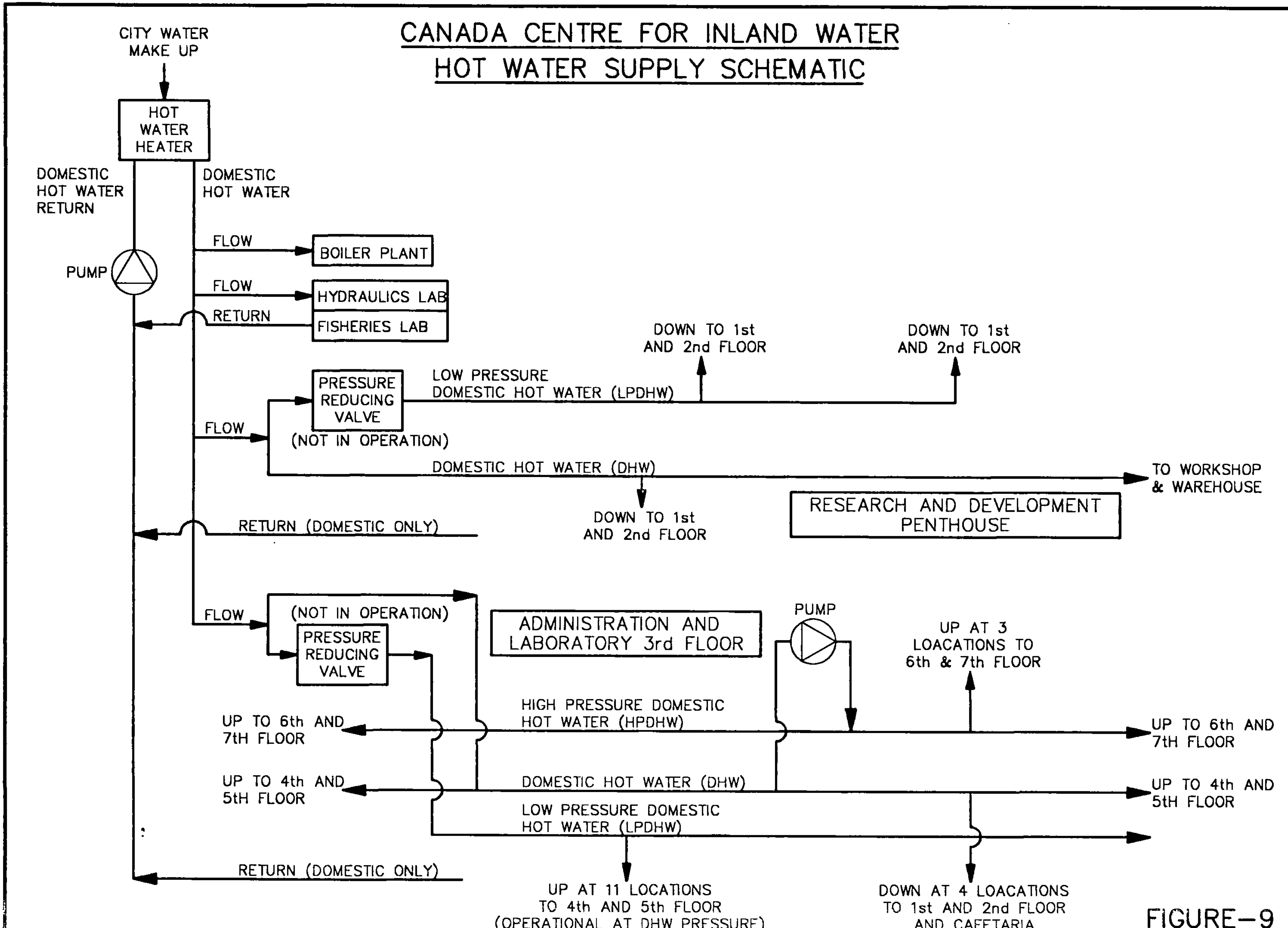


NOTE: MAIN SOUTH–NORTH PIPE RUN SHOWN IS LOCATED IN THE ADMINISTRATION AND LABORATORY 3rd FLOOR

FIGURE–7

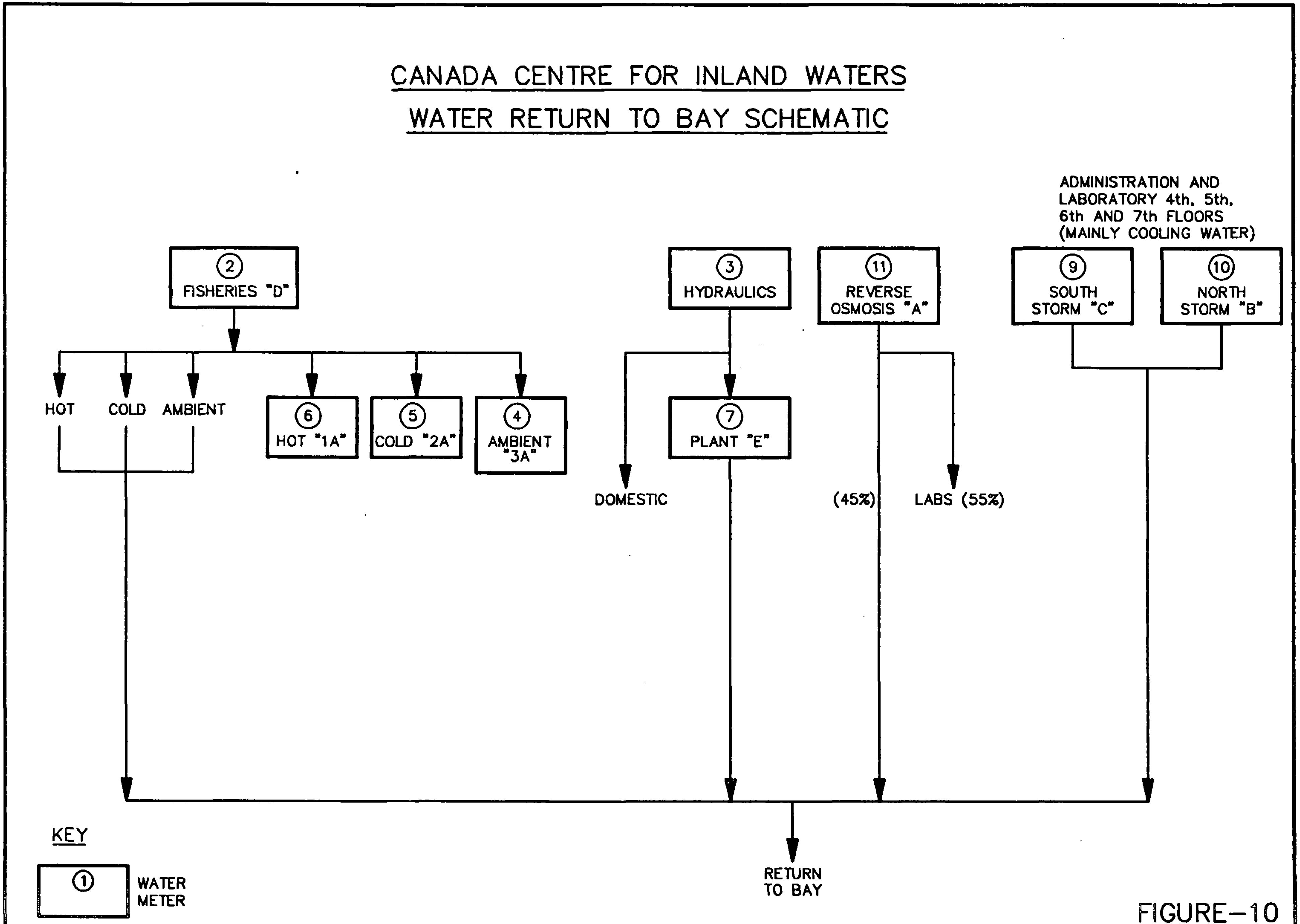

CANADA CENTRE FOR INLAND WATERS
WASTEWATER TECHNOLOGY CENTRE WATER SUPPLY SCHEMATIC
HOT WATER MAKE-UP
REVERSE OSMOSIS
LABORATORIES
PRESSURE REDUCING VALVE
LOW PRESSURE DOMESTIC COLD WATER
CITY WATER
8
MAIN METER
PLANT WATER
PRESSURIZED BREAK TANK
PILOT PLANT WATER
OUTSIDE BUILDINGS
FIRE MAIN
KEY
1
WATER METER

FIGURE–8



CANADA CENTRE FOR INLAND WATER
HOT WATER SUPPLY SCHEMATIC
CITY WATER MAKE UP
HOT WATER HEATER
DOMESTIC HOT WATER RETURN
DOMESTIC HOT WATER
PUMP
FLOW
BOILER PLANT
FLOW
HYDRAULICS LAB
RETURN
FISHERIES LAB
PRESSURE REDUCING VALVE
(NOT IN OPERATION)
FLOW
LOW PRESSURE DOMESTIC HOT WATER (LPDHW)
DOWN TO 1st AND 2nd FLOOR
DOWN TO 1st AND 2nd FLOOR
DOMESTIC HOT WATER (DHW)
TO WORKSHOP & WAREHOUSE
DOWN TO 1st AND 2nd FLOOR
RESEARCH AND DEVELOPMENT PENTHOUSE
RETURN (DOMESTIC ONLY)
FLOW
(NOT IN OPERATION)
PRESSURE REDUCING VALVE
ADMINISTRATION AND LABORATORY 3rd FLOOR
PUMP
UP AT 3 LOACATIONS TO 6th & 7th FLOOR
HIGH PRESSURE DOMESTIC HOT WATER (HPDHW)
UP TO 6th AND 7tH FLOOR
UP TO 6th AND 7tH FLOOR
DOMESTIC HOT WATER (DHW)
UP TO 4th AND 5tH FLOOR
UP TO 4th AND 5tH FLOOR
LOW PRESSURE DOMESTIC HOT WATER (LPDHW)
RETURN (DOMESTIC ONLY)
UP AT 11 LOCATIONS TO 4th AND 5th FLOOR (OPERATIONAL AT DHW PRESSURE)
DOWN AT 4 LOCATIONS TO 1st AND 2nd FLOOR AND CAFETARIA

FIGURE-9


CANADA CENTRE FOR INLAND WATERS
WATER RETURN TO BAY SCHEMATIC
ADMINISTRATION AND LABORATORY 4th, 5th, 6th AND 7th FLOORS (MAINLY COOLING WATER)
2 FISHERIES "D"
3 HYDRAULICS
11 REVERSE OSMOSIS "A"
9 SOUTH STORM "C"
10 NORTH STORM "B"
HOT
COLD
AMBIENT
6 HOT "1A"
5 COLD "2A"
4 AMBIENT "3A"
7 PLANT "E"
DOMESTIC
(45%)
LABS (55%)
KEY
1 WATER METER
RETURN TO BAY
FIGURE–10

CANADA CENTRE FOR INLAND WATERS
TABLE OF MANUAL METER READINGS
(Expressed as a Flow Rate in cu.m/day)

DATE	TIME	METER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		NAME	CCIW Main	Fish "D"	Hyd. Main	Fish "3A" Ambient	Fish "2A" Cold	Fish "1A" Hot	Hyd "E"	WTC Main	Sth. Stm "C"	Nth. Stm "B"	Rev. Os. "A"	Softeners	A&L New	R&D New
		UNITS	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day
29-Jul	12:30	Mon	659.40	158.19	30.00	12.00	0.00	18.00	0.00	30.00	138.00	30.00	10.91	24.55		
29-Jul	16:30	Mon	969.00	177.29	210.00	18.00	0.00	18.00	198.00	90.00	174.00	36.00	16.36	32.73		
30-Jul	08:30	Tue	559.35	168.42	42.00	16.50	0.00	19.50	36.00	16.50	148.50	31.50	4.77	16.36	224.83	32.36
30-Jul	12:30	Tue	877.80	253.66	48.00	18.00	0.00	24.00	12.00	24.00	180.00	36.00	5.45	19.09	395.15	47.69
30-Jul	16:30	Tue	817.80	174.56	72.00	12.00	0.00	18.00	54.00	36.00	216.00	36.00	16.36	30.00	411.05	45.42
31-Jul	08:30	Wed	571.50	176.60	43.50	16.50	0.00	27.00	37.50	21.00	162.00	40.50	5.45	16.36	238.46	21.57
31-Jul	12:30	Wed	885.60	185.47	48.00	18.00	0.00	24.00	30.00	30.00	156.00	30.00	10.91	27.27	413.32	52.23
31-Jul	16:30	Wed	780.60	169.10	54.00	12.00	0.00	24.00	24.00	36.00	180.00	36.00	16.36	32.73	381.53	52.23
01-Aug	08:30	Thu	603.45	180.70	36.00	18.00	0.00	27.00	31.50	36.00	178.50	40.50	8.86	21.82	273.66	32.36
01-Aug	12:30	Thu	809.40	240.02	18.00	12.00	0.00	18.00	0.00	42.00	162.00	36.00	8.18	21.82	388.34	36.34
01-Aug	16:30	Thu	915.60	190.92	42.00	18.00	0.00	30.00	24.00	36.00	186.00	30.00	16.36	30.00	463.28	43.15
02-Aug	08:30	Fri	546.15	173.88	97.50	16.50	0.00	33.00	96.00	19.50	187.50	36.00	4.77	17.05	267.41	27.25
02-Aug	13:00	Fri	2750.40	232.74	1242.67	16.00	0.00	32.00	1269.33	32.00	170.67	37.33	7.27	24.24	385.57	40.37
02-Aug	16:30	Fri	678.86	140.27	329.14	13.71	0.00	20.57	308.57	34.29	137.14	27.43	15.59	24.94	285.50	25.95
03-Aug	08:30	Sat	511.50	175.92	4.50	16.50	0.00	27.00	1.50	19.50	166.50	31.50	9.55	22.50	229.37	18.17
03-Aug	16:30	Sat	547.20	346.39	3.00	18.00	0.00	27.00	3.00	18.00	147.00	33.00	0.00	24.55	213.47	14.76
04-Aug	08:30	Sun	462.60	105.69	4.50	15.00	0.00	24.00	0.00	15.00	139.50	31.50	0.00	4.09	204.39	14.76
04-Aug	16:30	Sun	479.40	166.38	3.00	18.00	0.00	21.00	3.00	15.00	147.00	33.00	0.00	10.91	215.74	15.90
05-Aug	08:30	Mon	475.35	170.47	4.50	16.50	0.00	22.50	1.50	12.00	145.50	36.00	0.00	10.91	210.07	15.90
05-Aug	17:00	Mon	550.02	216.91	2.82	16.94	0.00	22.59	8.47	31.06	155.29	36.71	5.13	16.69	225.50	16.03
06-Aug	08:30	Tue	493.01	166.11	9.29	17.03	0.00	20.13	0.00	17.03	144.00	38.71	2.82	12.67	216.84	17.58
06-Aug	12:30	Tue	676.80	160.92	48.00	12.00	0.00	18.00	12.00	90.00	138.00	30.00	10.91	24.55	297.50	34.07
06-Aug	16:30	Tue	752.40	185.47	30.00	18.00	0.00	24.00	18.00	36.00	180.00	36.00	13.64	32.73	363.36	36.34
07-Aug	08:30	Wed	576.15	175.24	24.00	16.50	0.00	24.00	18.00	18.00	159.00	36.00	11.59	23.87	257.76	22.14
07-Aug	12:30	Wed	801.60	231.84	54.00	12.00	0.00	30.00	24.00	36.00	162.00	12.00	10.91	21.82	411.05	36.34
07-Aug	16:30	Wed	965.40	201.83	30.00	18.00	0.00	30.00	6.00	42.00	168.00	0.00	16.36	32.73	415.59	45.42
08-Aug	08:30	Thu	567.00	174.56	6.00	16.50	0.00	25.50	1.50	18.00	136.50	19.50	14.32	28.64	232.21	29.52
08-Aug	12:30	Thu	730.80	158.19	36.00	18.00	0.00	24.00	12.00	30.00	150.00	30.00	13.64	27.27	361.09	38.61
08-Aug	16:30	Thu	824.40	193.65	54.00	18.00	0.00	30.00	30.00	42.00	198.00	30.00	19.09	38.18	388.34	52.23

