SEWPCC Upgrading/Expansion
Conceptual Design Report

SECTION 10 - Secondary Clarifier

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10.0 Secondary Clarifiers

10.1 PURPOSE OF UNIT PROCESS

The secondary clarifiers receive mixed liquor from the discharge channel downstream of the bioreactors. Their main objective is solids-liquid separation of the mixed liquor prior to discharging effluent to the disinfection facility and outfall sewer. The secondary clarifiers also provides thickening of the underflow (settled solids) which are removed for further processing. Figure 10.1 identifies the flow streams to and from the secondary clarifiers.

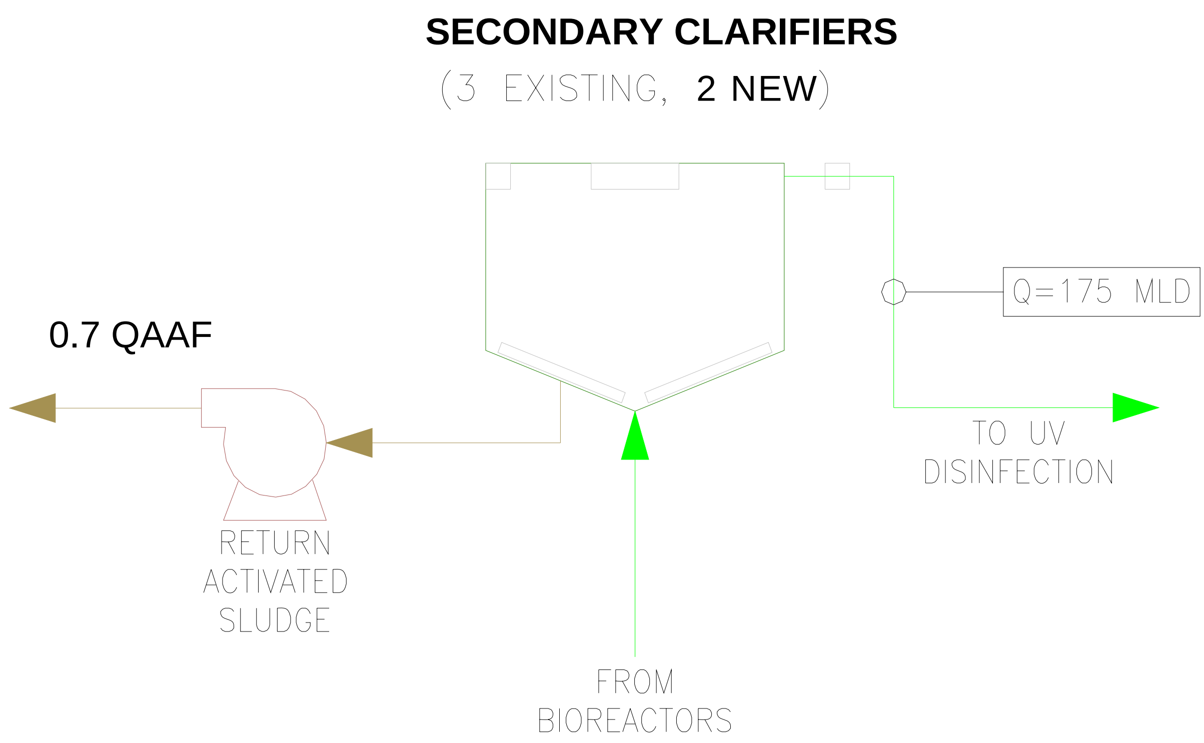


Figure 10.1: Secondary Clarifier Flow Stream Schematic

10.2 EXISTING SECONDARY CLARIFIERS

The SEWPCC is currently equipped with three (3) center column siphon feed and peripheral overflow type secondary clarifiers. Each has a central bridge driving mechanism that supports and rotates a center cage with two sludge rake arms and two scum blades.

Mixed liquor from the bioreactors is conveyed to Secondary Clarifiers No. 1, 2 and 3 via influent pipes. Each influent pipe is fitted with a magnetic flow meter and butterfly control valve to regulate and record the flow of mixed liquor, as shown in Figure 10.2. Mixed liquor is introduced to the clarifier, which provides quiescent conditions to promote settling of solids. Effluent overflows a V-notch weir into a circumferential launder around the perimeter of each clarifier. The effluent in the launder drains to a conduit that discharges into an effluent drop shaft. Clarifiers No. 1 and 2 share a common drop shaft while Clarifier No. 3 drains to a separate dropshaft. The dropshafts discharge to the plant bypass channel that runs the length of the secondary clarifier area. The plant bypass channel conveys both secondary effluent and any raw or primary effluent bypass flows from the upstream bypass facilities.

Figures 10.2: Secondary Clarifier Influent Pipeline and Flow Meter

Each secondary clarifier is equipped with a center column siphon feed and peripheral overflow with a central bridge driving mechanism that supports and rotates a center cage with two sludge rake arms and two scum blades. Sludge is siphoned off by draft tubes to a central hopper. The draft tubes consist of a series of 200 mm diameter suction pipes that are connected to the 600 mm diameter Returned Activated Sludge (RAS) suction header. Scum is collected from the water surface, dewatered on a beach plate and dumped into a hopper that drains to a scum tank. Clear liquid from the surface of the clarifier flows over a double weir to a launder and subsequent downstream disinfection processes.

10.3 DESIGN OF SECONDARY CLARIFIERS

In the proposed upgrade/expansion, the secondary clarifiers are sized to handle a peak summer flow of 175 ML/d and an average annual flow of 90.4 ML/d. The secondary clarification design was compared to the following requirements limits:

- Average surface overflow rate (SOR) = 24 $m^3/m^2/d$.

- Maximum SOR = 44 $m^3/m^2/d$.
- Average solids loading rate (SLR) = 144 $kg/m^2/d$.
- Maximum SLR = 216 $kg/m^2/d$.

The existing clarifiers (Final Settling Tanks or FSTs) No. 1 and 2 each have an area of 880 m^2 and FST-3 has an area of 1,640 m^2.

In order to provide the additional capacity required for secondary clarification, two new clarifiers are required. To maintain consistency in the facility in terms of operation and maintenance, the size of the new clarifiers are recommended to be the same as the existing large clarifier. This would provide two (2) additional 45.7 m diameter secondary clarifiers (FST-4 and FST-5).

Table 10.1 – Summary of Secondary Clarifier Design

Clarifier Number	Ex. FST-1	Ex. FST-2	Ex. FST-3 Prop. FST- 4 & 5 *
Clarifier Dimensions			
Diameter (m)	33.5	33.5	45.7
Side Wall Depth (m)	4.6	4.6	4.6
Volume (m^3)	4048.0	4048.0	7544.0
Surface Area (m^2)	880.0	880.0	1640.0
Weir Length (m)	105	105	144
Flow Distribution (ML/d)			
At 90.4 ML/d	11.3	11.3	22.6 (each)
At 175 ML/d	22	22	44 (each)
Percent of Total Flow	12.5%	12.5%	25.0% (each)
Surface Overflow Rate			
At 90.4 ML/d	12.8 $m^3/m^2/d$	12.8 $m^3/m^2/d$	13.8 $m^3/m^2/d$
At 175 ML/d	25 $m^3/m^2/d$	25 $m^3/m^2/d$	26.8 $m^3/m^2/d$
Weir Loading Rate			
At 90.4 ML/d	108 $m^3/m/d$	108 $m^3/m/d$	157 $m^3/m/d$
At 175 ML/d	210 $m^3/m/d$	210 $m^3/m/d$	306 $m^3/m/d$

* Values shown are per clarifier for Ex. FST-3, proposed FST-4 and proposed FST-5

With two new 45.7 m diameter secondary clarifiers, the total surface area will be increased to 6680 m^2. Dynamic simulation was run in BioWin™ for the design year and the simulated surface overflow rate and solids loading rate are presented in Figures 10.3 and 10.4. The results indicate the following:

- The average SOR design criteria of 24 $m^3/m^2/d$ was met at all times during the design year except the summer maximum week flows, where the maximum SOR of 44 $m^3/m^2/d$ should be applied and was met.
- The average SLR design criteria of 144 $kg/m^2/d$ was met at all times, even under peak flow conditions.
- The proposed secondary clarifiers meet the design requirements.

