APPENDIX D – CLIFTON FLOOD PUMPING STATION ELECTRICAL AND MECHANICAL OPERATING MANUAL

Winnipeg

CITY OF WINNIPEG

CLIFTON

FLOOD PUMPING STATION
ELECTRICAL/MECHANICAL
OPERATING MANUAL

1256 WOLSELEY AVENUE

FEBRUARY 2008

KGS GROUP

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1.0 INTRODUCTION

Clifton Flood Pumping Station (FPS) has four large flood pumps and is located at 1256 Wolseley Avenue at the end of Clifton Street on the north side of the Assiniboine River. This FPS is affiliated with a Sewage Pumping Station (SPS) located on the same property. The general arrangement of the Clifton FPS is shown on the isometric drawing in Appendix A.

Under normal combined sewer system flows, the combined sewer flow is intercepted by a weir within the trunk sewer. The SPS then pumps flow to the wastewater treatment plants via the interceptor system. Under certain conditions, the sewer flow will exceed the capacity of the SPS, overflow the weir and discharge by gravity through the outfall to the river.

Under conditions of high river levels, rainfall and/or snowmelt runoff cannot flow by gravity to the river. Flood pumps are therefore required to discharge excess flow up over the dykes and into the river, in an effort to prevent sewer system surcharging, which can eventually lead to basement flooding.

When the river level is high, maintaining a lower level in the sewer system also provides additional storage capacity in the sewer system. The additional storage capacity assists in accommodating significant rainfall and/or snowmelt runoff events, therefore reducing the risk of basement flooding.

The river level at which pumps are enabled at Clifton FPS is defined as the **activation level.** At this river level, the FPS is confirmed ready for operation.

The **activation** level is unique for each FPS including Clifton. A key criteria in establishing the activation level is the elevation of the lowest basement in the drainage district likely to flood. This basement elevation, less two feet, is called the **maximum activation level**. This maximum activation level is the highest acceptable river level to which the system gravity drainage is effective. The actual activation level for a particular FPS is therefore set lower than the maximum activation level. Clifton activation level information can be found in Section 3.0 – Key Operating Parameters.

With the FPS activated, the water level in the combined sewer will initiate start-up of the flood pumps. As the combined sewer system level is drawn down below the level of the river, a flap gate prevents river water from entering the sewer system. The combined sewer system flow is then pumped up into the FPS discharge box, overflows the discharge box concrete weir and flows out through the outfall. This station has a separate flood discharge outfall.

Once excess flow into the FPS wetwell decreases and the wetwell water level drops, the pumps automatically stop so that the pumping rate matches the excess inflow. Once flow decreases to within normal operating conditions, the weir once again prevents flow from entering the FPS and the SPS then pumps all flow to the interceptor system. Once the threat of flooding has passed, and the river water level drops below station activation level, WWD crews deactivate the station.

The original drawings for the Clifton Station were developed by the City of Winnipeg and the elevations shown on the drawings are in imperial units and referenced to James Avenue (727.57ft Geodetic). Thus a dimension shown on the drawings as +2.5 feet would correspond to a geodetic elevation of 729.97 ft (727.57ft. + 2.5ft. = 729.97 Geodetic, Actual). All measurements listed within this report are based on metric geodetic elevations. Further measurement references are available in the City of Winnipeg Flood Activity/Emergency Manual also called the Flood Manual.

All equipment inside the stations has been numbered so that the operator can more easily ascertain the particular electrical switchgear that operates the respective pump.

Appendix A contains documents which are helpful to understanding the FPS layout and operation.

2.0 FLOOD PUMP STATION OPERATION

A description of the FPS components and their operation is given below.

To assist with the description of operation, refer to the station isometric drawing in Appendix A.

2.1 OPERATING CONDITIONS

Normal Operation

Combined sewage (storm and sanitary) flows through the Clifton combined sewer by gravity. A weir prevents the normal flow from discharging to the river and diverts the flow to the Clifton SPS.

Operation During Excessive Storm Water Flow but Low River Water Levels

When the combined flow exceeds the capacity of the SPS the excess flow will discharge over the weir and into the river by gravity.

Operation During Excessive Storm Water Flow and High River Levels

When the river level rises, the river water backs up into the outfall pipe and is prevented from flowing into the combined sewer by the flap gate. The excess flow over the weir will rise in conjunction with the rise in river level and flow into the FPS wetwell. If the river is above activation level and the station has been activated the pumps start sequentially as water level rises in the wet well.

2.2 PUMPS AND LEVEL CONTROLS

There are four flood pumps at the Clifton station. They are vertical centrifugal pumps with drive shafts that extend upwards to the motors, located on the main floor.

Clifton FPS has 4 pumps with motor horsepower of 250HP (4-250HP). Total flow capacity of Clifton FPS is 5.66 m^3/sec (199.88 cfs).