FIGURE-11

CANADA CENTRE FOR INLAND WATERS
TABLE OF MANUAL METER READINGS
(Expressed as a Flow Rate in cu.m/day)

DATE	TIME	METER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		NAME	CCIW Main	Fish "D"	Hyd. Main	Fish "3A" Ambient	Fish "2A" Cold	Fish "1A" Hot	Hyd "E"	WTC Main	Sth. Stm "C"	Nth. Stm "B"	Rev. Os. "A"	Softeners	A&L New	R&D New
		UNITS	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day	cu.m/day
09-Aug	08:30	Fri	582.45	175.92	30.00	15.00	0.00	24.00	25.50	34.50	162.00	31.50	12.96	26.59	261.17	25.55
09-Aug	12:30	Fri	884.40	270.02	36.00	18.00	0.00	30.00	30.00	30.00	132.00	18.00	13.64	24.55	304.31	36.34
09-Aug	16:30	Fri	941.40	210.02	42.00	18.00	0.00	30.00	30.00	102.00	198.00	36.00	13.64	32.73	426.95	40.88
10-Aug	08:00	Sat	567.48	175.97	20.13	17.03	0.00	26.32	27.87	20.13	153.29	34.06	2.82	13.37	233.84	18.17
10-Aug	16:00	Sat	588.90	199.11	60.00	18.00	0.00	27.00	30.00	24.00	162.00	36.00	15.00	30.00	232.78	19.30
11-Aug	08:00	Sun	533.40	163.65	31.50	15.00	0.00	25.50	27.00	19.50	144.00	37.50	0.00	11.59	215.18	17.03
11-Aug	16:00	Sun	572.70	212.74	30.00	15.00	0.00	24.00	24.00	21.00	150.00	30.00	0.00	12.27	213.47	19.30
12-Aug	08:30	Mon	575.13	173.24	34.91	16.00	0.00	24.73	30.55	24.73	155.64	26.18	0.00	10.58	222.42	20.92
12-Aug	12:30	Mon	962.40	174.56	48.00	18.00	0.00	30.00	30.00	144.00	186.00	42.00	10.91	27.27	422.41	59.05
12-Aug	16:30	Mon	866.40	182.74	42.00	18.00	0.00	24.00	24.00	138.00	156.00	48.00	13.64	30.00	383.80	52.23
13-Aug	08:30	Tue	609.30	168.42	36.00	16.50	0.00	21.00	28.50	153.00	175.50	39.00	7.50	21.14	181.11	34.07
13-Aug	12:30	Tue	882.00	237.29	66.00	12.00	0.00	18.00	24.00	138.00	198.00	36.00	13.64	38.18	724.45	49.96
13-Aug	16:30	Tue	1309.20	190.92	366.00	18.00	0.00	24.00	354.00	78.00	234.00	42.00	13.64	21.82	470.10	59.05
14-Aug	08:30	Wed	565.20	154.78	30.00	16.50	0.00	19.50	24.00	67.50	198.00	39.00	0.00	10.91	272.52	28.96
14-Aug	12:30	Wed	1192.80	220.93	72.00	18.00	0.00	24.00	42.00	84.00	270.00	54.00	16.36	40.91	538.23	72.67
14-Aug	16:30	Wed	857.40	152.74	36.00	18.00	0.00	18.00	12.00	78.00	216.00	36.00	10.91	24.55	390.61	52.23
15-Aug	08:30	Thu	613.80	169.79	6.00	15.00	0.00	19.50	1.50	72.00	204.00	40.50	5.45	16.36	286.15	41.45
15-Aug	16:30	Thu	940.50	210.02	123.00	18.00	0.00	24.00	84.00	60.00	198.00	39.00	10.91	27.27	379.26	48.83
16-Aug	08:30	Fri	567.90	173.19	6.00	16.50	0.00	24.00	3.00	55.50	189.00	39.00	5.45	16.36	268.55	30.09
16-Aug	12:30	Fri	995.40	207.29	36.00	12.00	0.00	24.00	0.00	84.00	210.00	42.00	8.18	24.55	420.14	63.59
16-Aug	16:30	Fri	681.60	150.01	30.00	18.00	0.00	24.00	6.00	30.00	180.00	36.00	13.64	30.00	363.36	45.42
17-Aug	08:00	Sat	625.08	196.38	9.29	17.03	0.00	27.87	1.55	26.32	185.81	38.71	0.70	12.67	273.11	25.20
17-Aug	16:00	Sat	574.80	203.20	9.00	18.00	0.00	24.00	3.00	24.00	168.00	36.00	8.18	19.09	239.59	22.71
18-Aug	08:00	Sun	545.40	175.92	7.50	15.00	0.00	25.50	1.50	24.00	166.50	36.00	0.00	12.27	240.73	23.85
18-Aug	16:00	Sun	540.30	180.01	9.00	18.00	0.00	24.00	3.00	27.00	162.00	36.00	1.36	12.27	232.78	22.71

FIGURE-11

WATER EFFICIENCY AUDIT
CANADA CENTRE FOR INLAND WATERS

MAIN BUILDING SANITARY PUMPING RATE

DATE	TIME	HRS RUN hrs	AVG FLOW cu.m/day	DATE	TIME	HRS RUN hrs	AVG FLOW cu.m/day
09-Aug	08:30	3.15	305.07	15-Aug	16:30	1.31	506.97
09-Aug	12:30	1.59	617.89	16-Aug	08:30	2.97	287.28
09-Aug	16:30	1.26	488.95	16-Aug	12:30	1.42	552.03
10-Aug	08:00	2.41	240.95	16-Aug	16:30	1.27	493.82
10-Aug	16:00	1.37	265.61	17-Aug	08:00	2.86	286.34
11-Aug	08:00	2.34	226.86	17-Aug	16:00	1.65	320.14
11-Aug	16:00	1.47	284.64	18-Aug	08:00	3.02	292.91
12-Aug	08:30	2.30	216.30	18-Aug	16:00	1.46	282.59
12-Aug	12:30	1.43	554.48	19-Aug	08:30	2.89	271.32
12-Aug	16:30	1.35	522.07	19-Aug	12:30	1.58	613.99
13-Aug	08:30	2.97	288.16	19-Aug	16:30	1.32	510.72
13-Aug	12:30	1.56	603.09	20-Aug	08:30	3.17	307.00
13-Aug	16:30	1.84	714.41	20-Aug	12:30	1.34	519.17
14-Aug	08:30	2.68	259.98	20-Aug	16:30	1.29	501.33
14-Aug	12:30	1.49	577.73	21-Aug	08:30	3.19	308.87

FIGURE-12

CANADA CENTRE FOR INLAND WATERS
MAIN METER MONTHLY VOLUMES
JANUARY 1990 TO AUGUST 1991

MONTH	CCIW MAIN METER	WTC MAIN METER	TOTAL
	cu.m	cu.m	cu.m
1990			
JAN	18,014	1,250	19,264
FEB	21,831	1,054	22,885
MAR	18,113	1,572	19,685
APR	17,568	1,550	19,118
MAY	21,763	1,482	23,245
JUN	23,540	2,336	25,876
JUL	26,380	1,766	28,146
AUG	30,332	2,322	32,654
SEP	25,000	1,589	26,589
OCT	24,888	1,384	26,272
NOV	21,604	2,372	23,976
DEC	23,829	1,041	24,870
1991			
JAN	19,471	1,226	20,697
FEB	22,085	1,171	23,256
MAR	24,329	1,265	25,594
APR	19,996	1,302	21,298
MAY	25,257	1,512	26,769
JUN	22,851	1,917	24,768
JUL	19,301	1,299	20,600
AUG	19,700	1,900	21,600

FIGURE-13

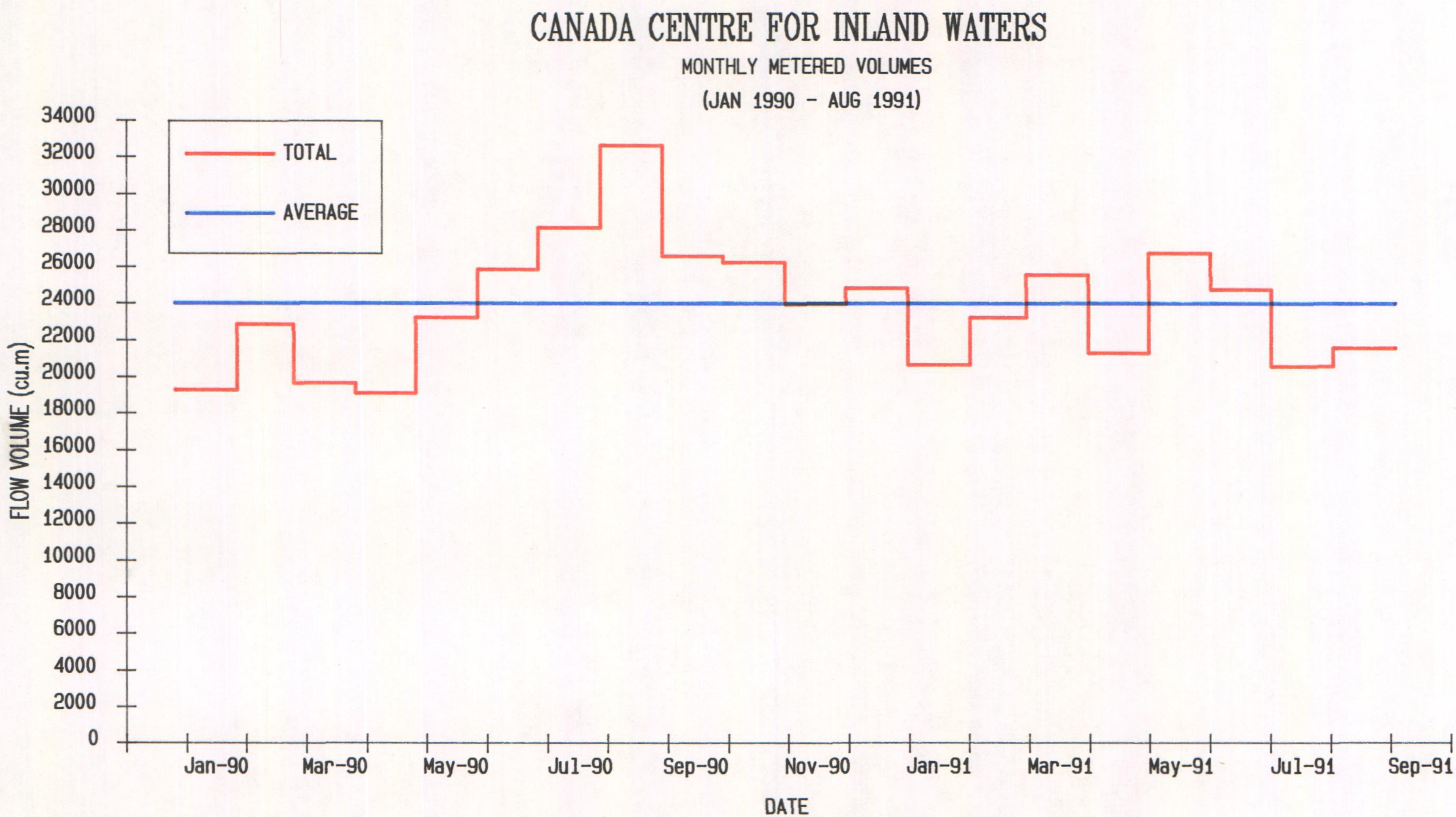

CANADA CENTRE FOR INLAND WATERS
MONTHLY METERED VOLUMES
(JAN 1990 - AUG 1991)
TOTAL
AVERAGE
FLOW VOLUME (cu.m)
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan-90
Mar-90
May-90
Jul-90
Sep-90
Nov-90
Jan-91
Mar-91
May-91
Jul-91
Sep-91
DATE