The secondary clarifiers were analyzed with one 45.7 m diameter secondary clarifier out of service to determine the effects on SOR and SLR. The purpose of this analysis is to determine the sensitivity of the system to changes in flow and clarifier capacity (should one clarifier be out of service). Three flow scenarios were tested in BioWin™ for two conditions: all of the secondary clarifiers in operation; and one large clarifier out of service. The three flow scenarios tested were: annual average flow (AAF) of 90.4 ML/d; maximum month flow (MMF) of 111 ML/d in spring; maximum week flow (MWF) of 178 ML/d in summer. The results are shown in Table 10.2.

Table 10.2 - Sensitivity analysis on Secondary Clarifier (SC) SLR and SOR

Flow (MLD)	Surface Overflow Rate ($m^3/m^2/d$)				Solids Loading Rate ($kg/m^2/d$)			
	All SC's in operation	One large SC out of service	Design SOR		All SCs in operation	One large SC out of service	Design SLR	
			Average condition	Peak condition			Average condition	Peak condition
90.4	13.4	17.8	24	-	72	96	144	-
111	16.5	21.9	24	-	118	156	144	-
178	25.8	34.2	-	44	125	166	-	216

The following conclusions can be drawn from the results presented:

- With all of the secondary clarifiers being operated, the design criteria were met in both conditions for the five different flow scenarios.
- With one 45.7 m diameter secondary clarifier out of service, the design criterion (solids loading rate) is breached only under the scenario of MMF. The significance of this relates more to operation and maintenance than normal facility treatment capabilities. This scenario demonstrates that clarifier maintenance should not be undertaken when flows are anticipated to exceed the average annual flow.

BioWin™ dynamic simulation results for SOR and SLR are shown in Figures 10.3 and 10.4 for the scenario where all clarifiers are in operation.

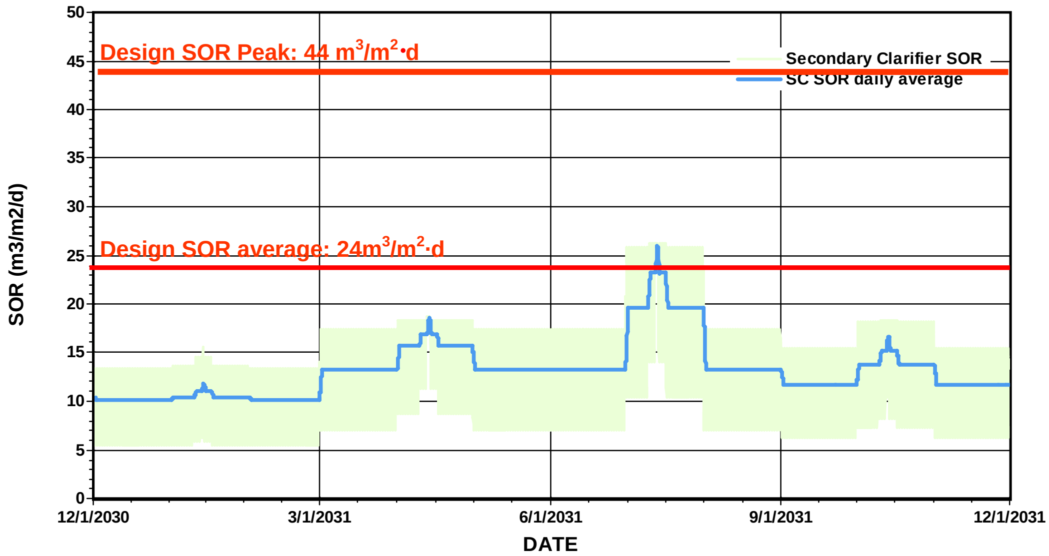


Figure 10.3 - Secondary Clarifier Surface Overflow Rate (SOR)

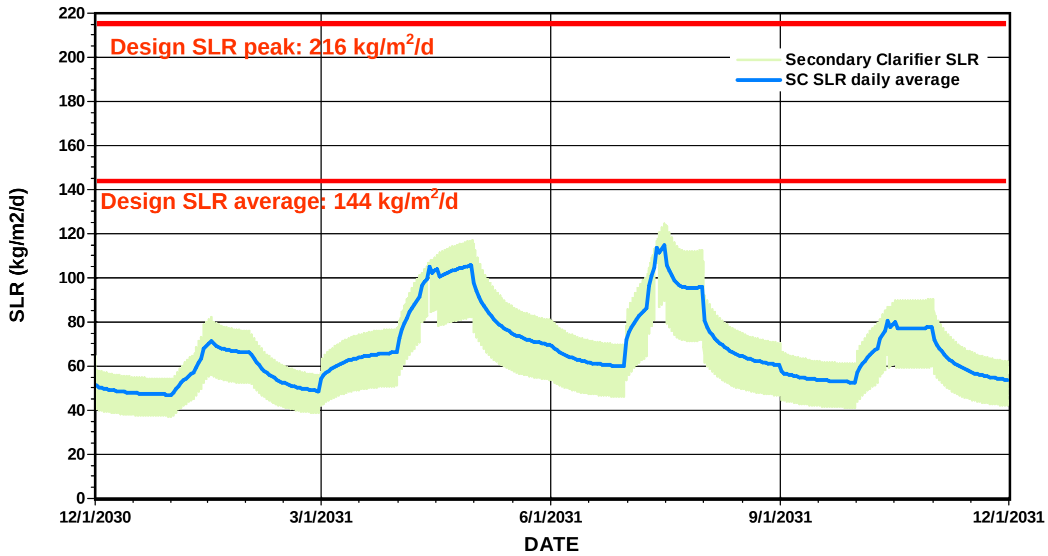


Figure 10.4: Secondary Clarifier Solids Loading Rate (SLR)

The proposed secondary clarifier expansion will result in no design criteria breaches under normal operating conditions and will only breach under maximum month flow when one clarifier is out of service. The BioWin™ analysis was undertaken using Bioreactor Option C and now that Option G (the IFAS Option) has been selected, solids loading to the secondary will be reduced which will help to mitigate the breach condition. This presents a low risk and the proposed clarifier expansion is recommended.

10.4 SECONDARY CLARIFIERS – FACILITY LAYOUT

The existing facility layout was developed with the future plan to install a new 45.7 m diameter secondary clarifier opposite the existing clarifier FST-3. Based on discussions with the City, there is a desire to continue the philosophy of channel flow and pipe galleries with indoor maintenance access. To accommodate this, the proposed layout expands upon the existing infrastructure.

