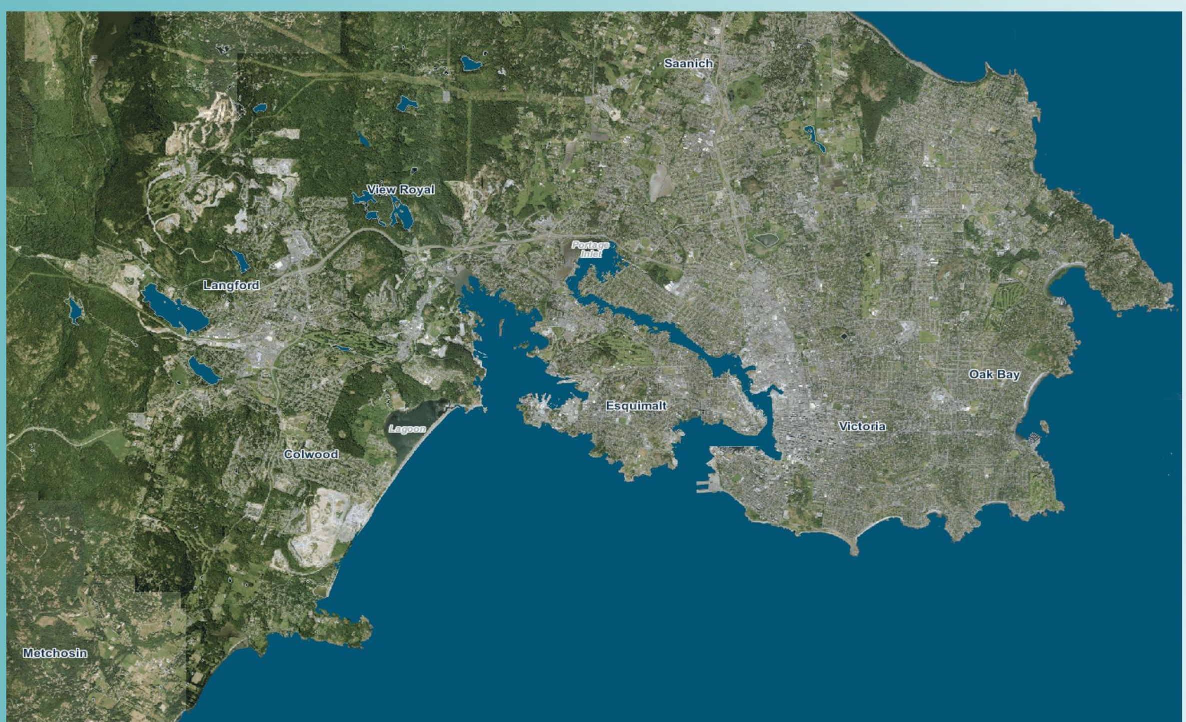
Capital Regional District

Core Area Wastewater Treatment Program
Wastewater Treatment Plant
Option 1A Prime 2



Prepared by:
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June 10, 2011

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Executive Summary

E.1 Background

The CRD is currently in the process of planning wastewater treatment facilities for the Core Area of Greater Victoria. The BC Ministry of Environment has mandated that secondary treatment be in place by the end of 2016. Decentralized treatment facilities have previously been identified to serve the major sanitary sewer catchments within Greater Victoria. Three program options: Option 1A, 1B and 1C were assessed earlier by the consulting team. Following detailed assessments, Option 1A has been selected as the preferred strategy for implementation by the CRD. Further refinements were made to this option and it was renamed Option 1A Prime2. The main differences between Option 1A Prime2 and the earlier Option 1A is that all wastewater is directed to one location only for treatment and the wet weather facilities for Clover Point have been deleted with increased dry weather pumping to McLoughlin Point. **Table E.1** describes the major facilities which are part of Option 1A Prime2.

Table E.1
Major Facilities to be Constructed Under Option 1A Prime2

Location	Description of Facility
Saanich East - North Oak Bay	Wet weather storage tanks with a capacity of 5,000 m^3.
Clover Point	• Pump station and forcemain to transfer flows up to 3 X ADWF to McLoughlin Point. • Screening and grit removal of all flow pumped to McLoughlin Point • Screening for flows above 3 X ADWF followed by ocean discharge using the existing Clover Point outfall.
Macaulay Point	• Pump station and forcemain to transfer flows up to 4 X ADWF to McLoughlin Point. • Screening and grit removal of all flow pumped to McLoughlin Point • Screening for flows above 4 X ADWF followed by ocean discharge using the existing Macaulay Outfall.
McLoughlin Point	• Secondary treatment plant to treat flows from Macaulay and Clover catchment areas up to 2 X ADWF • Primary treatment units sized to treat up to 3 x ADWF from Clover Point and up 4 X AWDF from Macaulay Point
Hartland Landfill	Regional biosolids treatment and energy facility using thermophillic anaerobic digestion to treat biosolids from the McLoughlin Point.

Conveyance Facilities	• Forcemain to transfer flows from Clover Point to McLoughlin Point including tunnel or horizontal directional drilling for the crossing of Victoria Harbour . • Upgrading of Craigflower pump station to accommodate flows from the West Shore • Upgrading of Currie pump station and upgrading of conveyance from Currie PS to Clover PS to accommodate flow from Saanich East and the East Coast interceptor • Sludge forcemain and pumping stations to transfer flows to Hartland landfill biosolids treatment facility and for the centrate return
Outfall	New Outfall at McLoughlin Point – new outfall terminus to be located adjacent to existing Macaulay Point outfall.
Resource Recovery	• Heat recovery from effluent for McLoughlin plant heating needs • Biosolids resource recovery including co-digestion with FOG and other food trucked liquid waste for recovery and sale of biogas, phosphorus recovery and use of dried biosolids as a fuel substitute

E.2 Facility Siting

Sites for new facilities that have been approved or are currently being investigated are summarized in **Table E.2**.

Table E.2
Current Siting Opportunities for Treatment Facilities

Location	Potential Facilities	Comments
Saanich East - North Oak Bay	Wet-weather storage tank	Arbutus site
Clover Point	Screening, grit removal and pumping	Existing site with limited available space, but adequate for proposed facility
McLoughlin Point	Secondary Treatment Plant	New site with limited available space which would require purchase and remediation. Risk associated with remediation and schedule impacts. Only available site identified which could be purchased in the Core Area. CRD has a First Right of Refusal to purchase.
Macaulay Point	Screening, grit removal and pumping	Existing site with limited available space but adequate for headworks and pumping. Adjacent land owned by DND.
Hartland Landfill	Biosolids Treatment and Processing Facility.	Site is owned and operated by CRD.

E.3 Design Criteria for New Facilities

The new treatment facilities must be designed to satisfy the BC Provincial Municipal Sewage Regulation (MSR) and the proposed Federal National Performance Standards (CCME). The National Performance Standards which were recently announced require secondary treatment plants to meet a performance requirement of $cBOD_5$ of 25 mg/L and a TSS of 25 mg/L based on a monthly average of at least five samples per week. These standards are similar to the BC Provincial not to exceed standards of 45 mg/L $cBOD_5$ and 45 mg/L TSS for discharge to marine waters.