FIGURE-14

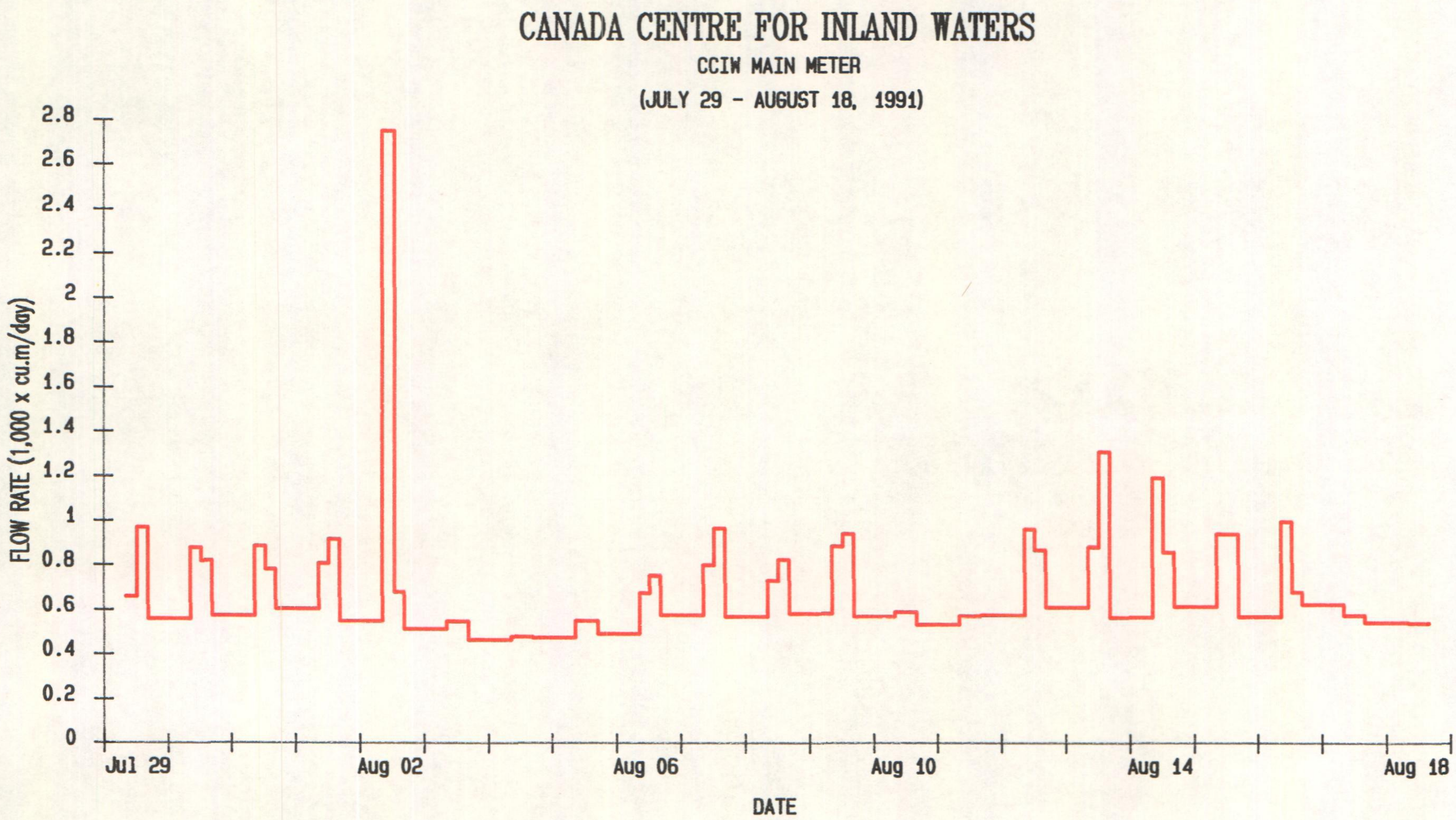

CANADA CENTRE FOR INLAND WATERS
CCIW MAIN METER
(JULY 29 - AUGUST 18, 1991)
FLOW RATE (1,000 x cu.m/day)
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jul 29
Aug 02
Aug 06
Aug 10
Aug 14
Aug 18
DATE

FIGURE-15

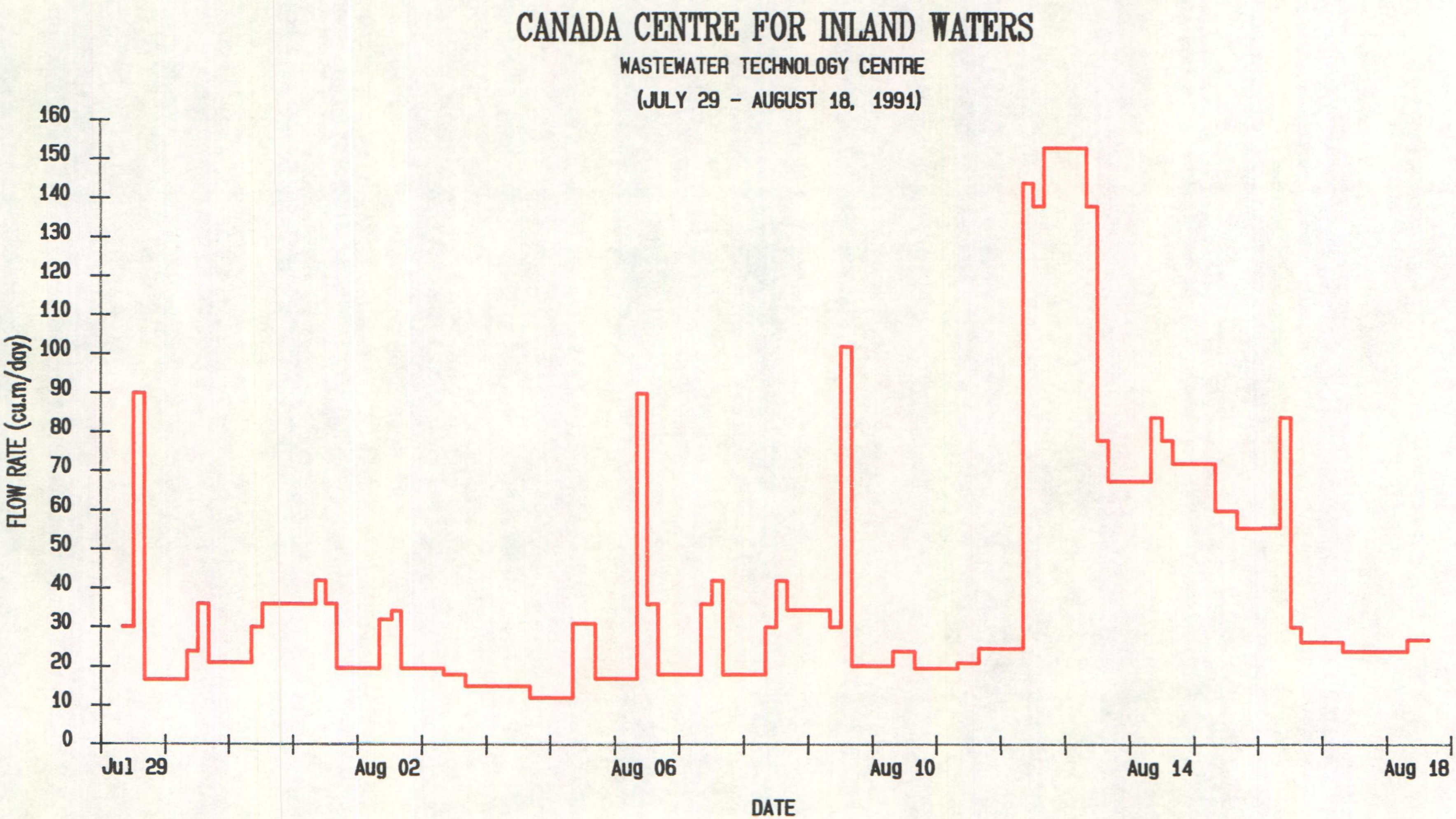

CANADA CENTRE FOR INLAND WATERS
WASTEWATER TECHNOLOGY CENTRE
(JULY 29 - AUGUST 18, 1991)
FLOW RATE (cu.m/day)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Jul 29
Aug 02
Aug 06
Aug 10
Aug 14
Aug 18
DATE

FIGURE-16

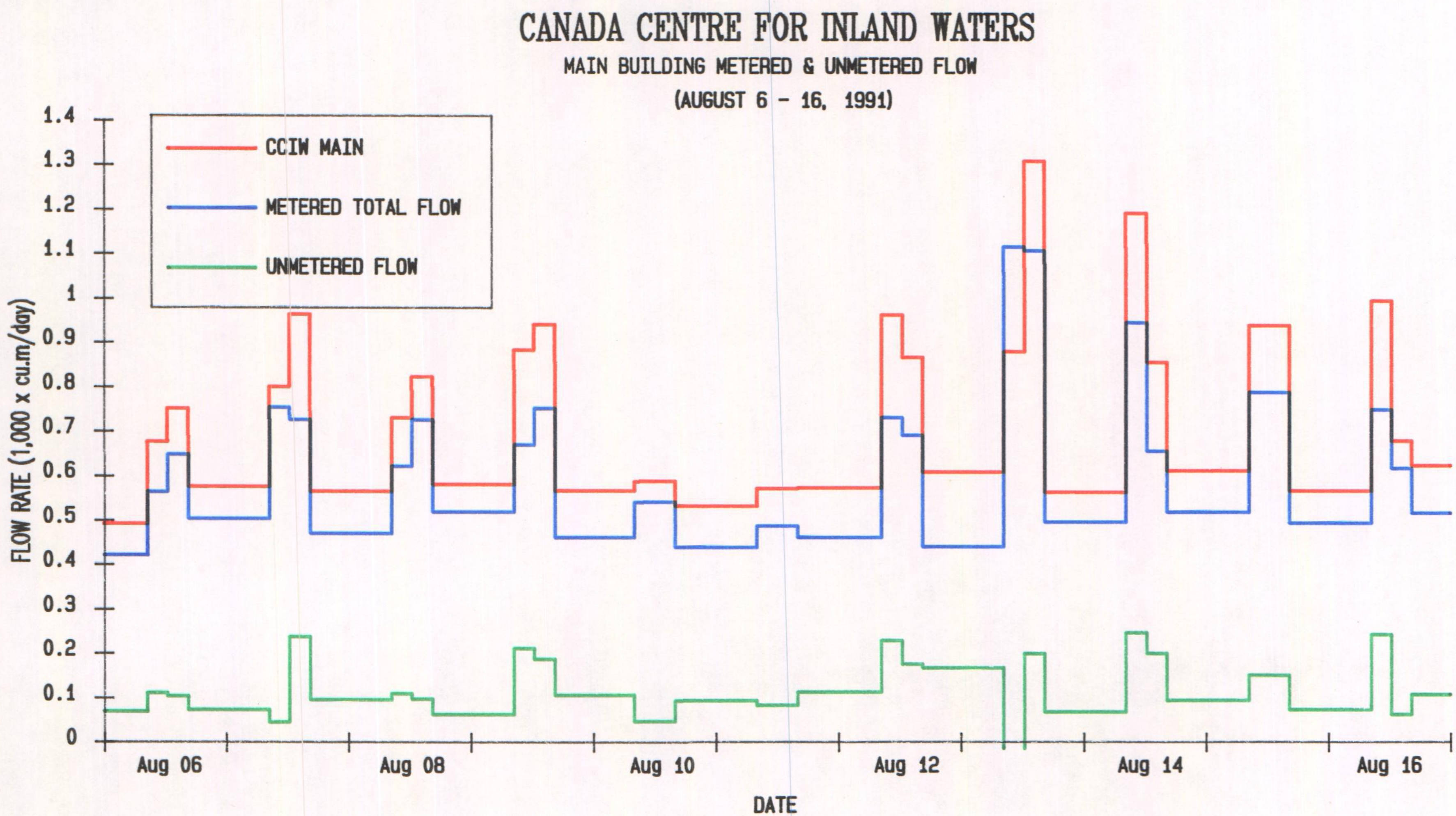

CANADA CENTRE FOR INLAND WATERS
MAIN BUILDING METERED & UNMETERED FLOW
(AUGUST 6 - 16, 1991)
CCIW MAIN
METERED TOTAL FLOW
UNMETERED FLOW
FLOW RATE (1,000 x cu.m/day)
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Aug 06
Aug 08
Aug 10
Aug 12
Aug 14
Aug 16
DATE