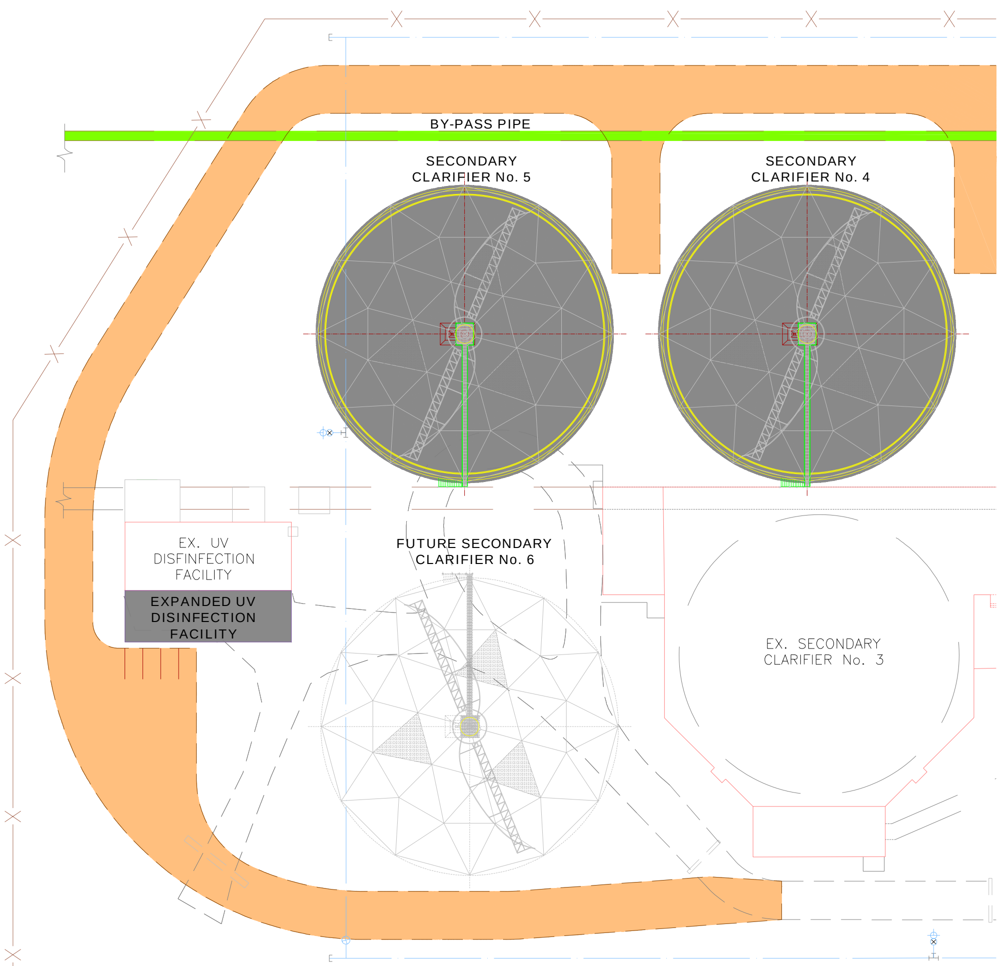
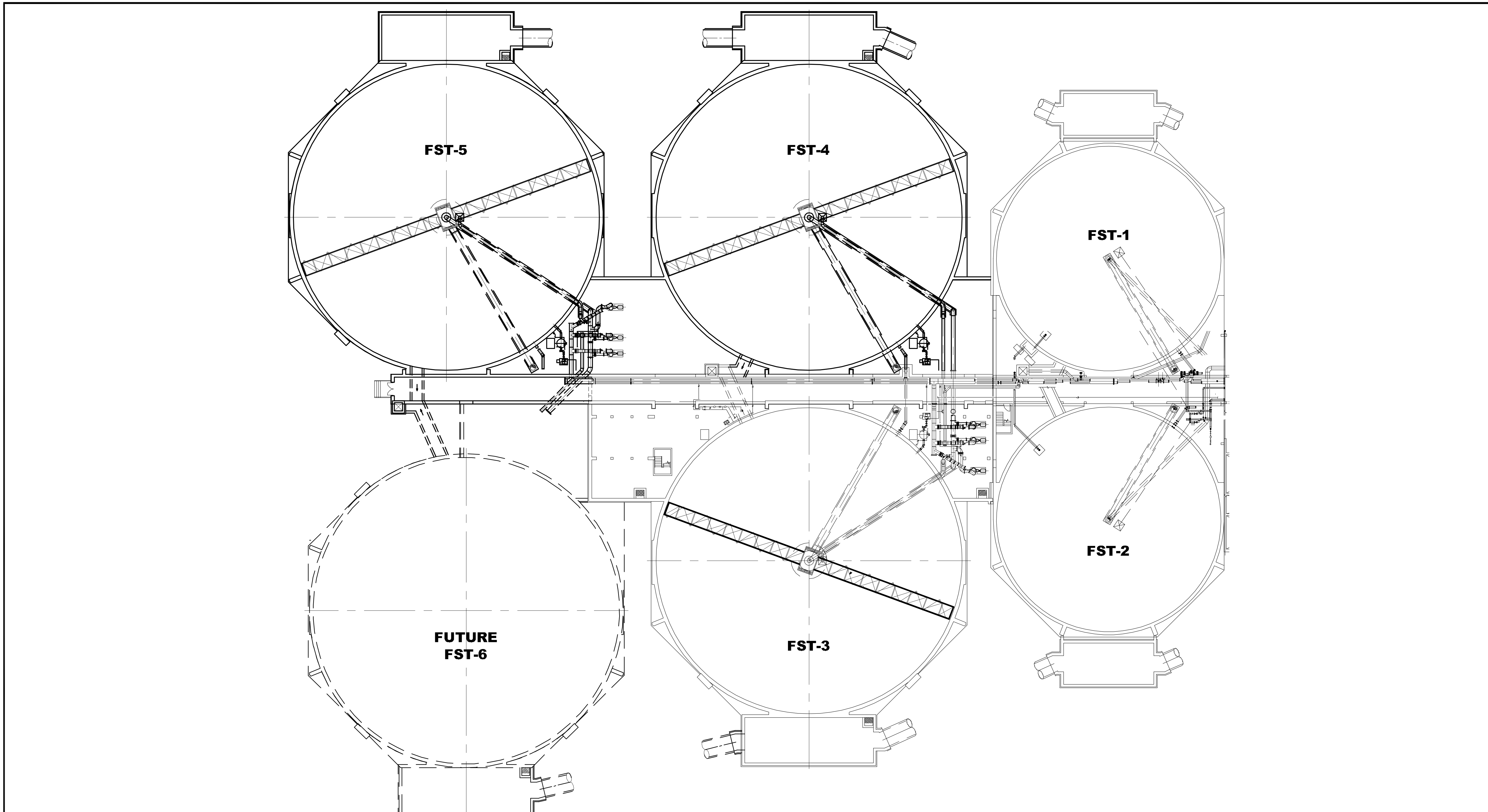


Figure 10.5: Proposed Secondary Clarifier General Layout

There was a previous plan to add one 45.7 m diameter clarifier across from FST-3. We are proposing to install one of the new clarifiers in this location with the second new clarifier installed adjacent to it. Provision will also be made for installation of a future clarifier opposite FST-5 and adjacent to FST-3. See Figure 10.5 for the general site layout.



LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE | DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

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DRAWN BY	K.R.	APPROVED BY	S.A.B.
HOR. SCALE: VERTICAL:	N.T.S.	RELEASED FOR CONSTRUCTION:	
DATE	2008.06.03	DATE	

ENGINEER'S SEAL

TENDER NO.