For flows in excess of two times average dry weather flow (ADWF), the BC MSR requires primary treatment capable of providing 130 mg/L TSS and 130 mg/L $cBOD_5$. For CRD, flows from 2-4 times ADWF will be provided with primary treatment.

It is not anticipated that facilities will have to be designed for ammonia nitrogen limits for discharge to marine waters.

Compounds of emerging concern (COECs) are a controversial topic in wastewater treatment design. COECs include microconstituents such as endocrine disrupting compounds, pharmaceutically active compounds (PhACs) and personal care products (PCPs). There is still much to be learned about COECs and their impacts on the environment and public health. Research is ongoing. However, it is prudent to plan for wastewater treatment facilities to include the capability for future process modifications for removal of these constituents should it become a requirement in the future.

E.4 Liquid Train Treatment Design for Options 1A Prime2

To enable preparation of cost estimates and assessment of siting options, representative technologies have been selected for evaluation of sites. The final technology selection will be made at the preliminary design phase and may be reconsidered depending on the results of the procurement process. This assessment uses proven technologies which have a track record of performance at the scale required for the CRD facilities. The technologies selected will meet the effluent quality discharge objectives and have been successfully used at many installations in North America and Europe.

When undertaking a major wastewater treatment program such as the CRD project, the owner and engineers often receive submissions by numerous technology suppliers who make many claims with respect to new and novel process performance, footprint, and lower costs. Some of these technologies may show promise, but most lack a track record at the scale of facilities required for CRD. The ability of novel technologies to satisfy discharge requirements at reasonable operating costs is often uncertain. If the CRD wants to consider some of these technologies, a thorough independent evaluation should be completed to confirm supplier's claims.

For the current plan, the following representative liquid treatment technologies have been considered:

- Lamella plate primary clarifiers to provide low footprint primary treatment.
- Biological Aerated Filters for McLoughlin Point secondary treatment.

E.5 Biosolids Design for Option 1A Prime2

The biosolids treatment train presents significant opportunities for resource recovery. The biosolids treatment technology will include thermophillic anaerobic digestion capable of producing a Class A biosolids, biosolids drying, recovery of biomethane to produce pipeline quality gas and struvite recovery. In addition, the biosolids facilities are designed to co-digest fats, oils and greases (FOG) and other food trucked liquid waste to enhance the production of biomethane gas by as much as 50%. The biosolids will be dried and used as a fuel at cement kilns.

Ideally the biosolids and liquid waste treatment facilities should be located at a common site. This is not possible under Option 1A Prime2, because the McLoughlin site is too small to accommodate the biosolids treatment facilities.

The CRD operated Hartland landfill is the site currently identified for the biosolids facilities. This site will involve construction of four pumping stations and a 17.7 km pipeline to transfer sludge to a biosolids treatment facility at Hartland landfill. This location would provide good synergies for acceptance of FOG to enhance digester gas production. In the future waste to energy facilities could be used as an add-on process for integrated biosolids and solid waste processing. The CRD is currently exploring siting opportunities to reduce the pumping requirements.

E.6 Conveyance & Pumping

Conveyance and pumping upgrades are required for Option 1A Prime2. Under Option 1A, wastewater will be conveyed from the Macaulay and Clover Point outfalls by pumping through new forcemains to the McLoughlin Point plant.

Pumping stations and a forcemain are also required for sludge transfer to the biosolids treatment facilities located at Hartland landfill.

A new outfall is required as part of this program. A new outfall adjacent to the existing Macaulay outfall will be required to handle design flows from the McLoughlin Plant.

E.7 Resources from Wastewater

Potential opportunities for recovery of resources from wastewater are being investigated. Opportunities for resource recovery include:

- Biomethane generation
- Dried sludge fuel for cement kilns or waste to energy facility
- Phosphorus recovery (struvite)
- Heat extraction for in-plant use
- Possible future addition of heat extraction for use in adjacent buildings

E.8 Carbon Footprint

A greenhouse gas (GHG) assessment has been completed for the selected option. In wastewater treatment the relevant GHGs include carbon dioxide, methane and nitrous oxide. The direct and indirect emissions and offsets of the GHGs associated with the proposed project have been investigated for the initial construction phase and ongoing operations. Carbon footprint analysis indicates that this configuration has the potential of being carbon positive depending on the degree of resource recovery implemented. The sale of biomethane gas and displacing coal with dried biosolids provide the largest offsets to make the project a negative carbon footprint.

E.9 Opinion of Probable Costs

The capital and life cycle costs have been developed for this option as summarized below:

Table E.3
Capital Costs

Capital Costs	Option 1A
Total Capital Costs	$791,000,000

Operations and Maintenance Costs for this option is shown in **Table E.4**.

Table E.4
Annual O&M Costs

	Option 1A
Annual O&M Costs	$14,571,000

Life cycle costs for this option is provided in **Table E.5**.

Table E.5
Life Cycle Costs

Costs	Option 1A
Life Cycle Costs	$991,537,000

Life cycle costs have been calculated assuming a 25 year period and a discount rate of 6%.

E.10 Risk Assessment

A preliminary risk assessment has been completed for this option. Preliminary evaluation indicates that option 1 A Prime2 has a high risk associated with site remediation at the McLoughlin site. Remediation of the site could impact schedule. However preliminary site investigations have identified the extent of soil contamination and estimates of the potential remediation cost have been prepared.

Risk mitigation strategies can be selected to reduce risks. These strategies will be assessed as the project proceeds and more detailed information becomes available.

E.11 Discussion of Analysis and Recommendations

Option 1A Prime2, with the main secondary plant at McLoughlin Point is a viable option because of its proximity to the Macaulay and Clover Point outfalls and the fact that the site is available for purchase. The McLouglin site is contaminated and will require remediation. This presents some risk in terms of overall project schedule but the extent of contamination and the range of potential cost have been identified. It is likely that much of the contaminated soils would be removed during plant construction as deep tanks will be constructed. The site is not large enough to accommodate the liquid and biosolids treatment facilities so a separate biosolids processing facility will be required..

Under Option 1A Prime2, a separate site at Hartland will be required for biosolids facilities. Biosolids conveyance between McLoughlin and the Hartland biosolids processing site will be by pipeline routed along existing roads and rights-of-ways.

It has been confirmed that under Option 1A Prime2, the wet weather facilities can be incorporated into the McLoughlin Point plant.

Based on the above considerations, the project team recommends the following:

- Carry forward with the grant applications using Option 1A Prime2 configuration.
- Proceed with further technical development and public engagement for all facilities.
- Continue to further develop resource recovery opportunities and explore the market potential for use of recovered resources.

Section 1 Introduction

1.1 Background

The Capital Regional District (CRD) is planning the construction of a secondary wastewater treatment facilities to serve the Core Area of Greater Victoria. This project, known as the Core Area Wastewater Treatment Program (CAWTP), has been in the planning stages for several years. A number of options from decentralized multi-plant treatment to regional wastewater treatment plant schemes have been investigated. Resource recovery has also been investigated. A significant amount of work was completed on assessing three options, referred to as Options 1, 2 and 3 in previous work. These options varied in terms of the number of plants (4 for Option 1, 7 for Option 2, and 11 for Option 3) and the degree of resource recovery.