FIGURE-17

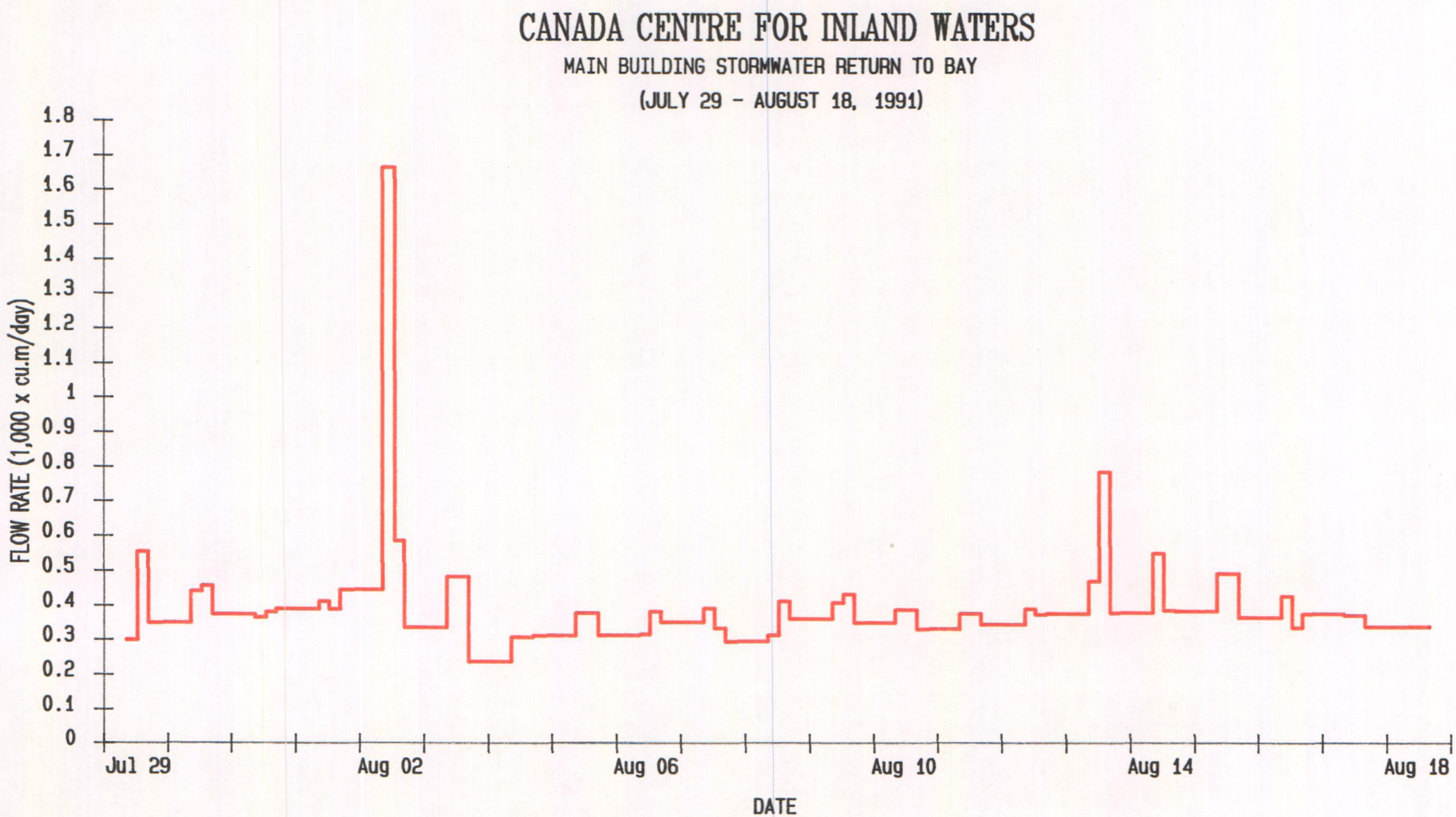

CANADA CENTRE FOR INLAND WATERS
MAIN BUILDING STORMWATER RETURN TO BAY
(JULY 29 - AUGUST 18, 1991)
FLOW RATE (1,000 x cu.m/day)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jul 29
Aug 02
Aug 06
Aug 10
Aug 14
Aug 18
DATE

FIGURE-18

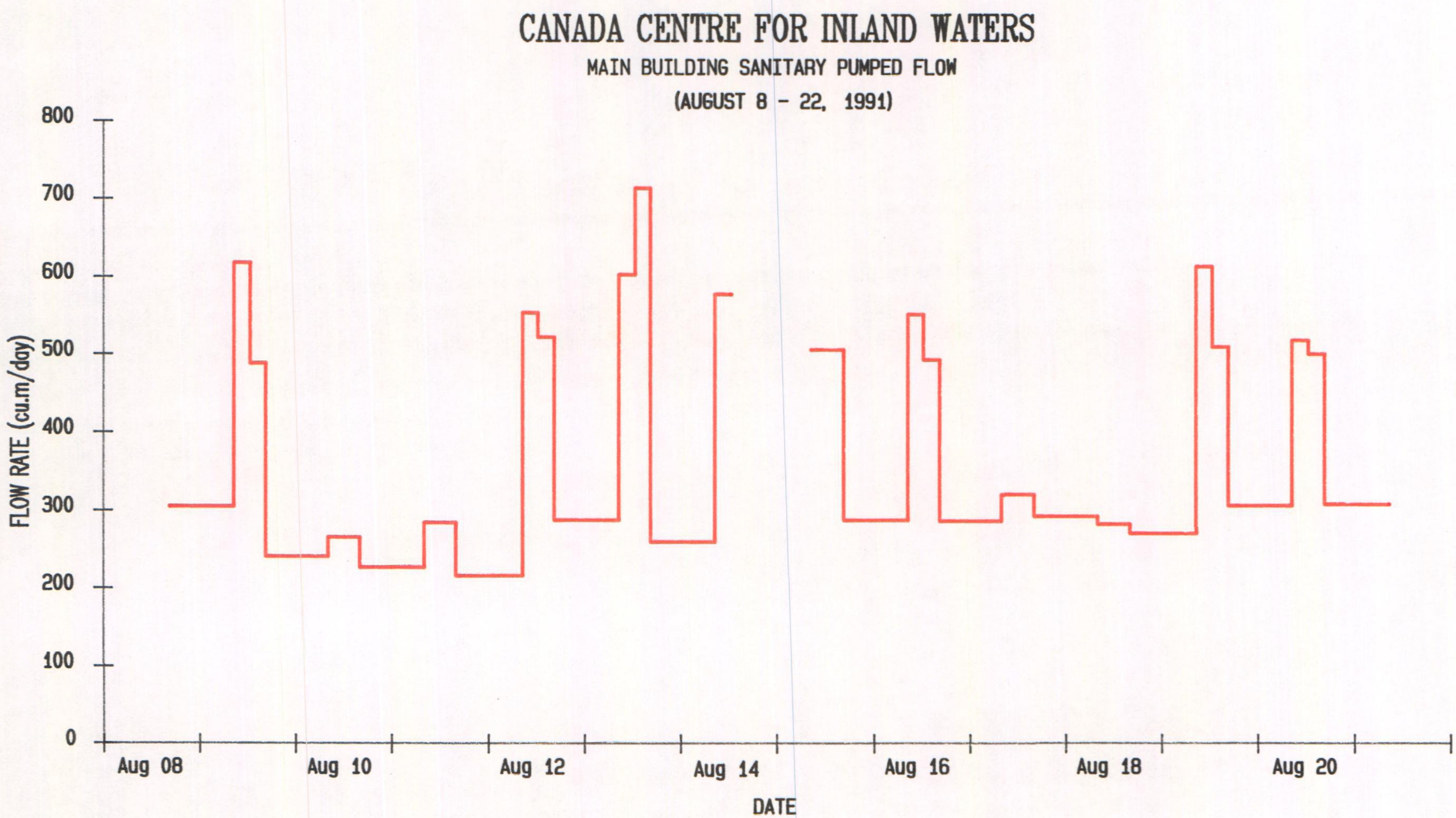

CANADA CENTRE FOR INLAND WATERS
MAIN BUILDING SANITARY PUMPED FLOW
(AUGUST 8 - 22, 1991)
FLOW RATE (cu.m/day)
0
100
200
300
400
500
600
700
800
Aug 08
Aug 10
Aug 12
Aug 14
Aug 16
Aug 18
Aug 20
DATE

FIGURE-19

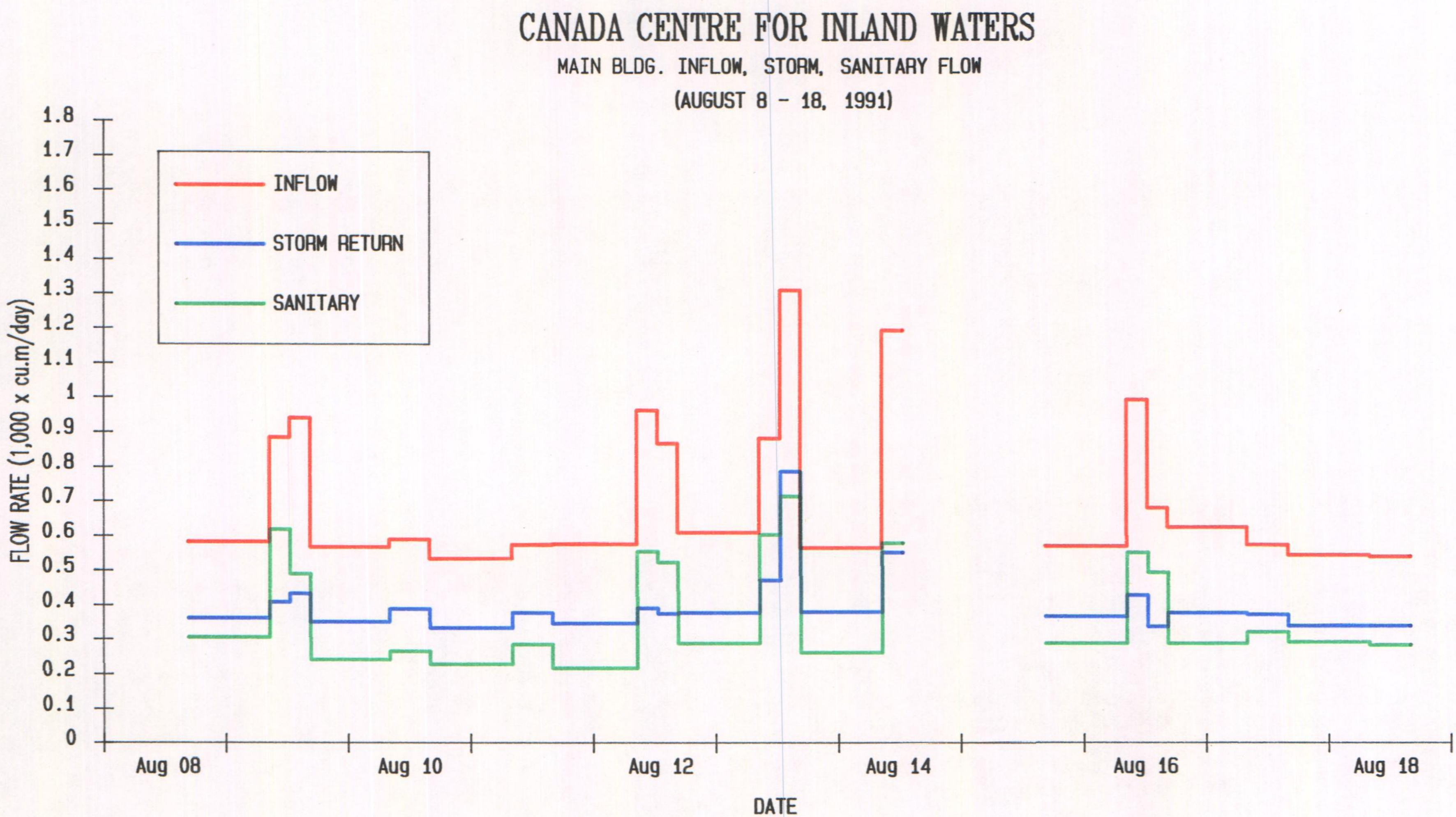

CANADA CENTRE FOR INLAND WATERS
MAIN BLDG. INFLOW, STORM, SANITARY FLOW
(AUGUST 8 - 18, 1991)
INFLOW
STORM RETURN
SANITARY
FLOW RATE (1,000 x cu.m/day)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Aug 08
Aug 10
Aug 12
Aug 14
Aug 16
Aug 18
DATE

FIGURE-20

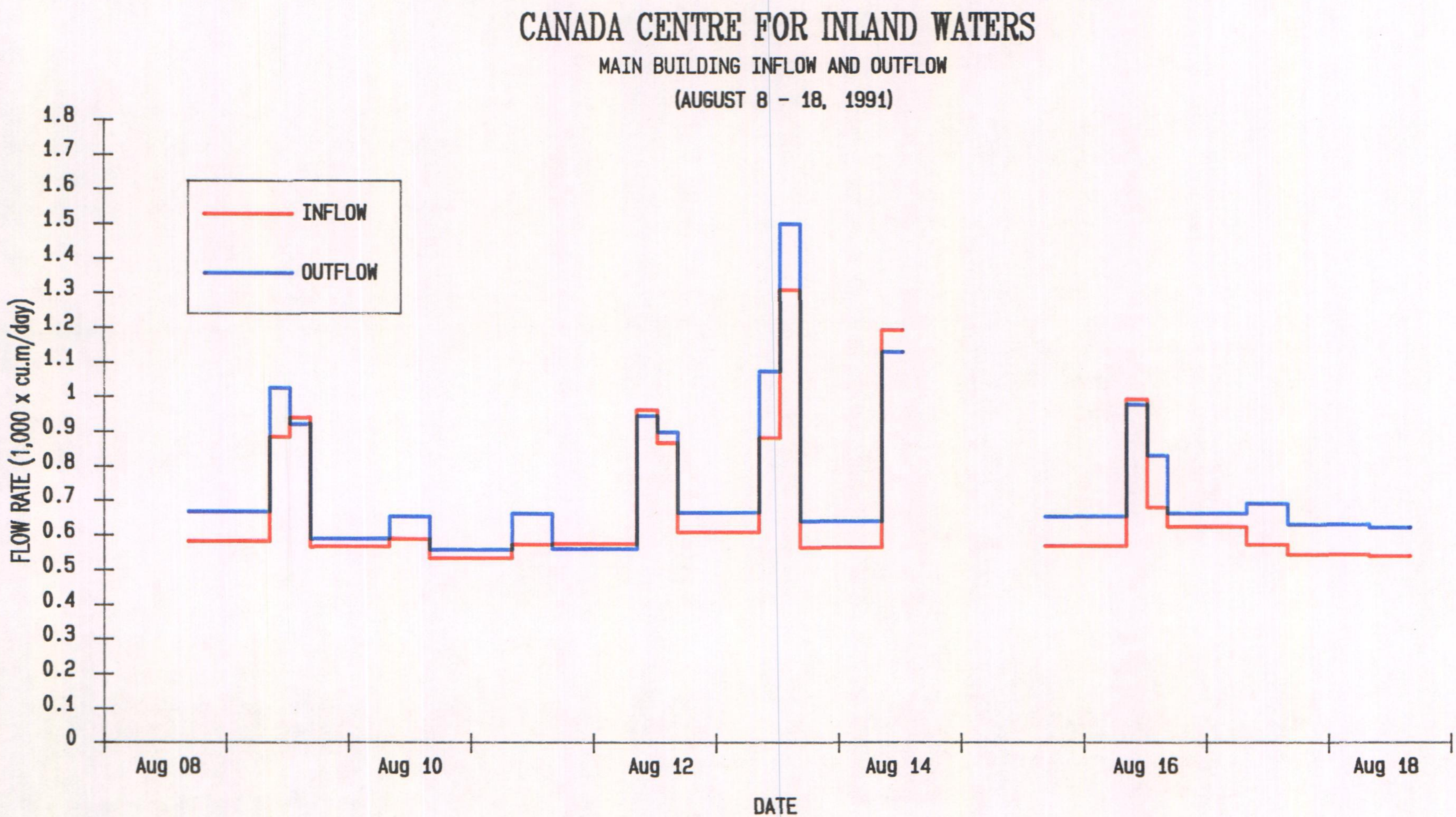

CANADA CENTRE FOR INLAND WATERS
MAIN BUILDING INFLOW AND OUTFLOW
(AUGUST 8 - 18, 1991)
INFLOW
OUTFLOW
FLOW RATE (1,000 x cu.m/day)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Aug 08
Aug 10
Aug 12
Aug 14
Aug 16
Aug 18
DATE