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

SOUTH END WATER POLLUTION CONTROL CENTRE

SECONDARY CLARIFIER LAYOUT AND MECHANICAL PLAN

CITY DRAWING NUMBER: FIGURE 10.6

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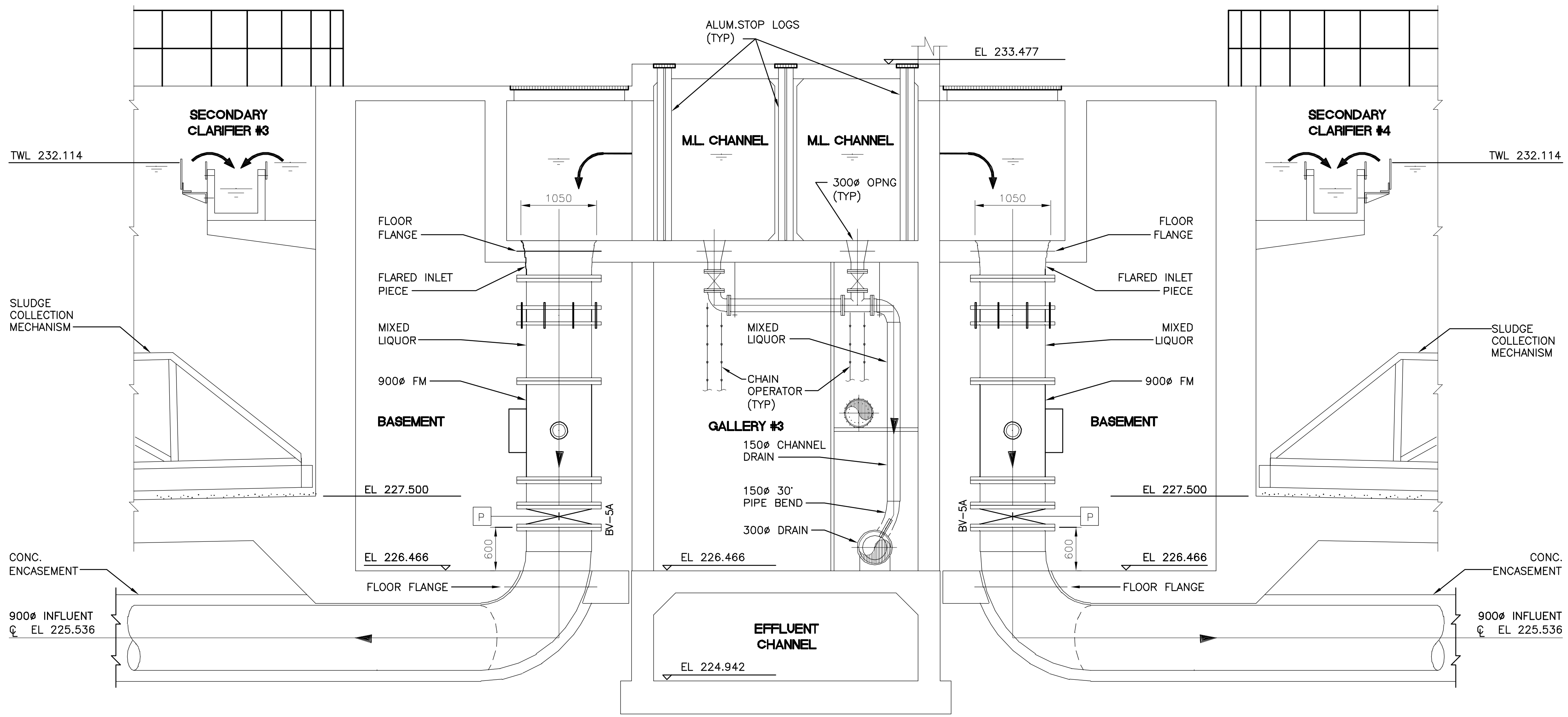

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HOR. SCALE:	1:75	RELEASED FOR CONSTRUCTION:	
VERTICAL:			
DATE	2008.06.03	DATE	

ENGINEER'S SEAL

TENDER NO.

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

SOUTH END WATER POLLUTION CONTROL CENTRE

SECONDARY CLARIFIER MIXED LIQUOR FEED SETUP

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Installation of the new clarifiers to the west of the existing clarifiers will reduce project cost by taking advantage of equipment and layouts already provided in the previous expansion as well as connecting to flow channels, piping and access ways already in place. This concept will require greater coordination and some operational interruptions for tie-ins but should not have any significant impacts. See Figure 10.6 for greater detail of the facility layout including preliminary mechanical layouts.

10.5 MIXED LIQUOR CHANNEL AND INFLUENT FLOW

Flow will be directed from the bioreactors down the existing mixed liquor flow channel. The existing clarifier mixed liquor feed pipes that contain a magnetic flow meter and modulating butterfly valve will remain in place. For the new clarifier opposite FST-3, stop logs and a knockout panel have already been incorporated into the previous upgrade. Thus, connection of a new mixed liquor feed pipe should be relatively simple. For the second new clarifier and proposed future clarifier, the mixed liquor channel will be extended. New stop logs will be installed for both and a mixed liquor feed pipe will be installed for the new clarifier. A knock out panel will be provided for the future clarifier feed. New magnetic flow meters and control valves will be installed similar to those already in place. See Figure 10.7 for details of the proposed influent works.

The existing mixed liquor channel was analyzed to determine if it has adequate capacity to convey future design flows. The conceptual future design flow value used was 250 ML/d to account for future secondary clarifier expansion and optimization even though the capacity required under this expansion is 175 ML/d. The analysis indicates that the extended channel has adequate capacity for this future flow.

10.6 SECONDARY CLARIFIER MECHANISMS

10.6.1 Existing Clarifiers

Each existing clarifier is equipped with a rotating sludge collector mechanism that withdraws settled sludge through multiple collection pipes called draft tubes. The collector mechanism rotates continuously while the clarifier is in service. Each clarifier has a series of 200 mm diameter suction pipes that are connected to the 600 mm diameter RAS suction header. This type of mechanism (shown in Figure 10.8) adequately collects the sludge in the tank given the existing high purity oxygen activated sludge process. However, this type of mechanism allows some sludge to collect between the suction pipes. As this sludge ages, it will negatively affect the treatment process and could result in phosphorus release into the effluent. Therefore, this mechanism needs to be upgraded as part of the process upgrade.