A Peer Review Team was engaged by CRD to review Options 1, 2 and 3 and identified three sub–options of Option 1 for further consideration by CRD. Options 2 and 3 were eliminated as they were significantly more costly. The Core Area Liquid Waste Management Committee (CALWMC) requested that the three options put forward by the Peer Review Team, referred to as Option 1A, 1B and 1C, be investigated further to refine the economic, social and environmental considerations to enable decision making through a triple bottom line (TBL) analysis. Option 1A was subsequently selected as the preferred option by the CRD CALWMC. Amendment No. 7 to the Liquid Waste Management Plan (LWMP) which was based on Option 1A was submitted in December 2009 and approved by the Minister of the Environment in February 2010.

The potential for deferment of West Shore facilities under Option 1A, referred to as 1A Prime, had also been investigated prior to submitting Amendment No. 7 to the LWMP. An opportunity was identified to defer the West Shore plant under Option 1A until such time that a new plant is constructed on the West Shore. However the deferment of the West Shore Plant was not incorporated into Amendment No. 7.

Following approval of Amendment No. 7, further refinement of the selected option were carried out including a review of growth projections and the 20-year design flow, a review of need for satellite plants on the West Shore and in Saanich East and the need for a wet weather treatment plant at Clover Point. Also additional investigations were carried out for a central plant at McLoughlin Point, Upper Victoria Harbour and the West Shore as well as for a biosolids facility located at Hartland landfill. These refinements were incorporated into Amendment No. 8 to the LWMP which as submitted on June 25, 2010 and approved by the Minister in August 25, 2010. As a result of the refinements made to Option 1A, this option was renamed **Option 1A Prime2**.

The Ministry of Environment had initially requested that secondary treatment be in place by the end of 2016 and in August 2009 the Federal Minister of the Environment has announced stricter wastewater treatment regulations which will require all communities to have wastewater treatment. This report presents the proposed wastewater treatment plan to serve the Core Area of the Capital Regional District in accordance with the latest approved amendment to the Liquid Waste Management Plan.

1.2 Previous Work and Reference Materials

During the preparation of this report various technical and background material were reviewed to obtain insight into the previous work. A significant amount of work has been completed previously by other consultants, CRD staff and the Peer Review Team. This past work forms a building block for a more detailed assessment of the option to be investigated in this report. Most of the reference documents from previous consulting work can be found on CRD web site.

- The September 16, 2009 *"Core Area Wastewater Treatment Assessment of Wastewater Treatment options 1A, 1B and 1C"* provides background on the evaluation of the three primary options.
- The December 8, 2009 "*Core Area Wastewater Treatment Program Wastewater Treatment Plant Option 1A*" provided more detailed analysis on the selected Option 1A prior to the submission of Amendment No. 7 to the LWMP.
- The May 11, 2010 *"Technical Memorandum on Management of Wet Weather Flow at Clover Point*" recommended diverting a portion of the wet weather flow to the treatment plant at McLoughlin Point and to delete the wet weather flow plant at Clover Point.
- The November 15, 2010 *"Sub-Marine Pipeline Crossing Alignment Evaluation*" provided preliminary information on the pipeline crossing of Victoria Harbour.

Reference reports and data from previous studies were used and augmented with more detailed assessments by the current study team.

1.3 Findings of the Peer Review Report

In early 2009 the CRD engaged the services of a Peer Review Team (PRT) consisting of North American wastewater treatment experts to review the work that had been completed by the previous planning consultants. The Peer Review Team outlined twelve guiding principles in their assessment of the wastewater treatment options for the CAWTP. These principles are provided below for reference purposes:

- Meet current and future regulatory requirements.
- Maximize potential opportunities for Integrated Resource Recovery.

- Strive for sustainability.
- Maintain greater flexibility for future options.
- Develop facilities that minimize construction and operating costs.
- Maximize wastewater and sludge management opportunities.
- Avoid sites that are difficult to permit.
- Strive to eliminate intermittently operated wet weather plants.
- Evaluate programs and projects using Triple Bottom Line analysis.
- Maximize benefit to the rate payer.

All of these guiding principles are good considerations and will serve as a basis for continued evaluation of the Wastewater Treatment Plan under consideration by the CRD. The current consulting team has reviewed the PRT comments and incorporated many of these suggestions where appropriate.

1.4 CRD Goals and Objective for the Core Area Wastewater Treatment Program

The primary goals outlined by the CRD Board for the CAWTP are:

- Protect public health and the environment.
- Manage wastewater in a sustainable manner.
- Provide cost effective wastewater management.

1.5 Overview of Selected Wastewater Treatment Plan – Option 1A Prime2

1.5.1 Option 1A Prime2

This section provides an overview of Option 1A Prime2. A more detailed description is included in the balance of the report.

The facilities to be constructed under Option 1A Prime2 are illustrated in **Figure 1.1** and summarized in **Table 1.1**. Under Option 1A Prime2, a central plant would be constructed at McLoughlin Point and the wastewater treatment facility on the West Shore would be deferred. The wastewater treatment facility in Saanich East / North Oak Bay is deleted from the project and wet weather storage tanks are provided instead to reduce the overflows from the East Coast Interceptor. The wet weather flow plant at Clover Point is deleted and instead more wet weather flow is conveyed to the central plant at McLoughlin Point. To this effect, the primary treatment units at McLoughlin Point are sized for the increased wet weather flow. From the

Clover Point outfall, up to 3 times the average dry weather flow (ADWF) is pumped to the plant at McLoughlin Point and up to 4 times ADWF is pumped from the Macaulay outfall. The capacity of the secondary treatment units at McLoughlin Point remain at 2 x ADWF.

In order to maximize the use of the McLoughlin site as a central plant to provide primary and secondary treatment, screening and grit removal is to be provided at the Clover Point and Macaulay Point pumping stations. Pumping, conveyance and outfall construction would also be required as part of the overall treatment strategy for CRD.

Table 1.1
Major Facilities to be Constructed Under Option 1A Prime2

Location	Description of Facility
Saanich East - North Oak Bay	Wet weather storage tanks with a capacity of 5,000 m^3.
Clover Point	• Pump station and forcemain to transfer flows up to 3 X ADWF to McLoughlin Point. • Screening and grit removal of all flow pumped to McLoughlin Point • Screening for flows above 3 X ADWF followed by ocean discharge using the existing Clover Point outfall.
Macaulay Point	• Pump station and forcemain to transfer flows up to 4 X ADWF to McLoughlin Point. • Screening and grit removal of all flow pumped to McLoughlin Point • Screening for flows above 4 X ADWF followed by ocean discharge using the existing Macaulay Outfall.
McLoughlin Point	• Secondary treatment plant to treat flows from Macaulay and Clover catchment up to 2 X ADWF • Primary treatment units sized to treat up to 3 x ADWF from Clover Point and up 4 X AWDF from Macaulay Point
Hartland Landfill	Regional biosolids treatment and energy facility to treat biosolids from the McLoughlin Point.
Conveyance Facilities	• Forcemain to transfer flows from Clover Point to McLoughlin Point including tunnel or horizontal directional drilling for the crossing of Victoria Harbour • Upgrading of Craigflower pump station to accommodate flows from the West Shore • Upgrading of Currie pump station and upgrading of conveyance from Currie PS to Clover PS to accommodate flow from Saanich East and the East Coast interceptor • Sludge forcemain and pumping stations to transfer flows to Hartland landfill biosolids treatment facility and for the centrate return

Outfall	New Outfall at McLoughlin Point – the new outfall terminus will be located adjacent to the existing Macaulay outfall.
Resource Recovery	• Heat recovery from effluent for McLoughlin plant heating needs • Biosolids resource recovery including co-digestion with FOG for, recovery and sale of biogas, phosphorus recovery and use of dried biosolids as a fuel substitute

1.6 FACILITY SITING

There are a number of factors which must be considered when siting a wastewater treatment facility. These include availability of land, zoning, cost of land, proximity to the major trunk sewers, room for future expansion, constructability and many other factors. Some of the most important factors are the availability of sites for purchase and the use of existing sites already under the control of CRD member communities. The CRD has engaged the services of Westland Resource Group to assist in the identification of candidate sites for the treatment plants. Westland has used a triple bottom line approach to assist in identification of candidate sites for sewage treatment. The approved and potential sites for the various facilities are summarized in **Table 1.2**. It is noted that the CRD is still in the process of identifying alternative sites to Hartland landfill for the location of the biosolids facility.