FIGURE-21

CANADA CENTRE FOR INLAND WATERS

HYDRAULICS LABORATORY

(JULY 29 - AUGUST 18, 1991)

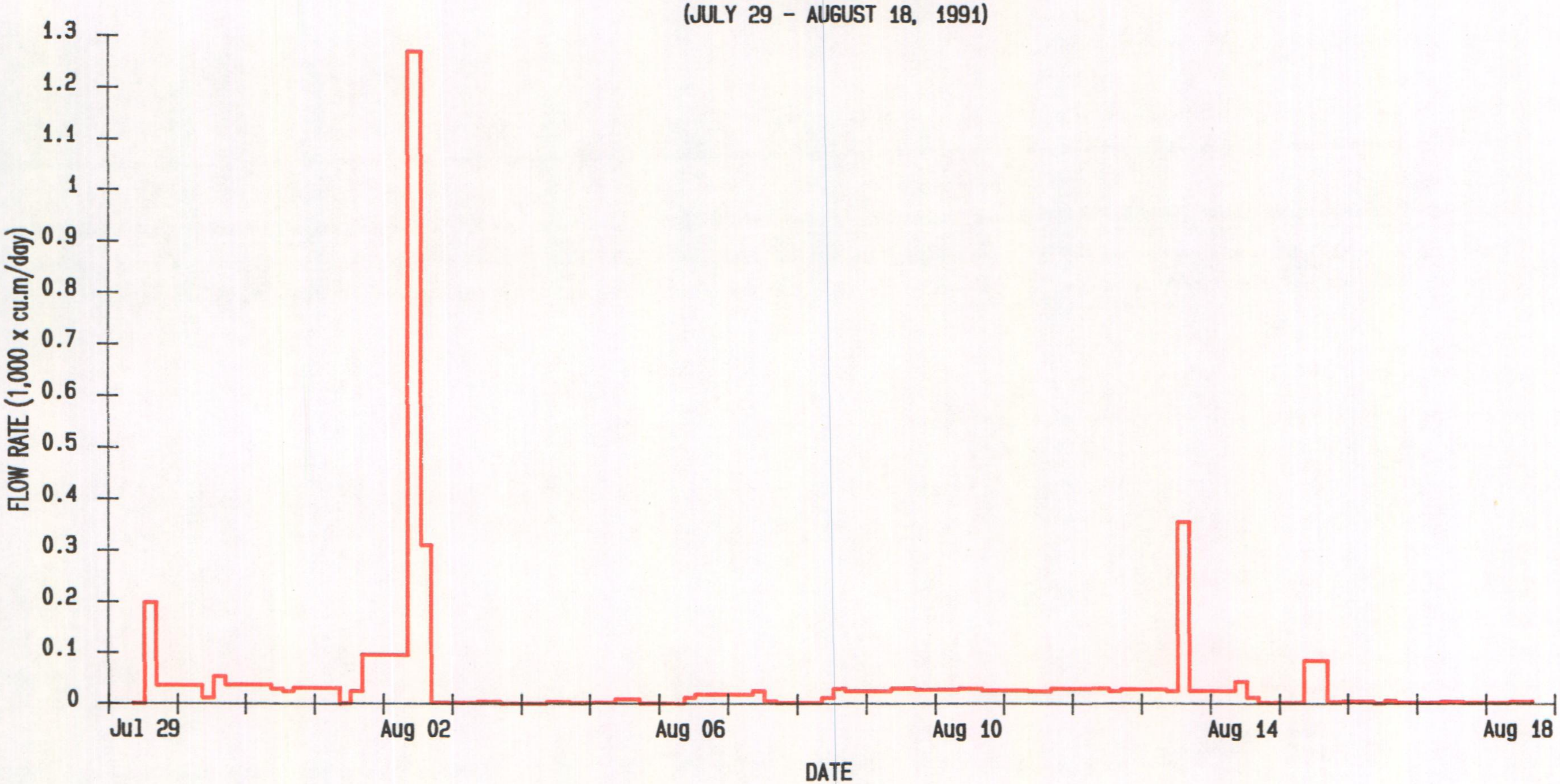


FIGURE-22

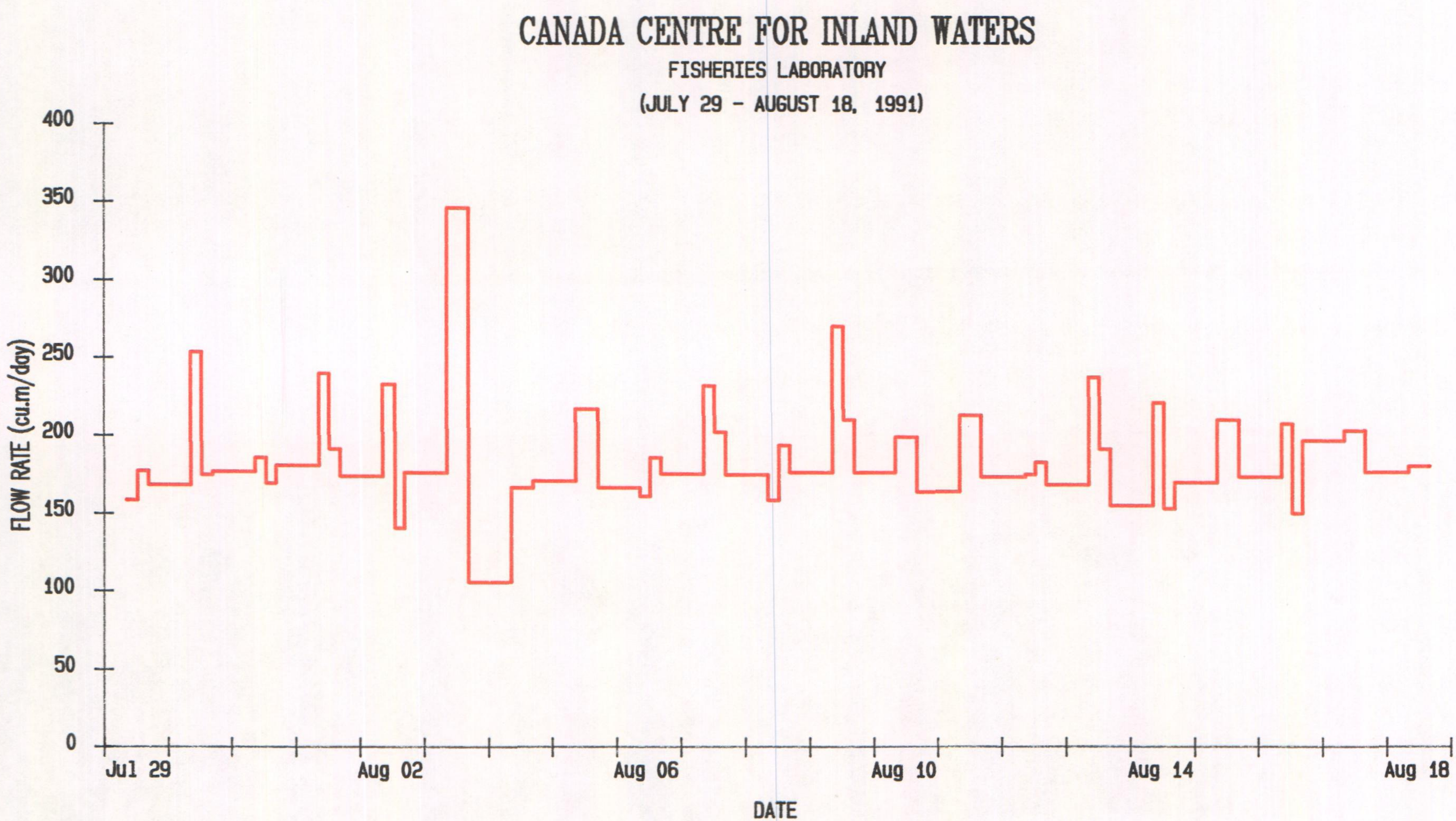
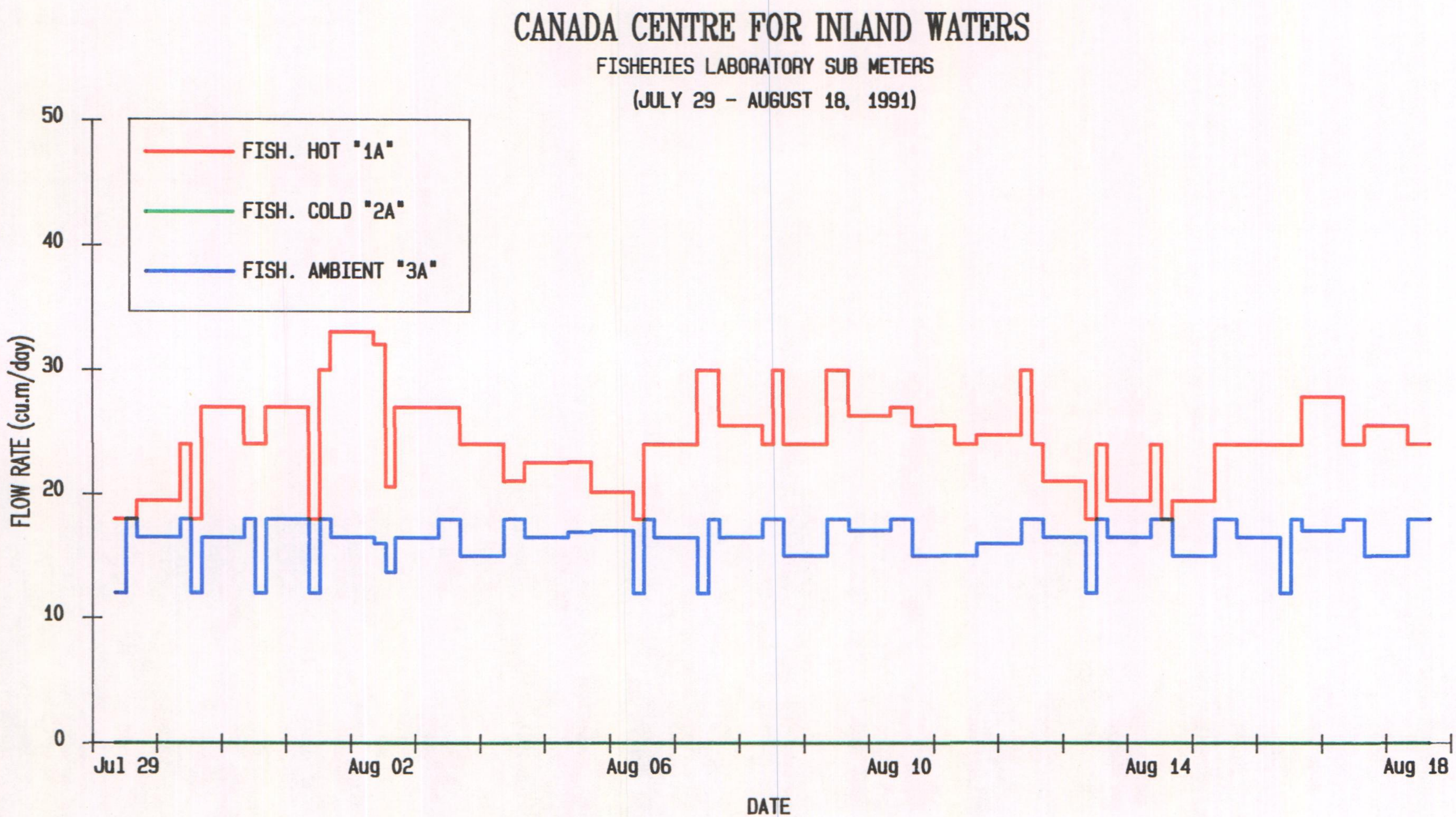