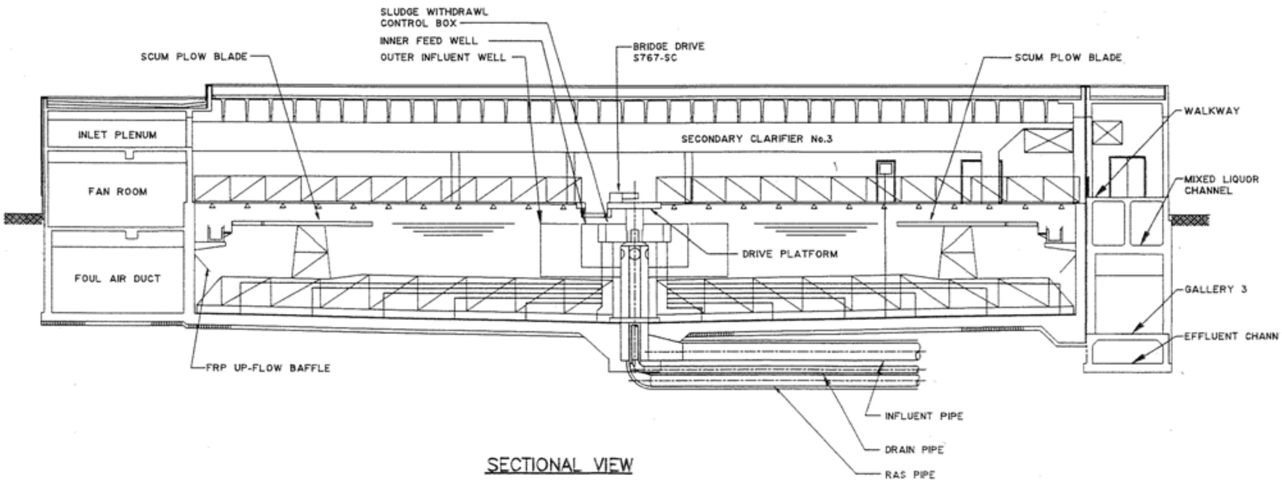

Figure 10.8: Sectional View of Existing Secondary Clarifier Mechanism

An effective technology at removing sludge from secondary clarifiers and reducing sludge age is the helical sweep mechanism as shown in Figure 10.9. The existing clarifiers would need to be converted from the existing draft tubes to helical sweeps. Through discussion with the clarifier equipment suppliers, we have determined that the existing clarifier mechanisms can be retrofitted to the helical sweep type.

Eimco (the manufacturer of the existing clarifier equipment) indicated that the drives and non-wetted parts should be able to be reused. They assumed that the outer feed wells can be reused. These assumptions are reasonable but further analysis will be required during the detailed design phase to confirm what equipment can be re-used for a retrofit. The condition of the existing clarifier mechanisms is good. Eimco identified the supply cost to retrofit each existing clarifier mechanism to rotating helical sweeps as $125,000 for each of the 3 existing clarifiers. Eimco provided an illustrative drawing of a similar retrofitted clarifier shown in Figure 10.10. Conversion from draft tubes to helical sweeps will require:

- Remove sludge lines and sludge collection box.
- Installation of smaller diameter center columns.
- Modification of cage and rake arms, sandblasting and repainting.
- Installation of spiral blades, squeegees and supports.

Information was obtained from WesTech for retrofitting of the secondary clarifier mechanisms. WesTech has provided the clarifier equipment for the WEWPCC and is very reputable but they

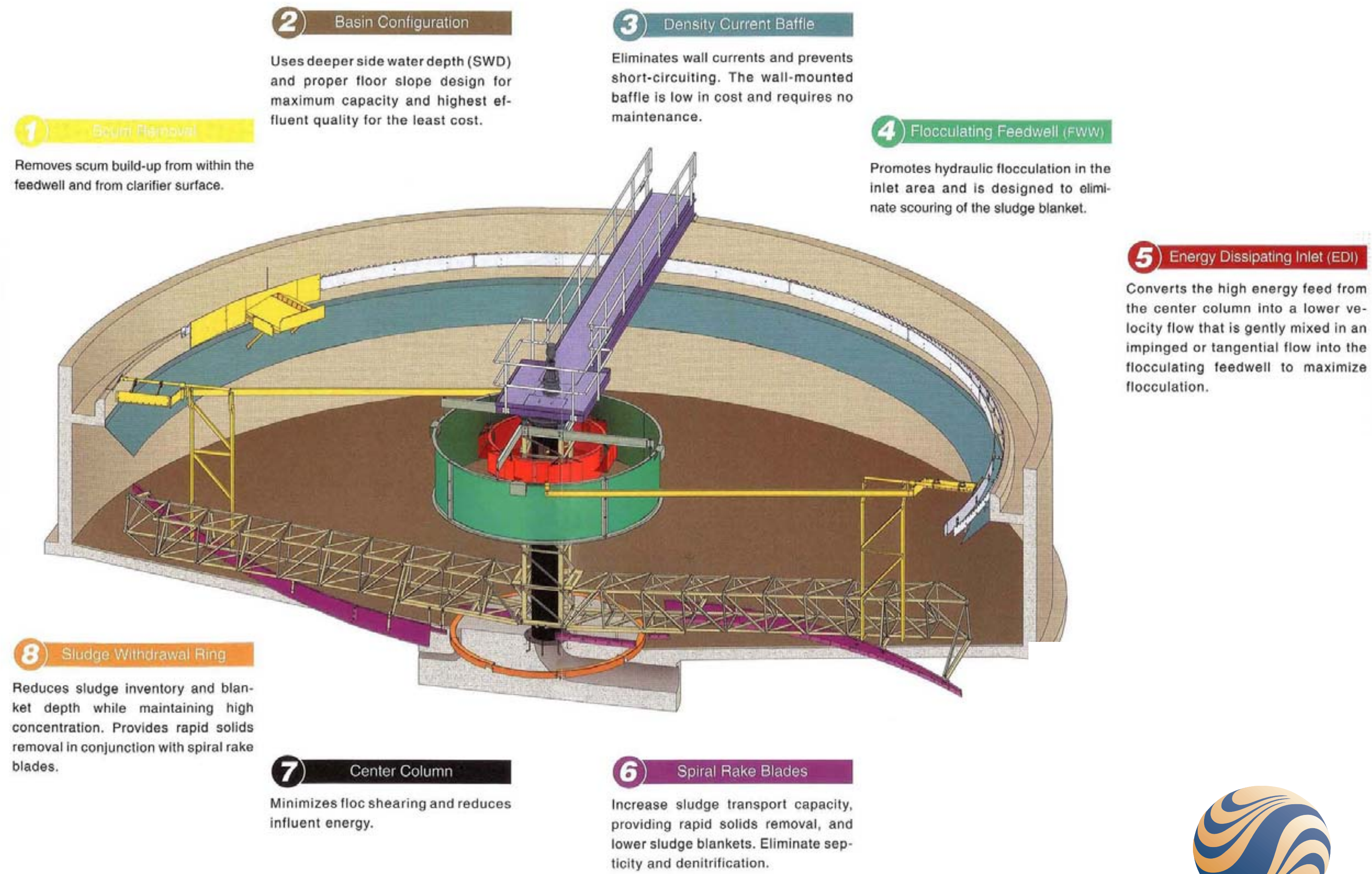

Figure 10.9: Sectional View of Typical Helical Sweep Type Secondary Clarifier Mechanism

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are less familiar with the existing mechanisms. As such they quoted a more encompassing scope of work that includes:

- A new center cage to transmit torque to the rake arms.
- Two (2) new rake arms per clarifier c/w stainless steel spiral blades.
- Two (2) new scum skimmers and scum box.
- New sludge withdrawal ring.

WesTech's quote is provided with the assumption that the motor drive unit, controls, center column and feed well are in useable condition. As with the Eimco assumptions, a more detailed analysis will be required during detailed design to determine exactly what components of the existing clarifier mechanisms can be incorporated into the retrofitted mechanisms. WesTech provided pricing for this work of $205,000 to retrofit each of the smaller clarifiers and $350,000 to retrofit the larger clarifier.