Table 1.2
Current Siting Opportunities for Treatment Facilities

Location	Potential Facilities	Comments
Saanich East - North Oak Bay	Wet-weather storage tank	Arbutus site
Clover Point	Screening, grit removal and pumping	Existing site with limited available space, but adequate for proposed facility
McLoughlin Point	Secondary Treatment Plant	New site which would require purchase and remediation. Risk associated with remediation and schedule impacts. Only available site identified which could be purchased in the Core Area. CRD has a First Right of Refusal to purchase.
Macaulay Point	Screening, grit removal and pumping	Existing site with limited available space but adequate for headworks and pumping. Adjacent land owned by DND.
Hartland Landfill	Biosolids Treatment and Processing Facility.	Site is owned and operated by CRD.

The approximate area for plant construction at each site is provided in **Table 1.3**. These areas are preliminary and will be refined as further work is completed.

Table 1.3
Approximate Area for Plant Construction

Site	Area (ha)
Saanich East - North Oak Bay storage tank (Arbutus site)	1.1
McLoughlin Point	1.7
Clover Point	No additional land required
Macaulay Point	No additional land required
Hartland Landfill Biosolids Site	1.3

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DESIGNED	RAF	SURVEYED	–
DRAWN	PRC	DATE	06/08/11
SCALE HORIZONTAL	N.T.S	CHECKED	
SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

McLOUGHLIN OPTION 1A PRIME 2
KEY PLAN

CONTRACT NUMBER	DRAWING NUMBER	ISSUE	SHT. No.
–	FIGURE 1.1	–	– OF –

Section 2 Design Criteria for New Facilities

This section provides background for the selection of design criteria for new Wastewater treatment facilities.

2.1 Catchment Areas

There are essentially only two catchment areas in the Core Area, each discharging to its own outfall: Clover Point and Macaulay Point.

The sanitary catchment and sub-catchment areas under consideration include the following:

- **Saanich East - North Oak Bay** – The wet weather storage tanks will capture flows that exceed the capacity of the downstream East Coast interceptor and release it at a controlled rate. It should be noted that the Saanich East – North Oak Bay area is a sub-catchment area of the Clover Point catchment area.
- **Clover Point** – Flows up to 3 x ADWF from this catchment area including the attenuated flow from the upstream Saanich East - North Oak Bay storage tank will be redirected to the plant at McLoughlin Point. At the plant, flows up to 2 X ADWF will be provided with primary and secondary treatment and flows between 2 X ADWF and 3 X ADWF will be provided with primary treatment only. Flow in excess of 3 X ADWF will be provided with screening before discharge using the existing Clover Point outfall
- **Macaulay Point** – Flows up to 4 x ADWF from this catchment area will be redirected to the plant at McLoughlin Point. At the plant, flows up to 2 X ADWF will be provided with primary and secondary treatment and flows between 2 X ADWF and 4 X ADWF will be provided with primary treatment only. Flow in excess of 4 X ADWF will be provided with screening before discharge using the existing Macaulay Point outfall
- **West Shore** – West Shore flow will continue to be directed to the Macaulay outfall. It should be noted that the West Shore area is a sub-catchment area of the Macaulay Point catchment area.

2.2 Current Liquid-Train Regulatory Requirements

Both the Province of BC and the Government of Canada have regulations and/or guidelines that must be considered for receiving water discharge of treated wastewater. Various reuse scenarios also require adherence to stipulated regulations. A wastewater management system is being proposed that consists of ocean discharge of treated effluent. Because of the time constraints imposed by the Province, the equivalent of secondary treatment prior to discharge is required by the end of 2016. Additionally, there are some aspects of the effluent quality requirements that have recently been announced by the Canadian Council of Ministers of the Environment (CCME) that will also have to be satisfied.

2.2.1 Provincial Regulation

In a BC Provincial document entitled "Municipal Sewage Regulation" (MSR) B.C. Regulation 129/99 under the Provincial Environmental Management Act, specific requirements for treated effluent quality are listed. If the treated effluent is to be discharged to the "open marine" environment, the regulations stipulate that secondary treatment (defined as effluent containing no more than 45 mg/L each of BOD and TSS at any time) must be provided for all flows up to 2 x ADWF. The limiting concentration values may be interpreted as values that are never to be exceeded, regardless of the type of sample taken.

If flows in excess of 2 times ADWF occur more than once every 5 years, a waste management plan or specific study must be undertaken to determine what treatment level is recommended for such occurrences. If the high flow does (Refer to MSR Section 17(1) and (2)) occur more frequently than once every five years, then the equivalent of primary treatment is acceptable for that high flow period. Primary treatment is defined under the MSR as being able to provide an effluent quality with a $cBOD_5$ of not more than 130 mg/L and a total suspend solids of not more than 130 mg/L. In the CRD system, flows in excess of 2 x ADWF do occur more frequently than once every five years at the Clover Point outfall.

For Option 1A Prime2, diversion of flows of up to 3 x ADWF from the Clover Point catchment area and discharge of wet weather flows above this level following fine screening to the sea via the Clover Point outfall reduces annual loadings by over 99% compared with levels that would be experienced in 2030 if raw sewage discharge would continue. Reduction in heavy metal loadings and some of the organics of concern would parallel these TSS load reductions. Providing advanced primary treatment to those wet weather flows in excess of 3 x ADWF would make only a small incremental improvement of about 1% in reduced load and at a cost of $27 million for capital expenditure, and an annual O&M cost of $0.6 million.

It was recommended that the discharge of flows in excess of 3 x ADWF during storm events be discharged via the Clover Point outfall following fine screening without disinfection. Continued reduction in inflow and infiltration flows and monitoring of accumulation of metals and of selected organics on the seabed in the vicinity of the outfalls should continue.

The MSR may also require disinfection for discharge to areas where recreational use is frequent or shellfish harvesting is completed.

2.2.2 Federal Initiatives

The Canadian Council of Ministers of the Environment (CCME) is comprised of the environment ministers of the federal, provincial and territorial governments. The Council meets at least once per year and focuses on issues that are national in scope and that require collective action by a number of governments. The purpose of the CCME is to assist its members to meet their mandate of protecting Canada's environment. While the CCME is a collaborative effort, each minister remains accountable to his/her government according to the laws and statutes governing their jurisdiction.