CANADA CENTRE FOR INLAND WATERS
FISHERIES LABORATORY
(JULY 29 - AUGUST 18, 1991)
FLOW RATE (cu.m/day)
400
350
300
250
200
150
100
50
0
Jul 29
Aug 02
Aug 06
Aug 10
Aug 14
Aug 18
DATE

FIGURE-23



CANADA CENTRE FOR INLAND WATERS
FISHERIES LABORATORY SUB METERS
(JULY 29 - AUGUST 18, 1991)
FISH. HOT "1A"
FISH. COLD "2A"
FISH. AMBIENT "3A"
FLOW RATE (cu.m/day)
0
10
20
30
40
50
Jul 29
Aug 02
Aug 06
Aug 10
Aug 14
Aug 18
DATE

FIGURE-24

CANADA CENTRE FOR INLAND WATERS

FISHERIES LABORATORY UNMETERED FLOW

(AUGUST 6 - 16, 1991)

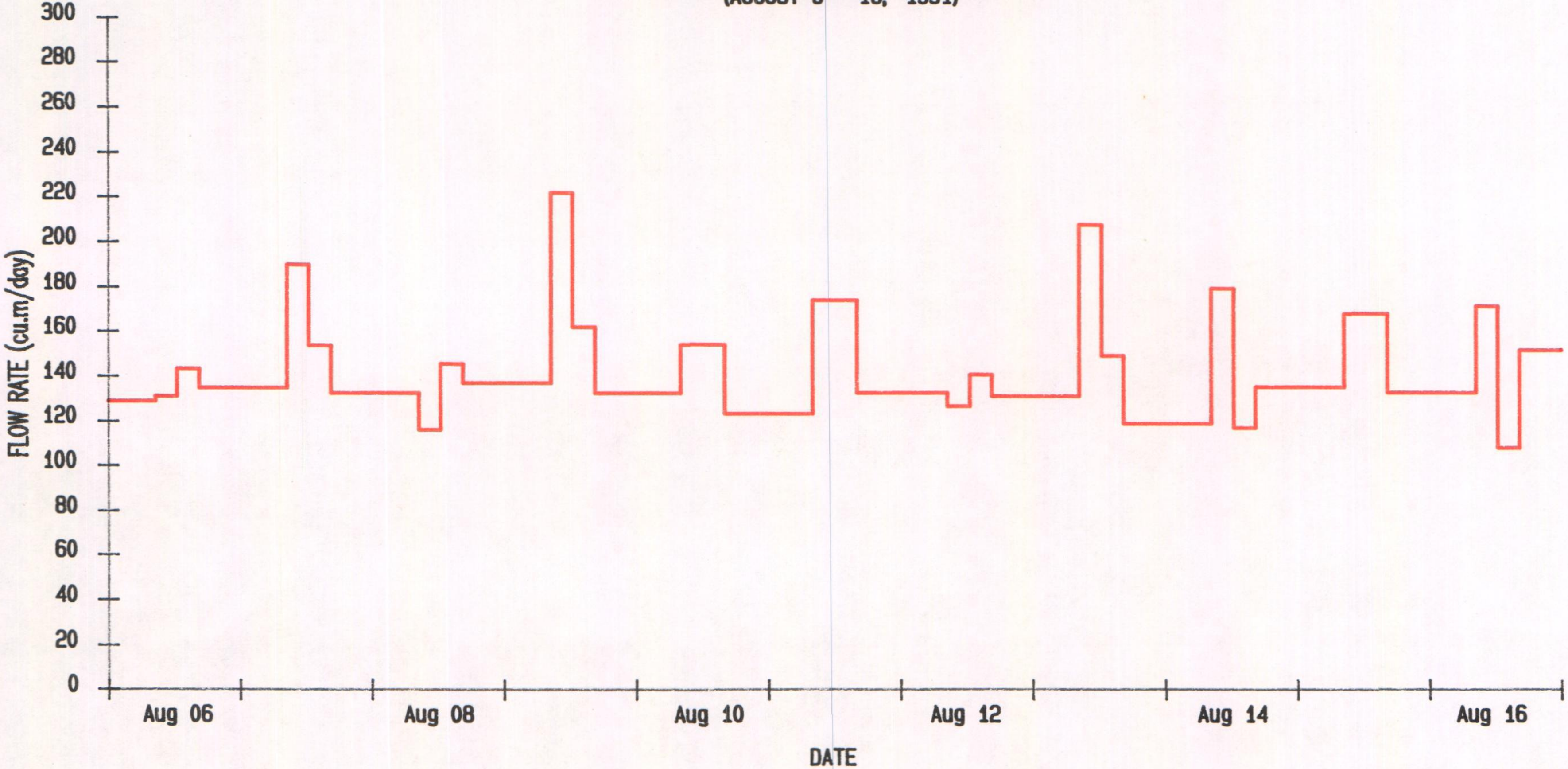


FIGURE-25

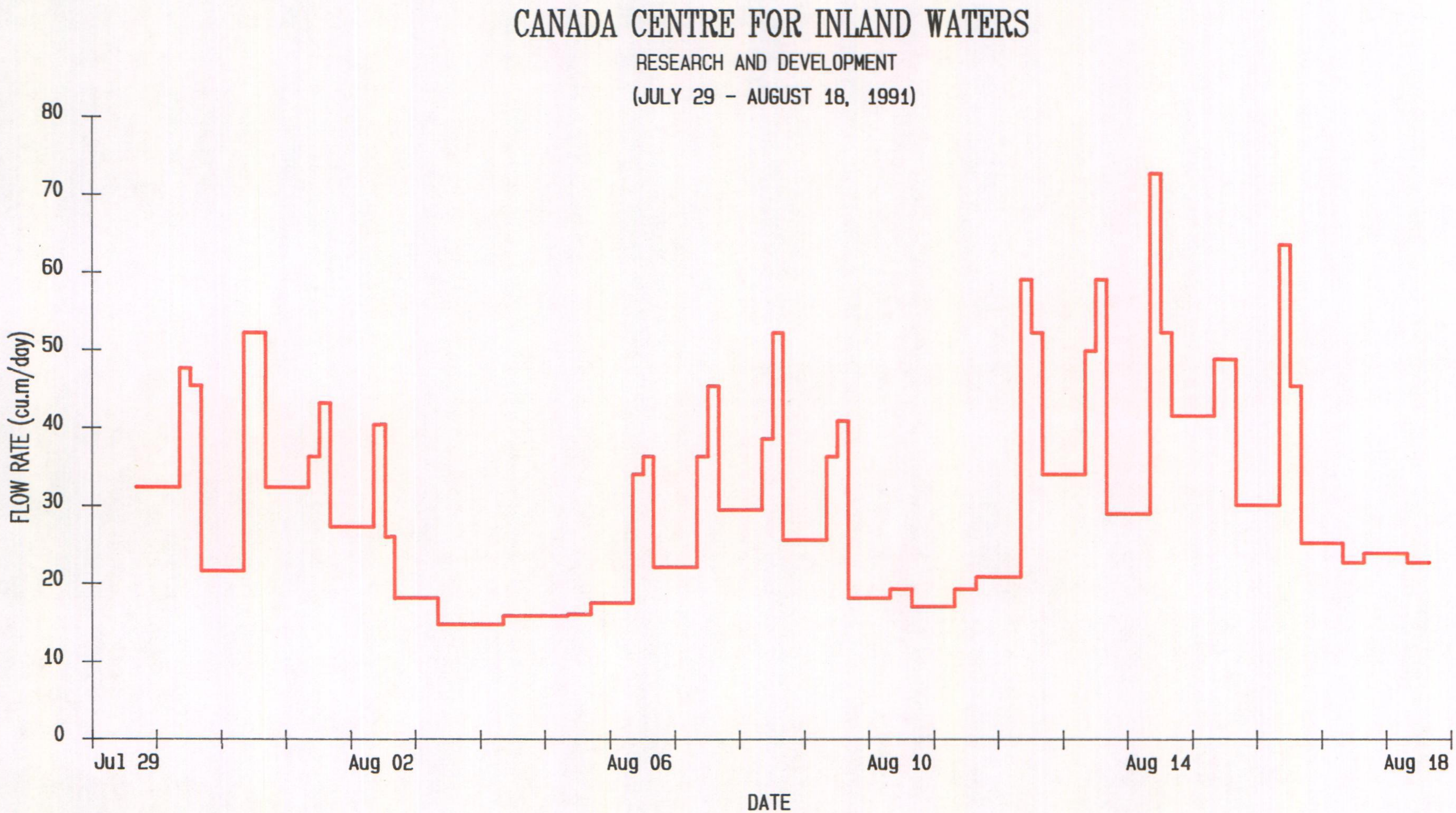

CANADA CENTRE FOR INLAND WATERS
RESEARCH AND DEVELOPMENT
(JULY 29 - AUGUST 18, 1991)
FLOW RATE (cu.m/day)
80
70
60
50
40
30
20
10
0
Jul 29
Aug 02
Aug 06
Aug 10
Aug 14
Aug 18
DATE

FIGURE-26

CANADA CENTRE FOR INLAND WATERS

ADMINISTRATION AND LABORATORY

(JULY 29 - AUGUST 18, 1991)

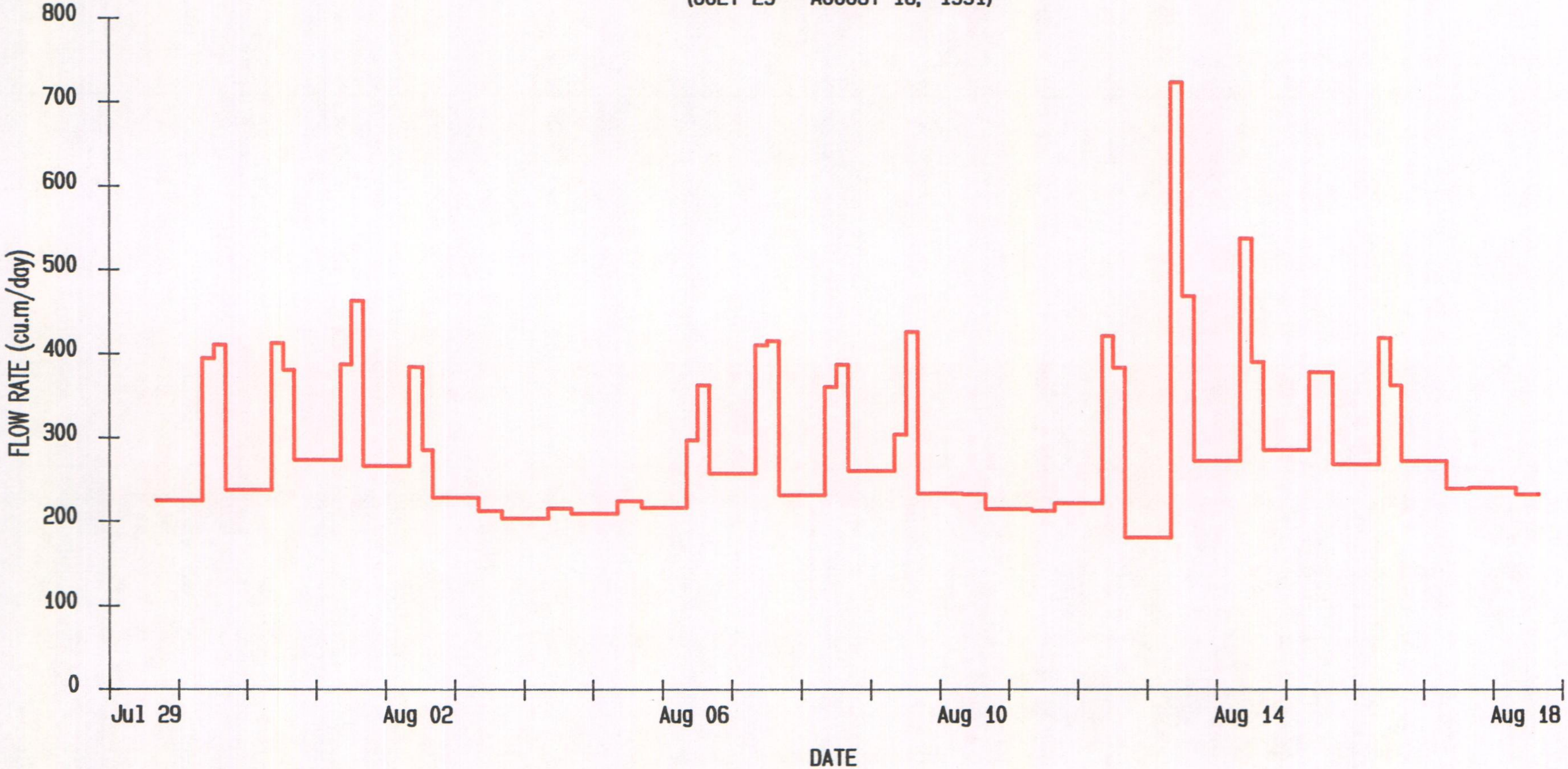


FIGURE-27

CANADA CENTRE FOR INLAND WATERS

A & L INFLOW AND STORM METERED OUTFLOW

(AUGUST 6 - 16, 1991)