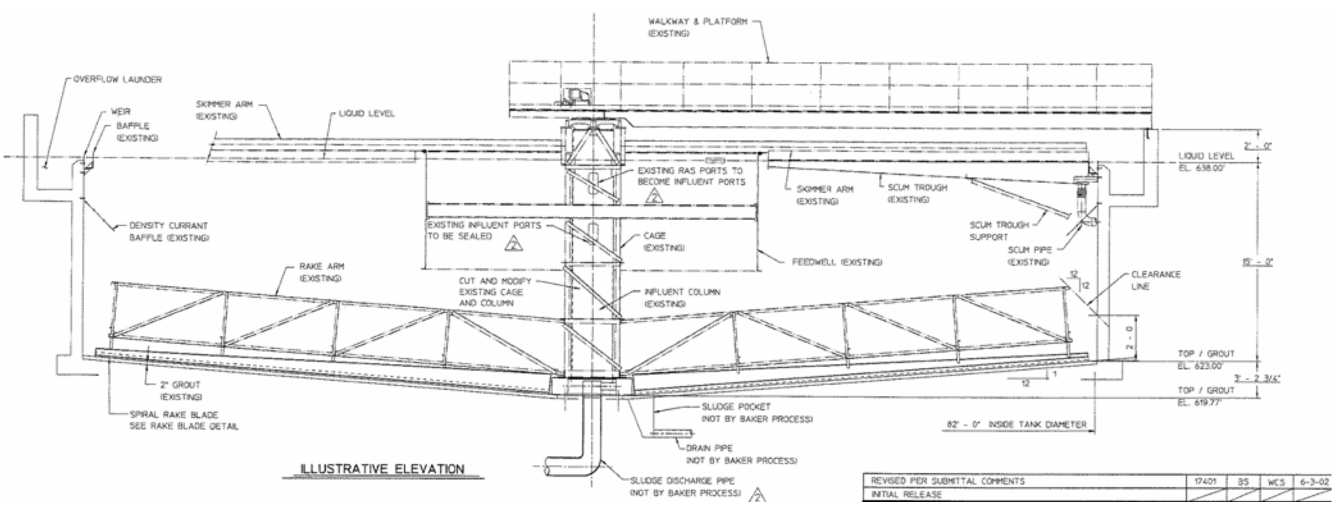

Figure 10.10: Sectional View of Sample Retrofitted Secondary Clarifier Mechanism

One item that needs to be provided as part of the existing secondary clarifier mechanism upgrade is additional corrosion protection. Sandblasting and epoxy coating of existing equipment was included in the scope of work provided to the two mechanism manufacturers. The City indicated that they recently used ARC S1 as a coating on Clarifier no. 3. This and other coating options will be investigated further during detailed design.

10.6.2 New Clarifiers

As previously mentioned, helical sweep style sludge collection mechanisms are likely the best to minimize sludge age and a phosphorus release. The two proposed clarifiers should be designed with helical sweep style sludge collection mechanisms.

In general, new mechanisms should have helical sweep arms, center column siphon feed, circular energy dissipating inlet, and effluent weirs and scum baffles. Budget pricing from EIMCO indicates a supply cost for each new clarifier mechanism of $450,000, with WesTech providing a price of $475,000.

The intention is for the secondary clarifiers to all contain helical sweeps. In order to reduce cost, retrofitting of the existing secondary clarifiers is recommended whereby as much of the equipment is reused as possible while helical sweeps are added. Due to this integration of existing and new components for the existing secondary clarifiers, the new mechanisms will be similar but not duplicates of the mechanisms recommended for the new secondary clarifiers.

10.7 SLUDGE HANDLING

There are presently connections for return activated sludge and waste activated sludge collection from each of the existing secondary clarifiers. With the new BNR treatment process, this philosophy will be changed. The revised flow scheme and sludge routing is shown in Figure 10.11.

Sludge collected in the Secondary Clarifiers will be returned to the front of the Bioreactors as RAS. No connections for Waste Activated Sludge (WAS) will be made to the new clarifiers. WAS systems in place for the existing clarifiers will remain in the event that sludge needs to be wasted but this would not be a normal operation and should not be required. All WAS will be collected from the last aerobic zone of each bioreactor train.

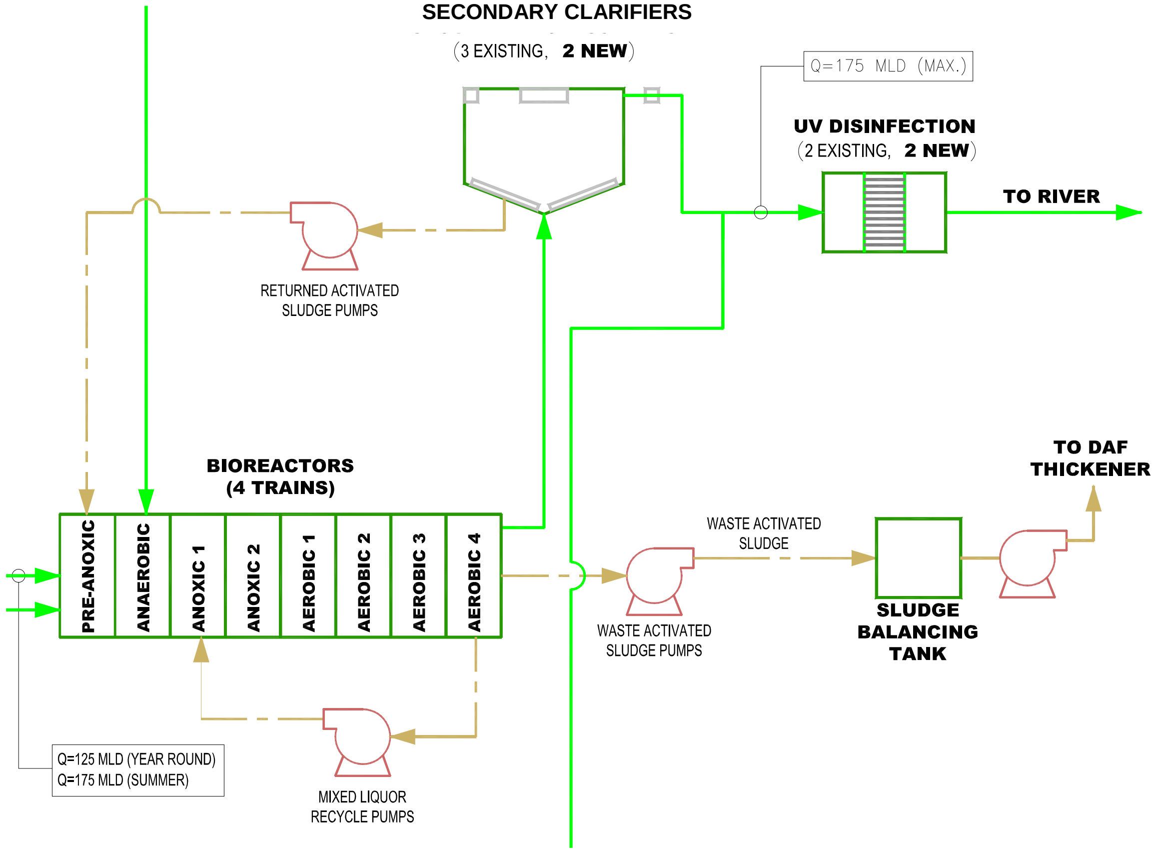

Figure 10.11: Secondary Clarifier Flow Schematic

10.8 RETURN ACTIVATED SLUDGE HANDLING

Sludge collected in the secondary clarifiers will be continuously removed from each clarifier by variable speed RAS pumps. Three pumps are currently dedicated to Clarifiers No. 1 and 2 (one duty pump for each clarifier and one standby pump), and two pumps are dedicated to Clarifier No. 3 (one duty/one standby). The pumps and mechanical installed for RAS handling for FST-3 also included provision for the addition of a 3rd duty pump when FST-4 is constructed. This will result in a setup similar to FST-1 and 2 where there are two duty RAS pumps and a common standby. For the two new clarifiers, we propose to provide three pumps, one duty pump for each clarifier and one common standby pump. The configuration would be similar to what was setup for FST-3 and 4. Each existing pump is equipped with a magnetic flow meter (magmeter) to monitor RAS and we will install a magmeter for each new RAS pump.