Over the past five years, the CCME has been developing the Canada-Wide Strategy for the Management of Municipal Wastewater Effluent, known as "the CCME Strategy" recently endorsed by the CCME Council of Ministers on February 17, 2009. In August 2009 the Federal Minister of Environment announced stricter effluent regulations which will require all communities to have wastewater treatment. Environment Canada has taken the lead in coordinating this effort. Among other things, the CCME Strategy establishes National Performance Standards to be considered, and minimum performance requirements for effluent quality from all municipal, community and government wastewater facilities that discharge municipal wastewater effluent to surface water. The Federal National Performance Standards for wastewater treatment facilities of a size likely to be installed in the Capital Regional District are:

- $cBOD_5 \leq$ 25 mg/L (monthly average of at least five samples per week);
- TSS ≤ 25 mg/L (monthly average of at least five samples per week);
- Total residual chlorine ≤ 0.02 mg/L (testing is required only if chorine is used as a disinfectant in the treatment facility; testing to be done three times per day if required).

The monthly average $cBOD_5$/TSS concentration limits of 25/25 mg/L contained in the CCME National Performance Standards generally are equivalent to the Provincial not-to-exceed concentration limits of 45/45 mg/L for the same parameters.

Wastewater facilities with flow rates in excess of 2,500 m^3/d, are also required to conduct whole effluent acute toxicity testing and evaluate chronic toxicity at the edge of a specified mixing zone. Given the likely size of the future CRD wastewater treatment facilities, toxicity testing will probably be a monthly requirement. If a facility fails an acute toxicity test, a toxicity reduction and evaluation process is used to identify and correct the cause of the toxicity. If the whole effluent acute toxicity test failure is due to ammonia, then the need for ammonia reduction must be determined on the basis of the assimilative capacity of the receiving environment. Given the

BOD_5 and TKN concentrations previously reported for Macaulay Point and Clover Point respectively, and making a simplistic assumption that 0.5 grams of biosolids containing 8% nitrogen will be produced for every gram of BOD_5 removed, the conservatively high estimates for the treated effluent ammonia-nitrogen concentrations from treatment plants located at Macaulay and Clover Points would be in the order of 38 mg/L and 31 mg/L respectively. From an examination of the plot given in **Figure 2.1**, it is unlikely that the future ammonia-nitrogen concentrations in CRD's treated effluent will be an issue for disposal to marine waters, presuming that the pH is less than about 7.8. Initial discussions with Environment Canada indicate that it is unlikely that nitrification would be required for discharge to marine waters.

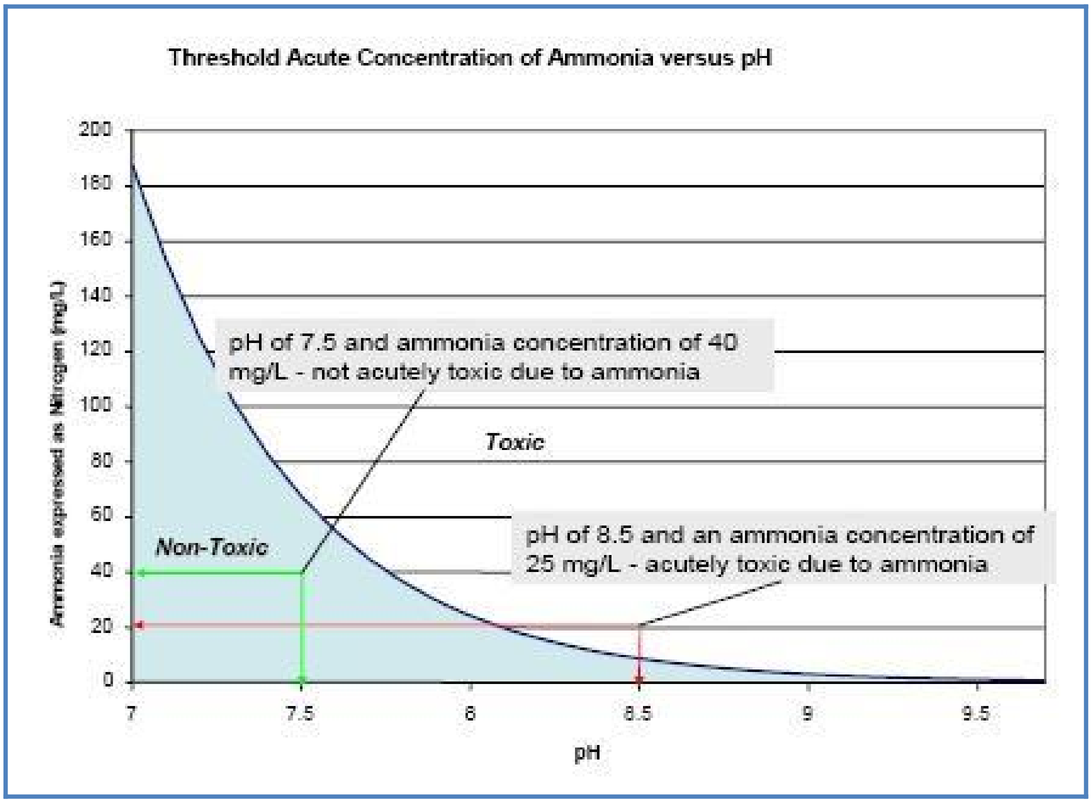

Figure 2.1
Acute Toxicity Relationship Between pH and Ammonia-Nitrogen Concentration
(after Environment Canada, 2007)

2.3 Flexibility for Potential Future Regulatory Changes

There are currently a number of generally present impurities in municipal sewage that are being studied to determine if effluent regulations should be expanded to include some measurable limits. The two main groups of impurities that are candidates for limitations in the CRD setting are Greenhouse Gas (GHG) agents and microconstituents such as endocrine disrupting compounds (EDCs), pharmaceutically-active compounds (PhACs), and personal care products (PCPs). These compounds are often referred to as Compounds of Emerging Concern (COEC). Every effort should be made to ensure that any treatment facilities being designed in the near future include a capability for easy addition of treatment reduction for the above impurities of concern should they be necessary in the future. It is unlikely that more stringent nutrient removals will be required for open marine discharge, but many reuse opportunities and any potential surface water discharges will be affected by more stringent effluent nutrient limits.

2.4 Odour Control

Odour emissions from wastewater collection and treatment systems are certainly nothing new. Regardless, the BC Municipal Sewage Regulation does not include specific requirements for odour control. It is reasonable to assume that the public will be intolerant of offensive odours from the new wastewater facilities and thus state of the art odour control equipment needs to be installed to mitigate odours to a reasonable level. It is possible that future regulations could be promulgated employing quantitative odour monitoring such as dilutions to threshold (D/T) at the plant fence line or at the nearest downwind receptor. However such regulations are not on the immediate horizon. The proposed liquid stream plant at McLoughlin Point is in close proximity to existing development so odour mitigation is included in all designs.

2.5 Wastewater Characteristics

For purposes of process design of liquid train treatment facilities and for estimation of produced biosolids which need to be handled and treated before final utilization or disposal, the comparison of options had initially been based on a “standard” sewage strength throughout the region following a review of limited wastewater characterization data collected by CRD. For this preliminary planning work the approach that has been used was adequate. Following completion of the wastewater characterization to be carried out during the preliminary design phase, the design impurity loads will be estimated more closely.