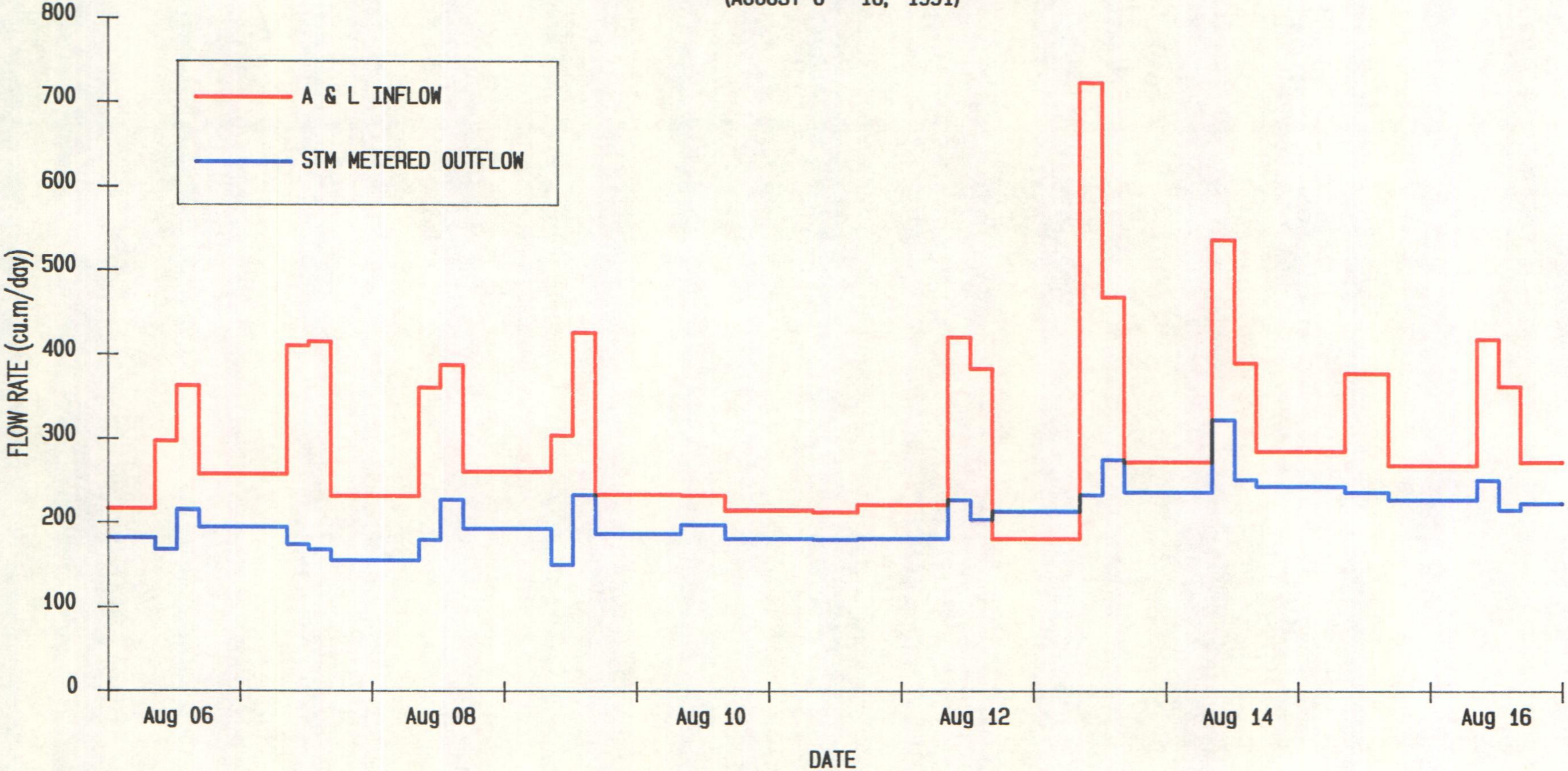


FIGURE-28

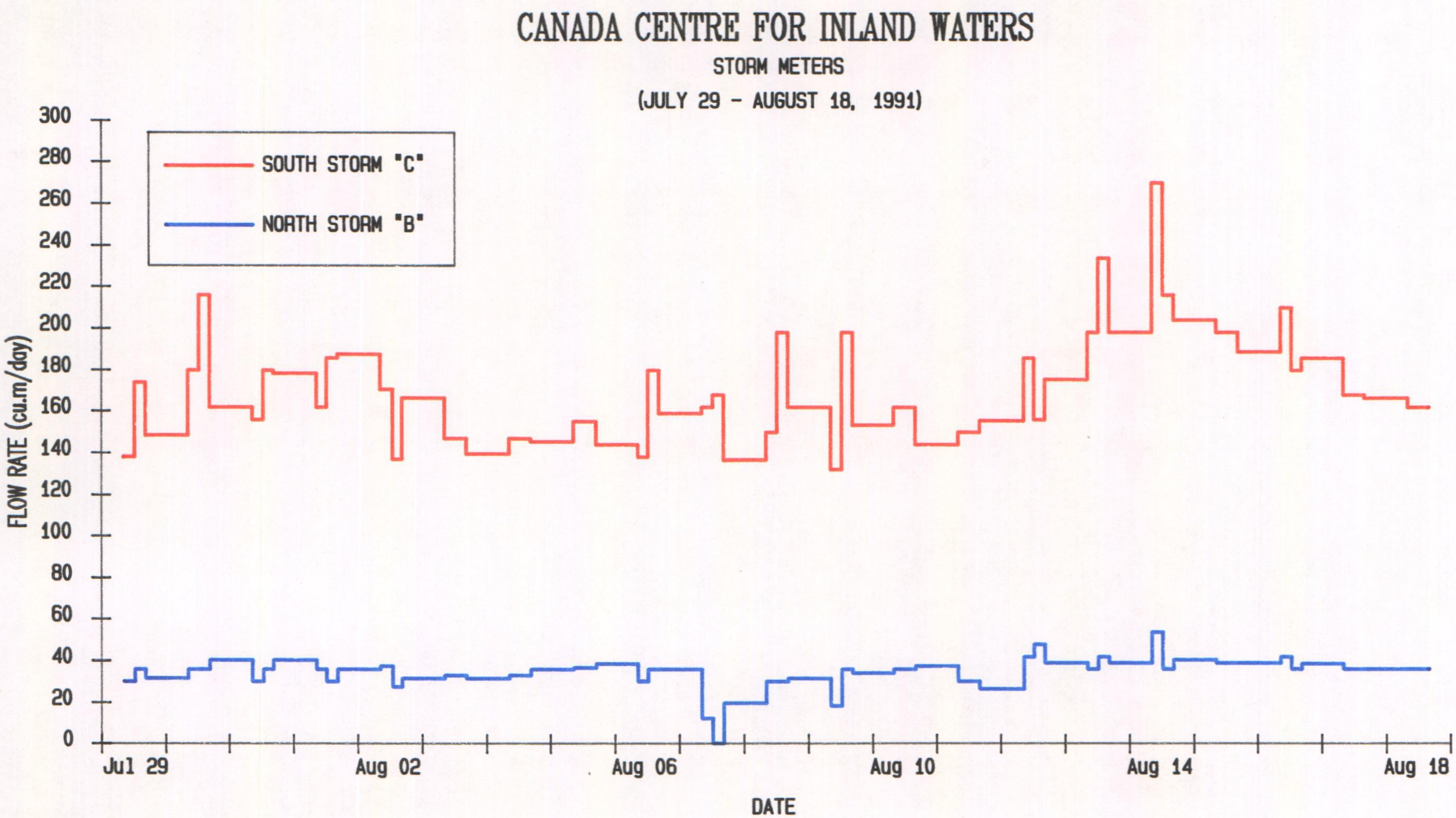

CANADA CENTRE FOR INLAND WATERS
STORM METERS
(JULY 29 - AUGUST 18, 1991)
SOUTH STORM "C"
NORTH STORM "B"
FLOW RATE (cu.m/day)
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
Jul 29
Aug 02
Aug 06
Aug 10
Aug 14
Aug 18
DATE

FIGURE-29

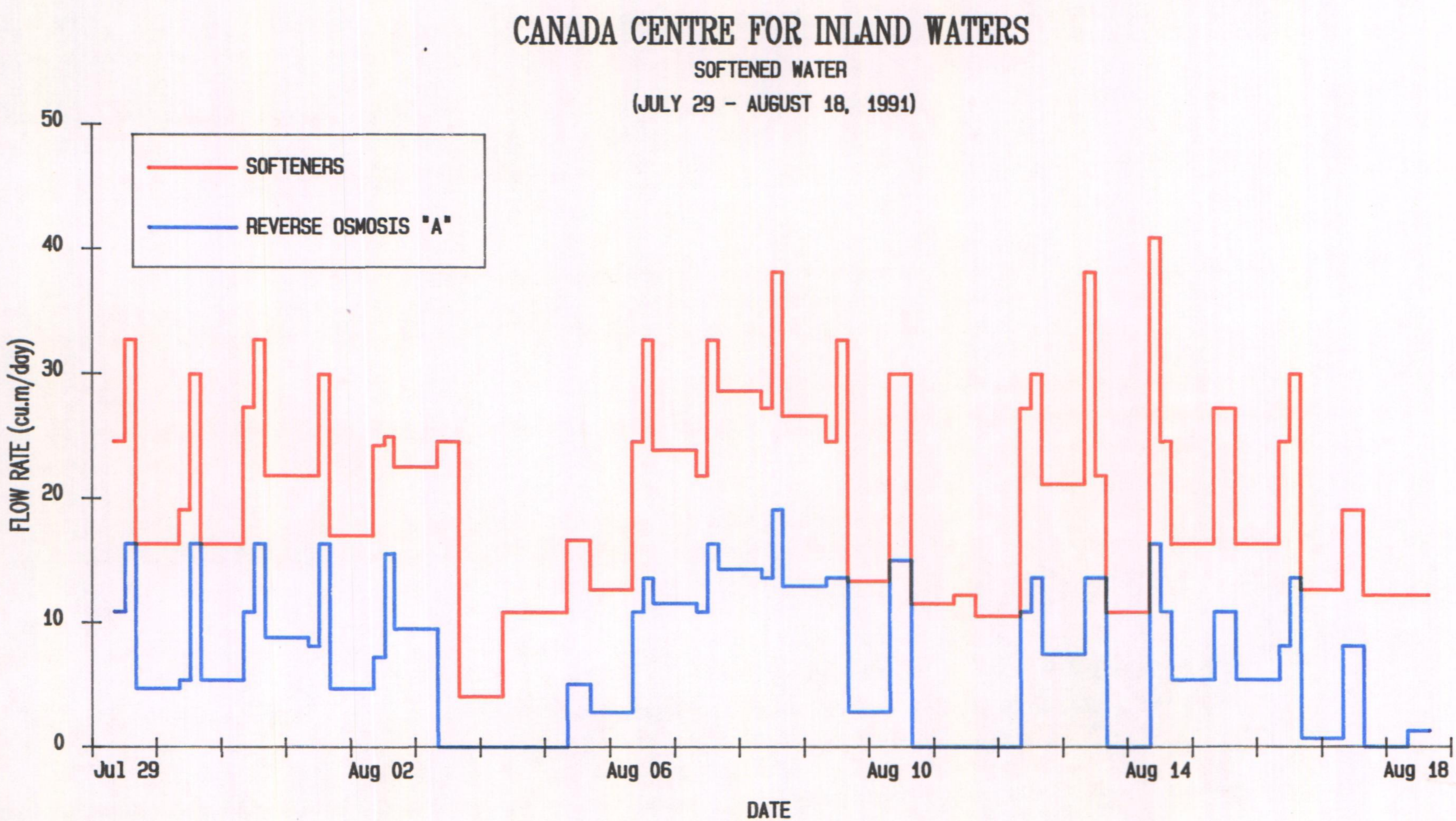

CANADA CENTRE FOR INLAND WATERS
SOFTENED WATER
(JULY 29 - AUGUST 18, 1991)
SOFTENERS
REVERSE OSMOSIS "A"
FLOW RATE (cu.m/day)
50
40
30
20
10
0
Jul 29
Aug 02
Aug 06
Aug 10
Aug 14
Aug 18
DATE

FIGURE-30

CANADA CENTRE FOR INLAND WATERS

BOILER MAKE UP WATER

(AUGUST 6 - 16, 1991)