There are no check valves in the piping to and from the pumps, although Clifton FPS has a slide gate at each pump inlet in the wet well that are normally open but which allows isolation of the FPS from the incoming sewer. These slide gates are manually operated.

An ultrasonic level sensing system measures water levels in the wetwell, and stages the pumps.

Once a flood pump station is activated, the station runs automatically. The start elevation is set low enough that available storage capacity in the combined sewer system is maximized. That is, the wetwell is drawn down early enough to allow rainfall runoff to enter a relatively empty (rather than a relatively full) sewer system. During the rainfall event, the pumps will continue to assist in keeping the sewer levels low. The Clifton pump sequence starts in accordance with the levels indicated in Section 3.0 – Key Operating Parameters.

Start elevations for additional pumps are controlled to activate at levels higher than the previous pump start elevation. Additional pumps are brought online as the water level rises and the previous pump(s) are not able to keep up with flow into the FPS wetwell.

Pump stop elevations are also staged. The last pump to start should be the first one to stop. Pumps are staged to stop at decreasing wetwell elevations until the first pump is stopped at the pump 1 low level stop elevation. There are “duty plugs” on the front of the control panel which allow manual selection of the order in which each pump is started.

In addition to pump start and stop elevations, station wetwells are equipped with an independent (Flygt Ball) High Level Alarm. The High Level Alarm indicates the wetwell water level has continued to rise after all pumps have been asked to start. Initiation of the high water level alarm indicates a potential problem and a need for station inspection and possible manual intervention by WWD personnel. Alarms are monitored by a central computer located at the McPhillips Control Centre.

2.3 DISCHARGE BOX OVERFLOW LEVEL

The flood pumps discharge into box areas inside an overall discharge box. These areas are contained by fixed concrete weirs and are part of the primary line of defense against flooding from high river levels.

These weirs are intended to provide protection against backflow of river water into the sewer system through the pump discharge line and the pump itself. Also if this backflow were allowed to occur, water flowing through the flood pump from the river could reverse rotate the impeller of a pump that is not running. Attempting to start a pump that is spinning in reverse could result in damage to the pump motor and therefore result in loss of station pumping capacity. If backflow from the river were to pass over the discharge box weirs, the FPS would be ineffective because flow being pumped out by one pump could simply return to the FPS wetwell through a pump that is not running.

3.0 KEY OPERATING PARAMETERS

Activation of the Clifton Flood Pump Station is done as per the Flood Manual and is related to river level. This corresponds to a water surface level at Clifton of approximately 229.02 m. Once the station is activated, the controls are set to automatically start and stop the pumps. Start/Stop elevations, alarm elevations and other key elevations for the Clifton FPS are shown below:

Key Operating Elevations	Geodetic	Controller Display
Low Basement Elevation	229.82 m	
Transducer Head Elevation		
Activation Level	229.02 m	
Duty 1 - Start	N/A	
- Stop	N/A	
- Differential	N/A	
Duty 2 – Start	N/A	
- Stop	N/A	
- Differential	N/A	
Duty 3 – Start	N/A	
- Stop	N/A	
- Differential	N/A	
Duty 4 – Start	N/A	
- Stop	N/A	
- Differential	N/A	
High Alarm Level	N/A	
Wet Well Inlet top of weir (spill) elevation	224.58 m	
Transducer span zero		0
Main Floor Elevation	232.13 m	
Is Main Floor Subject to River Flooding at Flood Protection Level (FPL) James 27.8 m	There is 1.83 m of freeboard before the FPS is flooded by overland water.	
Discharge Box Floor Elevation	229.587 m	
Discharge Box Overflow Elevation	232.736 m	
Key Operating Parameters		
Discharge Box Overflow Elevation (type)	Fixed	
Station Pumping Capacity (4 Pumps)	5.66 m^3/s	

City of Winnipeg drawing __-FS-Q-2 (Appendix A) shows the control panel and the geodetic reference elevations. These FS-Q drawings were prepared by the City of Winnipeg and the information shown was taken from the original construction drawings.

When referring to the pump start and stop settings the following items should be noted.

- There are no check valves on the pumps. When the pumps stop, reverse flow will occur with the water in the discharge boxes and discharge & suction piping draining back into the wet well. This would raise the wet well level and if the differential between the pump start and stop elevation settings are too small, the pump will start again. This would cause the pumps to cycle endlessly. Thus the minimum differential setting is established with this consideration in mind.

- When the pumps shutdown there is an effect on the flow in the sewers. The sudden stopping causes water to surge in the upstream branches. If more than one pump stops at the same time this effect can be dramatic enough to cause water to surge in toilets in the upstream branches.

  This typically occurs under power failure conditions, and is unavoidable.