The existing five RAS pumps are connected to a common 750 mm diameter transfer pipe. This pipe will be extended to the new pumps installed for FST-5. Its current discharge locations will be modified to convey RAS to the upstream end of the new bio-reactors. From the three proposed RAS pumps, new pipes will run to a common pipe header, very similar to that previously installed for FST-3 and 4. Individual RAS feed pipes (one for each bio-reactor) will be teed from the 750 mm diameter common header to the influent chamber of each bio-reactor. Each RAS feed pipe will be equipped with a magnetic flow meter and an automatic positioning valve for control of RAS flow to each bio-reactor.

In order to determine the adequacy of the existing RAS infrastructure, we determined the pumping requirements. Design parameters for RAS pumping are as follows:

Normal RAS Flow = Average Day Flow x 70%
= 90.4 ML/d x 0.7
= 64 ML/d

For pump sizing, RAS flow can fluctuate between 50% and 100% of average day flow
= 45 ML/d to 90 ML/d

The proposed RAS pumping system was analyzed and it was determined that additional pumps the same as the recessed impeller centrifugal pumps already existing for FST-3 could be used for FST-4. One pump would be added where space was provided for a future pump, making the current setup for FST-3 and FST-4 two duty and one common standby pump. The existing pump make and model are not adequate for the new clarifier FST-5 and future FST-6. The same pump model but with a larger motor is recommended. A duty and standby pump would be installed for FST-5 with provision for another duty pump installation for future FST-6.

The existing 750 mm diameter RAS transfer pipe would be extended to FST-5 and future FST-6. The piping configuration would mirror that already installed for FST-3 and FST-4. Some concern was expressed about corrosion protection of buried steel pipelines. Corrosion protection measures presently in place are to epoxy coat the lines externally and this would be implemented for the new buried RAS and drain pipes. Additionally, cathodic protection is recommended for these lines, specifically a sacrificial anode as is used in underground waterline protection, to protect them from corrosion at locations where the epoxy coating is damaged during installation.

Preliminary head loss calculations were completed to determine the adequacy of the existing pumps to carry the additional flow as well to determine if additional pumps for the new secondary clarifiers could be the same make and model. The calculations indicate that the existing pumps are adequate for FST-1, 2 and 3 and for proposed FST-4. For proposed FST-5 and future FST-6, head losses are higher and require the same pump but with a 40 HP motor instead of the 30 HP motor existing for FST-3. Using the same pump but with the larger motor would maintain consistency in the plant.

The current pumps for FST-1 and 2 are rated for 2.5 ML/d to 20.7 ML/d @ 7.6 meters and the pumps for FST-3 are rated for 5 ML/d to 30 ML/d @5.5 meters (as confirmed with the original supplier). All pumps are controlled by VFD and will be programmed to adjust operational speed relative to plant flow.

10.9 WASTE ACTIVATED SLUDGE HANDLING

The following discussion on WAS pumping is intended to be general. It provides an understanding of the proposed WAS handling scheme because it differs from the existing scheme that involves taking WAS directly from the secondary clarifiers and RAS lines.

The existing WAS system is comprised of two variable speed positive displacement progressive cavity pumps in a duty/standby arrangement. The pumps withdraw excess sludge from the 750 mm diameter RAS header and also draw WAS directly from Final Clarifiers No. 1 and 2 via two – 150 mm diameter drain pipes. The WAS pumps convey sludge to the primary settling tanks (PST) through a 200 mm diameter header. WAS is discharged into the PST influent channel from four 150 mm diameter ports, which are equipped with magnetic flow meters to monitor and record WAS volumes.

Two WAS removal options were analyzed as part of the design. These were:

- Remove WAS from the secondary clarifiers with the benefit being more concentrated sludge and thus smaller WAS pumps. Many older designs utilize this philosophy.

- Remove WAS from the last anaerobic zone of the bioreactors, which results in increased pump size (likely double) as the WAS is less concentrated but allows the WAS system to remove scum (which can be problematic) from the bioreactors. More recent designs incorporate this setup mainly to enhance scum removal.

The recommended option is to remove WAS from the bioreactors.

The existing WAS systems for the secondary clarifiers will be left in place, but will not normally be used. They will be left in place in the event that sludge wasting from the secondary clarifiers is ever required, however, this is not anticipated under normal operating conditions. The new secondary clarifiers will not have connections for WAS to be removed either directly or indirectly. Only RAS will be removed from the Secondary Clarifiers and pumped to the inlet to the bioreactors.

The existing WAS pumps are connected to the secondary clarifiers such that they can be used to completely drain the tanks. Although WAS pumps and lines will not be associated with the new secondary clarifiers, lines will be installed to permit draining of the secondary clarifier tanks. This will likely be incorporated into the RAS pumping system. This concept will be further refined during the detailed design. There is the possibility that the RAS pump turndown may be insufficient to drain the tanks properly, in which case a portable dewatering pump should be provided and a sump included in the design.

As described above, WAS will be pumped from the last aerobic zone of the bioreactor rather than the secondary clarifiers. The reason is that scum can easily be collected at the end of the bioreactors. This is a good location for scum collection as it is prevalent in the bioreactors and collection at the bioreactors prevents significant carryover to the secondary clarifiers. From the last aerobic zone of the bioreactors, WAS will be pumped to an equalization/holding tank. From there, sludge will be pumped to the DAF unit and consequently the existing sludge holding tank, which forms part of the proposed solids handling facility.

10.10 SCUM HANDLING

Scum removal is primarily intended to be done in the PSTs and in the bioreactors. However, some scum is anticipated to carry over to the secondary clarifiers and thus scum collection equipment is required in the secondary clarifiers. Scum will be collected from the surface of the secondary clarifiers by sweep arms that convey it to a collection trough with each revolution of the clarifier mechanism. The scum will be flushed from the collection trough to scum holding tanks. Scum in the holding tanks will be pumped to the new dissolved air flotation (DAF) process for dewatering.