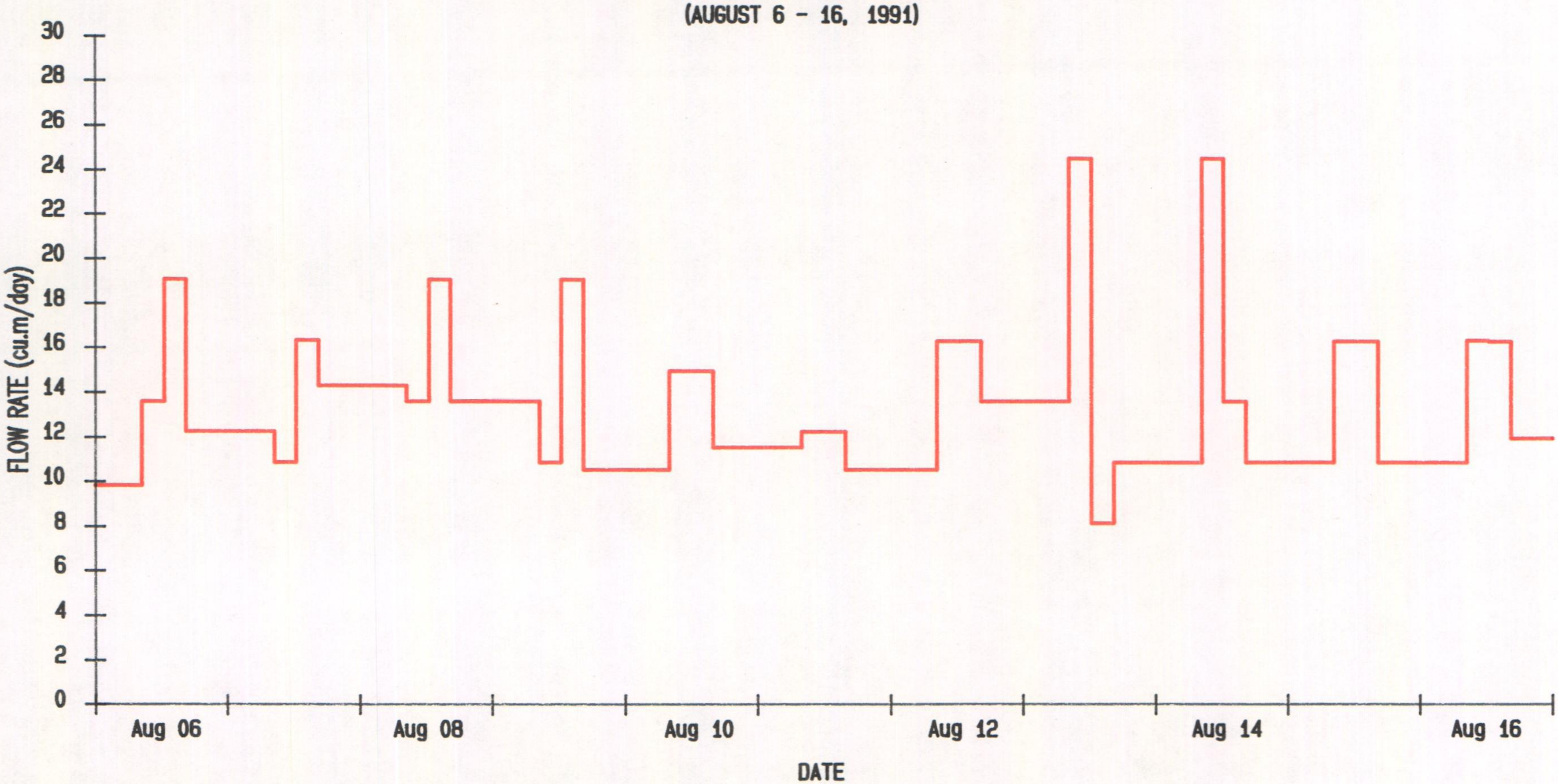


FIGURE-31

CANADA CENTRE FOR INLAND WATERS

INVENTORY OF WATER USE

Location	24 Hour Base Flow (m3)	Discharge Storm or Sanitary	Category of Use	8 Hour Daytime Flow (m3)	Discharge Storm or Sanitary	Category of Use
Boiler Plant	40	Sanitary	Cooling - Boilers	10	Sanitary	Domestic - hot water make up
	12	None	Process - boiler make up	3	Sanitary	Lab - reverse osmosis
	8	Storm	Process - reverse osmosis			
TOTAL (73 m3)	**60**			**13**		
Hydraulics Laboratory	6	Sanitary	Cooling - cold room	7	Storm	Process - tank top up
	19	Storm	Process - tank top up	2	Sanitary	Domestic
TOTAL (34 m3)	**25**			**9**		
Fisheries Laboratory	133	Storm	Process - fish tanks	3	Sanitary	Process - carbon filter backwash
	41	Sanitary	Process - fish tanks	6	Sanitary	Lab - sinks
TOTAL (183 m3)	**174**			**9**		

FIGURE-32

CANADA CENTRE FOR INLAND WATERS

INVENTORY OF WATER USE

Location	24 Hour Base Flow (m3)	Discharge Storm or Sanitary	Category of Use	8 Hour Daytime Flow (m3)	Discharge Storm or Sanitary	Category of Use
Research and Development	13.5	Sanitary	Cooling - A. C. unit in photo lab	2	Sanitary	Lab - sinks
	13.5	Sanitary	Cooling - A. C. unit in computer room	1	Sanitary	Lab - photography
	1	Sanitary	Cooling - cold rooms	4	Sanitary	Domestic - washrooms
TOTAL (35 m3)	**28**			**7**		
Administration and Laboratory	200	Storm	Cooling - fridges, freezers on floors 4 to 7	7	Sanitary	Domestic - cafeteria
	47	Sanitary	Cooling - computer room	17	Sanitary	Domestic - washrooms
	2	Sanitary	Cooling - fridges, freezers on floors 1 and 2	24	Sanitary	Lab - sinks
	2	Sanitary	Cooling - cafeteria fridges, freezers			
TOTAL (299 m3)	**251**			**48**		

FIGURE-32

CANADA CENTRE FOR INLAND WATERS

INVENTORY OF WATER USE

Location	24 Hour Base Flow (m3)	Discharge Storm or Sanitary	Category of Use	8 Hour Daytime Flow (m3)	Discharge Storm or Sanitary	Category of Use
Wastewater Technology Centre	2	Sanitary	Cooling - cold room	4	Sanitary	Domestic - washrooms
	15	Sanitary	Process - outside greenhouse	6	Sanitary	Lab - sinks
	7	Sanitary	Process - pilot plant	1	Sanitary	Lab - reverse osmosis
				2	Sanitary	Domestic - hot water make up
				2	Sanitary	Process - outside buildings
				2	Sanitary	Process - pilot plant
TOTAL (41 m3)	**24**			**17**		

SUMMARY TOTALS

Main Building **(624 m3)**	**538**			**86**		
Wastewater Technology Centre **(41 m3)**	**24**			**17**		
Complex Total **(665 m3)**	**562**			**103**		

FIGURE-32

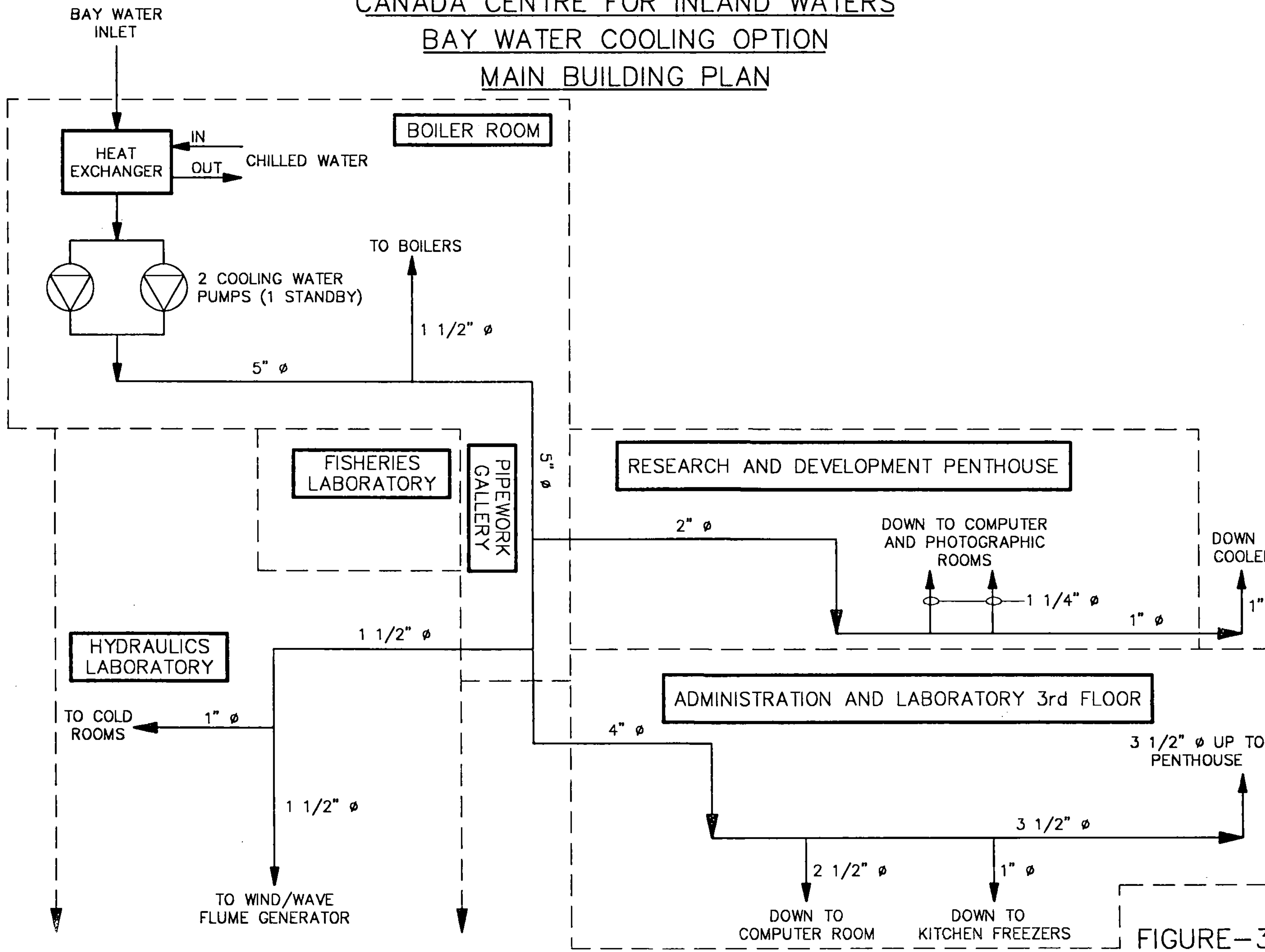
CANADA CENTRE FOR INLAND WATERS

CATEGORY OF WATER USE SUMMARY

Category	Location	City Water Inflow (m3)	Discharge	
			Storm (m3)	Sanitary (m3)
Cooling	Boiler Plant	40		40
	Hydraulics Lab	6		6
	Research & Development	28		28
	Administration & Lab	251	200	51
	WT C	2		2
	TOTAL	**327 (50%)**	**200**	**127**
Process	Boiler Plant	20	8	
	Hydraulics Lab	26	26	
	Fisheries Lab	177	133	44
	WTC	26		26
	TOTAL	**249 (36%)**	**167**	**70**
Domestic	Boiler Plant	10		10
	Hydraulics Lab	2		2
	Research & Development	4		4
	Administration & Lab	23		23
	WTC	6		6
	TOTAL	**45 (7%)**		**45**
Laboratory	Boiler Plant	3		3
	Fisheries Lab	6		6
	Research & Development	3		3
	Administration & Lab	25		25
	WTC	7		7
	TOTAL	**44 (7%)**		**44**

FIGURE-33

CANADA CENTRE FOR INLAND WATERS
BAY WATER COOLING OPTION
MAIN BUILDING PLAN



FIGURE–34

CANADA CENTRE FOR INLAND WATERS
BAY WATER COOLING OPTION
ADMINISTRATION AND LABORATORY 3rd FLOOR TO PENTHOUSE ELEVATION

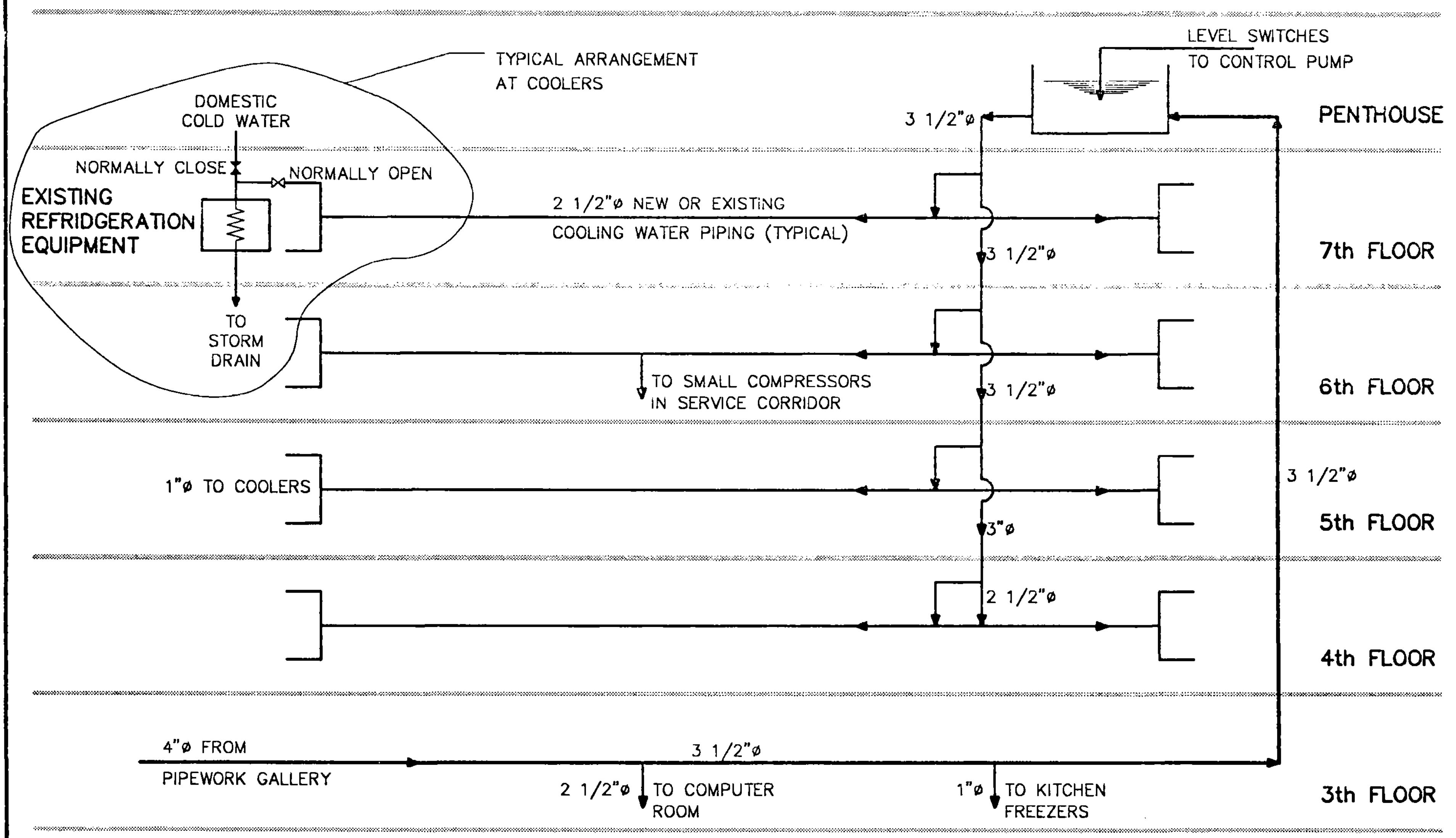


FIGURE-35