  Under normal operating conditions pumps should be turned off one at a time, according to water levels in the wet well, with a minimum one minute interval before shutting off another pump.

- Pumps should not be started at the same time, to reduce instantaneous electrical power draw. This also causes surging in the upstream sewer lines.

4.0 MECHANICAL AND ELECTRICAL EQUIPMENT

4.1 MAIN SERVICE

Manitoba Hydro services a 600 V, 3 ph, 4 W Customer Service Termination Equipment (CSTE) panel from 3 - 333 KVA local vault transformers. From the CSTE, a feeder provides service to the FPS. Revenue metering is provided by a Manitoba Hydro meter located in the CSTE.

4.2 FLOOD PUMPS

Clifton FPS has four Faibanks Morse Model 5710 vertical angleflow centrifugal pumps with non-clog impellors installed in the FPS drywell. The sizes are: 24" (250HP), 24" (250HP), 24" (250HP) and 24" (250HP). The pump seals are packing type and require a continuous flow of fresh water at approximately 60psi. The pump discharge lines are ductile iron or steel, discharging into a concrete riser which empties into the discharge box.

The starters at the Clifton FPS consist of air circuit breakers and reduced voltage, resistor type, magnetic starters. The distribution configuration can be seen in the single line diagram in Appendix A.

The pumps at the Clifton FPS are controlled by a Milltronics Multi Ranger Plus (tagged as) ultrasonic level controller. This transducer will stop and start the pumps at the wet well water levels (identified in Section 3, Key Operating Parameters) when the pumps are placed in "Automatic" operation mode. Configuration of the pump controls can be seen in the FSQ drawing in Appendix A.

When the pumps are stopped for any reason, the water in the discharge pipe flows back through the pumps, reversing the impeller rotation and causing an audible "flushing" sound. This is normal operation and nothing to be alarmed about. There are no check valves on either the suction or discharge piping. The backwash action allows the intake trash screens and the pumps to be flushed of debris.

The motors for the pumps are of the squirrel-cage induction type. They operate at 600 volts, 3 phase, 60 cycle and are of open drip proof design. The motors are located on the main floor with long shafts coupling to pumps located on the dry well floor. This arrangement allows the pumps to still operate should the dry well become flooded.

The original motors have motor winding insulation that is susceptible to moisture absorption. When sufficient moisture is absorbed, the insulation value deteriorates and there is a risk of an electrical fault when the motor is energized. This problem has generally been addressed by testing the motor winding insulation prior to start-up each spring and drying the motors by use of fans as necessary to obtain acceptable insulation values.

4.3 DEWATERING PUMP

CLIFTON FPS has a 10 HP dewatering pump which is used to lower the residual water level in the wet well. It is manually controlled and only used to lower the water level for inspection purposes. The dewatering pump discharges into the discharge block.

4.4 SUMP PUMPS

In the dry well, a small sump pump has been installed to handle minor leakage, groundwater seepage through the foundation and water discharged past the pumps' packing glands. The sump pump discharges into the wet well. These pumps are left on automatic at all times. An independent high level alarm (Flygt type float switch) provides an indication of water in the dry well.

4.5 SHAFT SEAL SYSTEM

The station is equipped with a water service, which distributes clean lubrication and cooling water to the shaft seal packing gland on each pump. The water service is protected by a backflow preventor. A common solenoid valve on the main water supply to all four pumps opens to allow water flow whenever a pump is asked to operate. Manual shut off valves at each pump are closed on a seasonal basis and opened when the FPS is activated and closed when it

is deactivated. A pressure switch on the water's supply pipe provides a remote alarm should the water supply fail.

The original documentation for the FPS indicates a water pressure of 15 lbs greater than the effluent pressure is required to keep effluent from entering the shaft seal and possibly damaging the shaft or seal. Water fed to the non-running pump shaft seals will simply drain to the sump.

4.6 HVAC EQUIPMENT

Main Floor Ventilation - Clifton FPS has no main floor ventilation.

Dry Well Ventilation- A manual controlled ventilation fan blows fresh air at 1200 cfm into the dry well. The fan has ductwork extension which delivers the air to the bottom of the dry well and the air is relieved through the access hatch. This fan is normally left in the off position and only activated when staff need to enter the drywell.

Dry Well Heating –The dry wells are heated with thermostatically controlled electric heaters and are kept at approximately 10°C. A low temperature thermostat set at 5°C provides remote alarm should the heating fail.

Motor Room Heating - The motor room is an unheated space. There is no equipment that is subject to damage with freezing.

Motor Room Ventilation - Clifton FPS does not have motor room ventilation or cooling fans installed.

4.7 EQUIPMENT CUT SHEETS

No pump OEM information is available for Clifton FPS.