For those unit processes at each site that need to be designed on the basis of flow (e.g. – headworks and primary clarifiers) the flows mandated by the Provincial regulators have been used, while for the unit processes that need impurity loads for design sizing, BOD_5 and TSS concentrations in the raw wastewater have been taken as 240 mg/L and 195 mg/L respectively at ADWF conditions. Process design sizing has been set at 1.3 the ADWF conditions so that the process will still provide the mandated effluent quality with flows up to 2 x ADWF, as mandated by the Provincial Regulators.

2.6 Design Flow

2.6.1 Population and Flow Projections

This section describes the population projections and flows that were used to establish the design criteria for the Core Area wastewater treatment program. The development of design flows is essential to optimize the most effective system design. The historical records and trends for population and per capita sewage flows have been analyzed to determine design flows for the wastewater treatment and the conveyance facilities.

Average Dry Weather Flow

The average dry weather flow (ADWF) is made up of the following two components:

- Average domestic flow (ADF) – this is the sewage generated in all residences, institutions, commercial and industrial establishments, and
- Summer groundwater infiltration (GWI_{summer}).

Average Dry Weather Flow (ADWF) = ADF + GWI_{Summer}

The current ADF sewage generation rate is 225 litres per capita per day (LC/d). With conservation measures, the ADF is projected to drop to 195 LC/d by 2030 and to 184 LC/d in 2065.

Ground Water Infiltration

The total sewage flow to a wastewater treatment plant includes the domestic, industrial, commercial and institutional contributions and groundwater infiltration. Ground water infiltration consists of leakage of ground water into the sewer system through cracked pipe, manholes or pipe joints. Infiltration occurs on private property laterals as well as main trunk sewers and collectors. Older systems typically have higher GWI than newer systems. Ground water infiltration will occur throughout the year including the summer months but at a lower rate than during the winter months. Typically, GWI increases with time as a sewer system deteriorates due to age. Ground water infiltration varies considerably from year to year depending on the amount of rainfall. Older systems typically have higher groundwater infiltration than newer systems. Heavier rainfall in the previous winter months can result in a higher ground water table and increased ground water infiltration during the summer months.

Groundwater can form a significant component of the base flow particularly in older sewerage catchments. The summer groundwater infiltration for the Clover Point catchment area has been assessed at 3,200 L/ha/day. The summer groundwater infiltration rate for the Macaulay catchment was assessed at 1,900 L/ha/day. Based on a review of recent data, summer ground water infiltration for the entire Core Area is projected to increase from the current flow of 22.4 ML/d to 24.1 ML/d in 2030.

Projected Population

The projected population is made up of the following two components:

- Residential population, and
- Equivalent population for the industrial, commercial and institutional (ICI) sectors.

Table 2.1 shows the existing and projected sewered residential population and equivalent population for the ICI sectors up to 2030 based on the historical, low and a high rates of growth of 1.0%, 1.3% and 2.1% respectively. As indicated in Table 2.1, the projected total equivalent population for the year 2030 is 493,000 persons based on a high rate of growth. The high rate of growth population projection includes a residential population of 342,000 persons and an equivalent population of 151,000 persons for institutional, commercial and industrial sectors Using a moderate rate of growth, the projected sewered equivalent population in 2030 is 436,000 persons. Using the lower historical rate of population growth for Greater Victoria of 1%, the equivalent population in 2030 would be 416,000 persons.

Table 2.1
Sewered Equivalent Population Projections

	2008/2009	2030 – Historical Rate of Growth	2030 – Low Rate of Growth	2030 – High Rate of Growth
Growth Rate		1%	1.3%	2.1%
Equivalent Population	341,000	416,000	436,000	493,000

Projected Sewage Flows

Table 2.2 shows the projected average dry weather sewage flow for 2030 for the historical, low and high rates of growth. The projected average dry weather sewage flow is the sum of average domestic flows (ADF) generated by the sewered equivalent population in 2030 plus the groundwater infiltration during the summer months. As indicated above, the projected sewage generation rate of 195 Litre per person per day has been used for calculating the projected sewage flow for the year 2030.

Table 2.2
Projected Sewage Flows (ML/d)

	2030 – Historical Rate of Growth	2030 – Low Rate of Growth	2030 – High Rate of Growth
Average dry weather flow	81.1	85.0	96.1
Ground Water Infiltration	24.1	24.1	24.1
Projected Sewage Flow	105.2	109.1	120.2

Figure 2.2 illustrates the impact that population growth has on the year when the capacity of the wastewater treatment plant would be reached. At the historical rate of growth of 1%, the plant capacity would be reached by approximately 2033. At a growth rate of 1.3%, the plant capacity would be reached by approximately 2029. Several years before the capacity of the liquid plant at McLoughlin Point is projected to be reached, the planning of a satellite wastewater treatment plant should be initiated to ensure that a plant on the West Shore is constructed. The West Shore plant would reduce the flow to the McLoughlin Plant.

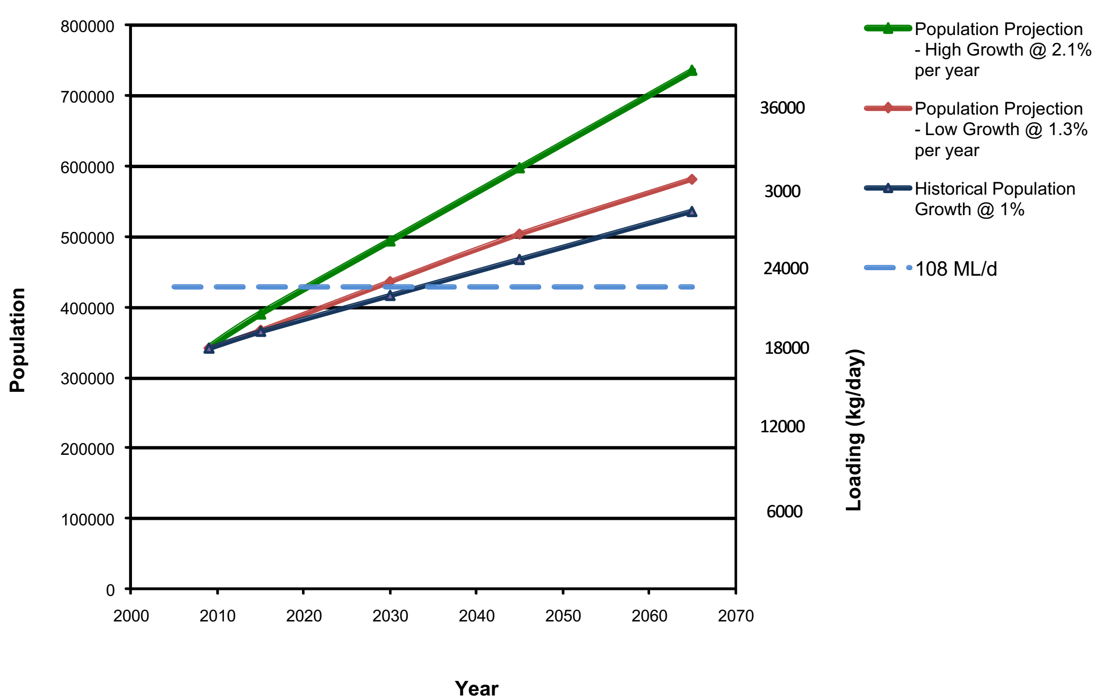

Figure 2.2 – Projected Flows and Growth Rates

2.6.2 Design Flows

Table 2.3 below shows the design flow expectations at **Clover Point Pump Station** and where those flow ranges will be sent. Up to 3 x ADWF will be sent to the McLoughlin Point for primary and/or secondary treatment, while the flow in excess of 3 times ADWF will be provided with preliminary treatment (screening) prior to ocean disposal at the existing Clover Point outfall.