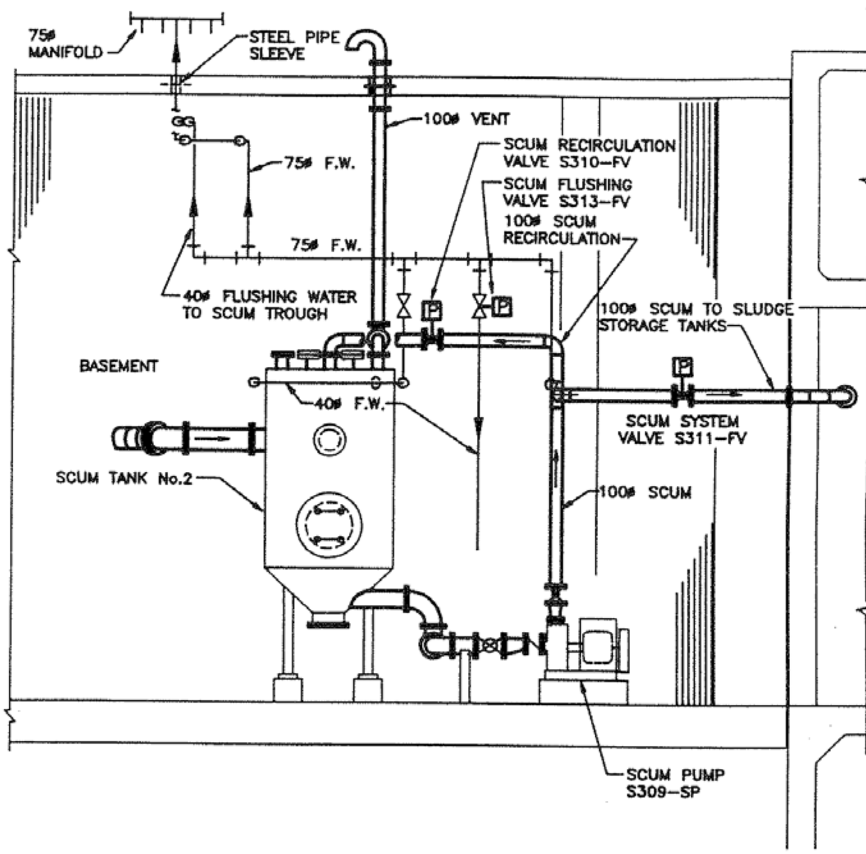

Figure 10.12: Existing Scum Handling Equipment

Existing Clarifiers No. 1 and 2 share a common scum tank designated as Scum Tank No. 1, which is equipped with two-constant speed pumps (duty/standby) Clarifier No. 3 has a dedicated scum tank (Scum Tank No. 2), which is equipped with one-constant speed pump.

Each of the two new clarifiers will be fitted with individual steel scum holding tanks similar to the arrangement for FST-3. A dedicated constant speed pump will be provided for each tank. See Figure 10.12.

Operationally, the existing scum pumps can circulate scum back to the scum tanks. This feature maintains consistency within the tank and reduces pumping problems. Recirculation capabilities will be provided with the new tanks. The scum removal system also includes flushing water connected to the suction side of each scum pump.

There has been discussion regarding the need for scum handling at the Secondary Clarifiers. This has partially been a result of the removal of scum equipment from the secondary clarifiers at the WEWPCC. We believe that scum equipment is necessary at the secondary clarifiers. The bioreactors produce scum that is primarily taken out by the WAS pumping system but not entirely. The design of the SEWPCC also allows for bypassing the PSTs during wet weather flows. This will result in additional scum that would need to be handled by the secondary clarifiers. There is also likely to be some carryover from the bioreactors to the secondary clarifiers during normal plant operation. Other major facilities with similar design processes utilize scum collection at the secondary clarifiers.

Based on this information, it is recommended that scum collection equipment be included with the secondary clarifiers.

10.11 DOME COVERS

Dome covers are proposed over the new secondary clarifiers in lieu of concrete structures as are present over the existing secondary clarifiers. This rationale deviates from the City's previous practice to provide a building enclosure for the final clarifiers. However, the cost of the dome covers ($650,000 supply) is less than 50% than to provide a building over the clarifiers.

Figure 10.13: Typical Dome for Secondary Clarifiers

The following features are proposed for each dome:

- Either fiberglass or aluminum construction with insulation.
- Dual entrances.
- Integrated HVAC options that can include venting from each dome individually or providing inlet air through the top of each dome.
- The domes do not contain any perimeter walls so perimeter walkways will be constructed as part of the secondary clarifier concrete and miscellaneous metal work. The clarifier tank walls will have to extend 1200 mm above the walkways in order to provide adequate headroom at the side of the dome.

Due to the relatively low cost of the domes and their numerous features, we recommend that domes be used in the secondary clarifier design.

10.12 HEATING AND VENTILATION

A number of documents were reviewed to determine the ventilation requirements for the secondary clarifier domes. NFPS 820 has no specific requirements pertaining to secondary clarification tanks. The Canadian electrical code also does not require rated equipment in this area. The time weighted average (TWA) for exposure to H2S over an 8 hour average is 10ppm and the short term exposure limit (STEL) is 15 ppm according to the American Conference of Governmental Industrial Hygienists. Based on the measured gas levels undertaken during the odor control sampling in the existing secondary clarifiers, theses criteria are currently met. The national Manual of Good Practice for Biosolids recommends an air exchange of 12 to 15 air changes per hour for a secondary clarifier. Thus the clarifier structures should be designed for 12 air changes per hour or approximately 41,000 cfm. Since this is based on recommendations and not code requirements, this rate should likely be reduced to 6 air changes per hour for the winter months.

There are many design details that require further exploration. These include how air is supplied to and discharged from each dome. One option is to duct air to the domes and vent through the top of each dome. A second option is to have the top center of the dome provide the primary intake and draw foul air off the top of the launder for release through the main vent stack. This option has not been included in the proposed vent stack capacities. These options will be analyzed in greater detail as part of the detailed design.

For heating of the secondary clarifiers and ancillary spaces, heat recovery units will be used to draw effluent from the new secondary clarifiers, pass it through filters and a heat exchanger, and inject it back into the secondary clarifier from which it was taken. This concept duplicates what is being done currently. Specifics on the heat exchange equipment will be provided in the detailed design.

10.13 CONSTRUCTABILITY

The impacts of the proposed modifications to the secondary treatment facility on constructability and maintaining plant operations are minimal. The new secondary clarifiers can be constructed adjacent to the existing facility without interrupting plant operation. Temporary shutdowns of FST-3 will be required for interconnections between the new and existing influent and effluent channels. There will also be interruptions to the RAS pumping systems as various modifications are required to connect the new clarifiers and change the discharge locations.

10.14 RECOMMENDATIONS

10.14.1 New Secondary Clarifiers

- Add two new 45.7m diameter secondary clarifiers to obtain the design capacity of 175ML/d.
- The addition of two new secondary clarifiers meets the design conditions for the surface overflow rate and solids loading rate.
- The new secondary clarifiers shall be located between the existing secondary clarifiers and UV building with the ability to add a future FST-6.
- The new secondary clarifier mechanisms will have helical sweep sludge collection arms, center column siphon feed, circular energy dissipating inlet, and effluent weirs and scum baffles.

10.14.2 Retrofit of Existing Clarifiers

- Require new center column, new helical sweeps, upgrade and refurbish the existing sweep arms.

10.14.3 Sludge Handling

- Provide new RAS pumping similar to that already provided for FST-3. This will require two new duty pumps and one standby pump. Flow will be directed to the front of the bioreactors.
- Modify the WAS pumping system so that WAS is pumped from the end of the bioreactors and not from the secondary clarifiers.

10.14.4 Scum Handling

- Provide scum holding tanks and pumping for each new secondary clarifier similar to that already provided for FST-3.

10.14.5 Clarifier Domes

- Aluminum or FRP dome structures should be provided as a cost savings measure.

- Inside access would be provided to all domes.

10.14.6 Heating and Ventilation

- The proposed domes can provide either exhaust air from the top center of the dome or intake air. This will be incorporated to either the current fresh air supply system or foul air ducts based on further design analysis.

- Heat recovery equipment will be installed for each dome to help reduce heating costs.

10.14.7 Possible Deferred Work

As a result of discussions with the City and additional analysis during development of the opinion of probable cost, it has been determined that the construction of one secondary clarifier could be deferred. Modeling was undertaken for the 10 year design period and shows that one new secondary clarifier is adequate to provide treatment for this design period. Based on hydraulic calculations, a new secondary clarifier would be required at just prior to year 10 of the design period (approximately 9.5 years).

The main benefit of deferring the work is that it would help to defer the capital cost, thus reducing the initial cost of the upgrade. It is important to recognize that deferral of this work would lead to the design not meeting the stipulated 20 year design flows. A determination on whether or not to proceed with this work will have to be made once a project implementation method is determined and budgetary considerations are evaluated.

For the purposes of this section of the conceptual design report, it is recommended that two secondary clarifiers be constructed as this meets the 20 year design period.