4.8 ALARM AND MONITORING SYSTEMS

4.8.1 General

The Clifton FPS is provided with a Telesafe RTU and communicates over a telephone modem. A WWD monitoring system polls the RTUs and thus alarms are reported centrally. Alarmed points are listed in the table in Section 4.82. Automatic polling typically occurs several times an hour.

4.8.2 Remote Alarms

Monitored points are listed in the table below.

Alarm	*Description*
Lockout	N/A
High wet well	N/A
Station flood	N/A
Low temperature	N/A
Seal water loss	N/A
Loss of 600 V	N/A
Pump #1 running	N/A
Pump #1 fail	N/A
Pump #2 running	N/A
Pump #2 fail	N/A
Pump #3 running	N/A
Pump #3 fail	N/A
Pump #4 running	N/A
Pump #4 fail	N/A

* Used when staff are working in the flood pump station. Eliminates nuisance alarm.

4.9 TRASHRACKS

Trashracks are located in the wet well of the station to prevent the pumps being clogged and jammed with large size debris.

5.0 OPERATING PROCEDURES

5.1 INTRODUCTION

There is a Sanitary Pump Station (SPS) on the same property as, and to the east of the Clifton FPS. The SPS operates automatically year round and normally the flow of sewage is pumped to the interceptor system that flows to North End Water Pollution Control Centre. The role of the SPS during high river water levels is to continue to pump the normal effluent flow to its maximum capacity.

Five major activities are undertaken annually on the Flood Pump Station; a Preseason Activity, Activation Activity, De-Activation Activity, Fall (Winterize) Activity and Regular Maintenance Activity. Checklist used by City staff can be found in Appendix B.

5.2 PRE-SEASON ACTIVITIES

In early spring the following activities are required to prepare the FPS for activation:

Operations

- Verify all alarms listed in Section 4.8.2 report back to McPhillips
- Check ventilation fans and blowers to ensure they operate correctly
- Turn drive shaft by hand
- Check for vandalism

Electrical

- Electrical Service Inspection by MB Hydro - Initiated by Field Services Operations Engineer.
- Megger motors and cables and dry if required
- Calibration checks
- Disconnect motor leads and operate starters

5.3 ACTIVATION ACTIVITIES

When the river level at the Clifton FPS reaches elevation 229.02 the following activities are required to activate the station.

Operations

- Open water valves to pump seals
- Check sump pump to ensure it operates automatically
- Check operation of ventilation fan and blowers
- Remove ventilation duct covers
- Energize pump circuit breakers
- Turn pump starter selector switch to auto position
- Open station and/or pump intake gates, check for position
- Record information on log sheets
- Complete and submit Flood Station/Gate Activity Form to Regional Wastewater Supervisor.

Electrical

- Support available as required

FPS is now activated

5.4 ACTIVATION PERIOD ACTIVITIES

During the activation period the following activities are required to ensure proper operation of the pumping station

Operations

- Monitor Station daily
- Record run times for each pump
- Check wetwell elevation
- Check breakers and pump controls
- Check oil levels
- Check pump glands
- Check for vandalism

5.5 DE-ACTIVATION ACTIVITIES

When the river level drops below the activation level of 229.02 and the flow in the sewer can again flow to the river through the outfall the following activities are required to de-activate the FPS.

Operations

- Record final pump run-hour readings
- Complete Station Pump Hour Log sheet and submit to Regional Wastewater Supervisor.
- Turn pump starter selector switch to “off” position
- De-energize pump circuit breakers

- Turn off seal water to the pumps
- Close pump and/or station intake gates

Electrical

- Support available as required

The station is now de-activated.

5.6 FALL WINTERIZING ACTIVITIES

Near the end of September the following activities are required for winterizing the FPS.

Operations

- Check to ensure that water is off to pumps
- Check to ensure heater is on and working
- Check sump pump
- Check to ensure all breakers and pump controls are in the off position
- Exercise and lubricate station intake gates
- Check flood station discharge and outfall
- Close ventilation fan dampers
- Check trash racks and remove debris

Electrical

- Support available as required

5.7 REGULAR MAINTENANCE ACTIVITIES

On a regular basis the following maintenance activities are required on a 7-10 day cycle.

Operations

- Check building exterior for vandalism and required repairs
- Check interior of station for required repairs
- Turn pump shafts on a regular basis
- Clean trash racks and remove and dispose of excess garbage
- Check oil levels in pumps
- Check pump packing, tighten and replace as required
- Replace light bulbs as required
- Sweep all floors
- Cut grass/weeds
- Clear snow as required
- Remove debris from station discharge and outfall

Electrical

- Support available as required

APPENDIX A

DRAWINGS (Attached)

- Station Isometric Plan
- Single Line Diagram (electrical)
- Clifton Flood Station – Electrical and Controls (WWD Dwg No. __-FS-Q-1)

APPENDIX B

OPERATIONAL CHECKLISTS