Table 2.3
Clover Point Pump Station Flows

Item	2030	
	Flow (ML/d)	Action
ADWF	53.9	
3 x ADWF	161.7	Transfer to McLoughlin
>3 x ADWF	≅35	On-site screening to outfall (based on 5-year return storm)

Table 2.4 below shows the design flow expectations at **Macaulay Point Pump Station** and where those flow ranges will be sent. Up to 4 x ADWF will be sent to the McLoughlin Point for primary and/or secondary treatment, while the flow in excess of 4 times ADWF will be provided with preliminary treatment (screening) prior to ocean disposal at the existing Macaulay Point outfall.

Table 2.4
Macaulay Point Pump Station Flows

Item	2030	
	Flow (ML/d)	Action
ADWF	53.6	
4 x ADWF	214.4	Transfer to McLoughlin
>4 x ADWF	≅7.5	On-site screening to outfall (based on 5-year return storm)

The **McLoughlin Point site** is to be designed to accept the total flows from the Clover Point and Macaulay Point pumping stations as indicated in Tables 2.3 and 2.4 above. **Table 2.5** shows the anticipated design flows for the various liquid treatment levels that are required to meet the provincial mandate.

Table 2.5
McLoughlin Point WWTP Design Hydraulic Flows

Item	2030	
	Flow (ML/d)	Action
ADWF (from Clover)	53.9	
ADWF (from Macaulay)	53.6	
ADWF	107.5	
2 x ADWF	215	On-site Secondary
>2 x ADWF	215 - 376	On-site primary only
Biosolids		Pumped to a separate site

2.7 Design Loads

Most unit processes in a conventional secondary treatment plant are designed on the basis of BOD_5 and TSS loads expected to enter that plant in the design year. Some assumptions have been made regarding wastewater strength. The assumptions that were used are listed below.

- A raw sewage ADWF BOD_5 of 240 mg/L has been used for the combined wastewater from the Clover and Macaulay catchment areas.
- A raw sewage ADWF TSS of 195 mg/L has been used for the combined wastewater from the Clover and Macaulay catchment areas.
- A primary clarification efficiency of 55% has been used for TSS removal.
- A primary clarification efficiency of 30% has been used for BOD_5 removal.
- A net yield factor of 0.8 has been used for conversion of primary effluent (PE) BOD_5 to secondary solids.
- A factor of 1.3 has been applied to ADWF load to account for increases in loads that occur at flows above ADWF conditions (i.e. maximum month load conditions).

It has been assumed that flows greater than 2 x ADWF occur so infrequently and at reduced BOD and TSS concentration, that the use of the 1.3 multiplying factor will more or less account for the biosolids load at flows up to that value of 2 x ADWF. These factors can range from 1.1 – 1.4 ADWF depending on the characteristics of the catchment area, commercial and industrial contributions and I & I. For preliminary analysis 1.3 is deemed appropriate. This factor is used to account for maximum month load conditions for process design. For the peak 14 day load period for preliminary digester sizing, a value of 1.4 x ADWF was used.

The proposed secondary treatment facilities at McLoughlin Point will be capable of providing secondary treatment to flows up to 2 x ADWF from both the Macaulay Point catchment and the Clover Point catchment. In addition the site will provide primary treatment only for tributary flows between 2 and 4 times ADWF, and biosolids treatment at the Hartland landfill site. These design loads are summarized in **Table 2.8**.

Table 2.8
Option 1A Prime2 – McLoughlin Point Secondary Treatment Design Loads

Item	Flow (ML/d)	Conc. (mg/L)	Load (kg/day)	Action
ADWF BOD_5	107.5	240	25,800	
ADWF TSS	107.5	195	20,960	
Process Des. BOD_5 (1.3 x ADWF)			33,540	On-site secondary
Process Des. TSS (1.3 x ADWF)			27,250	On-site secondary
Primary Biosolids (55% removal)			15,000	
Second. Biosolids (30% rem in PC) (0.8 yield factor)			18,800	
Total biosolids			33,800	Off-site treatment

Section 3 Liquid Train Treatment for Option 1A Prime2

3.1 General

This section discusses liquid train wastewater treatment for the treatment plants serving CAWTP. The plant will use secondary treatment technology that has been proven at other locations.

3.2 Representative Secondary Treatment Technology

To enable preparation of cost estimates and assessment of siting, representative treatment technologies were investigated and one technology has been selected for this evaluation. The representative technologies investigated all use proven secondary wastewater treatment processes which will meet the regulatory discharge objectives and which have been constructed at numerous other locations in North America and Europe.

When undertaking a major wastewater treatment program such as the CRD, the CRD will be inundated with many new and novel technology suppliers who make many claims with respect to process performance and cost. While many of these technologies show promise, most have no track record or history at the scale of facilities required for CRD. Any future assessments of these novel technologies should consider the long term operating costs, reliability and track record at a similar scale.

Considering the discussion on effluent requirements in Section 2 of this report, a biological treatment plant capable of producing an effluent quality (never to be exceeded) of 45 mg/L BOD5 and TSS will need to be provided for the plant serving the CRD for flows and organic loads up to 2 times ADWF. This is the Provincial Ministry of Environment standard for effluent discharge via outfalls to the open marine environment. The same plant must also meet the proposed Federal National Standards (CCME) of an average monthly $cBOD_5$ of 25 mg/L and TSS of 25 mg/L. Such an effluent quality can reliably be met or exceeded by a range of treatment technologies including: conventional activated sludge systems (CAS), fixed film systems such as trickling filter/solids contact (TF/SC) and biological aerated filter (BAF) processes, or hybrid systems which incorporate characteristics of both suspended growth and fixed film processes such as Integrated Fixed Film Activated Sludge (IFAS) processes or moving bed bioreactors (MBBR). Membrane bioreactor (MBR) activated sludge systems as previously proposed were also considered appropriate because of their small footprint..

For municipal applications proven processes which have a track record at other locations throughout North America were only considered. While there are a number of new and emerging technologies being promoted by many suppliers, their track record, performance and operating cost is unproven at the scale required for the CRD installation. A preliminary assessment of the above secondary process options based upon relative capital and operating cost and track record in Canada and USA as well as such considerations as aesthetics of the facilities resulted in the following choice of biological aerated filters (BAF) technology for CRD plant at McLoughlin Point. This technology has one the lowest footprint which is of utmost importance with the McLaughlin Point site which as limited site availability.

3.3 Option 1A Prime2 Liquid Train Treatment

The liquid treatment facility for Option 1A Prime2 will be located at McLoughlin Point as follows:

- A 215ML/day biological aerated filter (BAF) for secondary treatment

Primary treatment with a capacity of 376 ML/day in order to incorporate the wet weather facilities for the Clover and Macaulay catchment areas into the McLoughlin site so there are no separate wet weather treatment facilities. The proposed primary treatment consists of using high rate lamella primaries with the capability for chemical addition to enhance solids removal (chemically enhanced primary treatment).

A biological aerated filter (BAF) design provides the most compact design on the limited McLoughlin Point site. BAF is an attached growth process where a polystyrene or shale filter bed in the order of 3 to 4 metres is used as a filter media. The reactor also uses compressed air which is introduced into the filter bed to satisfy oxygen demand of aerobic microorganisms. The yield of excess sludge is similar to activated sludge at between 0.8 to 0.9 kg cells/ kg of BOD removed. In a typical design, multiple filter cells are used so that one can be backwashed approximately once every 24 hours. The backwash is directed to a dirty wash water tank and solids are removed and directed to thickening facilities. The BAF requires no secondary clarifiers so this provides a significant footprint reduction. To meet the new federal requirement of 25 mg/L and BOD/ 25 mg/L TSS the BAF will be designed in a two stage series configuration.

Preliminary layouts indicate the BAF can fit on the McLoughlin site but there will be no space available for biosolids processing. If BAF is selected as the final process the tankage should be sized for the maximum flow that can be accommodated on this site. Process diagrams, design criteria and layouts of the BAF plants are appended to this report. BAF have been installed at Kingston and Windsor in Ontario and at Canmore, Alberta. There are also a number of installations in the USA. Several suppliers can provide BAF process equipment.

At McLouglin Point, because of the confined site the BAF is an ideal candidate but the filter tanks are quite deep which requires significant soil and rock excavation thereby resulting in increased capital costs. Preliminary geotechnical information indicates that the rock profile is irregular and that special foundations may be required for portions of the plant. A detailed geotechnical investigation will have to be carried out.

3.3.1 Disinfection

The BC Ministry of Environment has requested that UV Disinfection be included in the current planning over concerns regarding potential impact on shellfish. Outfall plume delineation modeling is currently being completed to confirm the requirement for disinfection. For capital budgeting purposes at this time, UV disinfection is included for all plants.

Section 4 Biosolids Treatment Design

4.1 Biosolids Treatment Technology

This section describes how biosolids will be treated and managed for the CAWTP. A detailed Biosolids Management Plan was prepared in November 2009 by the consulting team (Stantec / Brown and Caldwell). More detailed information can be obtained from the BMP report. The principal biosolids treatment technologies to be used include thermophilic anaerobic digestion and co-digestion with other organic substrates such as fats, oils, and grease (FOG) to increase biomethane production; thermal drying to produce a dried biosolids product suitable to be used as a fuel substitute in cement kilns or in a waste-to-energy facility; gas scrubbing to produce pipeline quality biomethane fuel; and phosphorus recovery from dewatering centrate to produce a saleable fertilizer. The representative technologies selected for the biosolids treatment process are shown schematically in **Figure 4.1**.

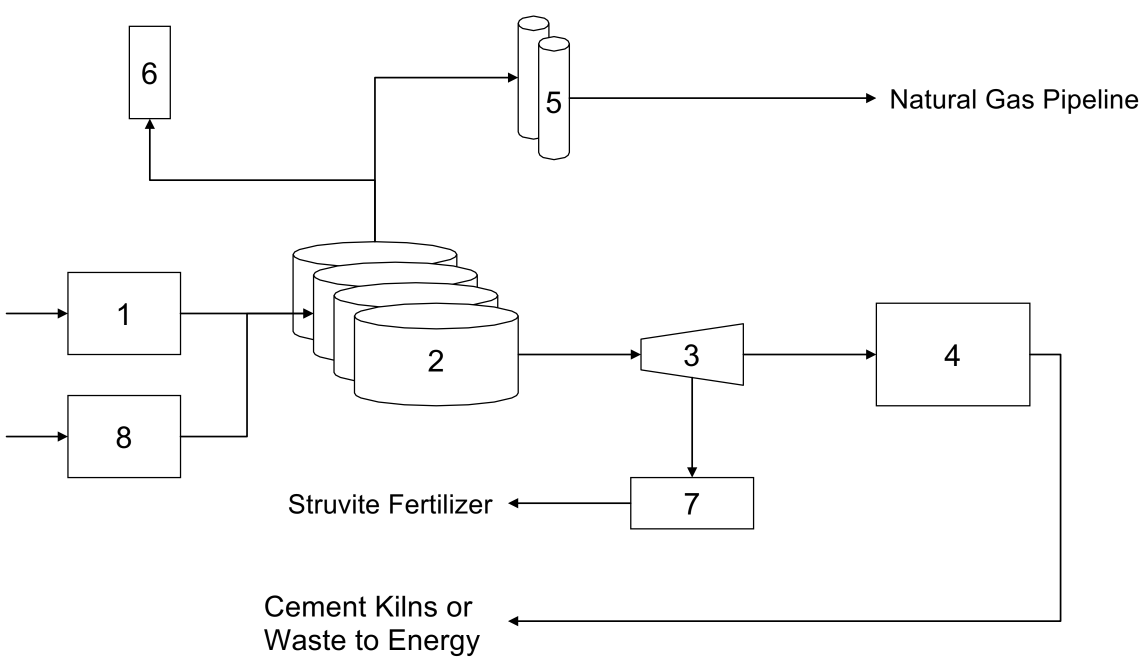

Figure 4.1 – Biosolids Treatment and Resource Recovery

1. Screening – Co-thickened primary and secondary sludge is screened to remove visible foreign material.
2. Thermophilic anaerobic digestion – Anaerobic digestion of thickened solids at thermophilic temperatures to reduce solids and pathogens and enhance production of usable biogas. Co-digestion of FOG is included in the design.
3. Dewatering – Dewatering of digested biosolids through centrifugation.
4. Thermal drying – Removal of moisture from biosolids with a belt dryer and produce a product that can be used as a fuel.
5. Gas Scrubbing – Digester biogas would be cleaned and scrubbed to pipeline quality and sold to the local gas utility.
6. Flare – Complete combustion of any waste gas streams.
7. Nutrient Recovery – A nutrient recovery process would precipitate out struvite from the centrate. Struvite can be sold as a fertilizer product.
8. Liquid Waste Receiving – Certain organic wastes from liquid waste streams such as FOG from commercial or industrial sources and other food trucked liquid waste would be screened and added to the digestion process to increase digester gas production.

Combining fats, oils and grease or "FOG" (including brown grease and some yellow grease) with wastewater solids loaded to the digester will greatly increase biogas production. The biosolids facilities are capable of receiving FOG at a liquid waste receiving station. A screening process at the liquid waste receiving facility will ensure FOG and other trucked liquid wastes added to the biosolids treatment process do not contribute any undesirable inert material to the final biosolids process. The biosolids facilities have been configured and sized to be capable of receiving a significant fraction of available FOG from the community. This includes an additional 10 percent volume of anaerobic digester tankage.

Another future option for the dried solids is combining dried biosolids with combustible solid waste in a regional waste-to-energy facility. Drying is included in the representative biosolids processing facilities evaluated in this report. However, the assumption is made that the dried product is used as cement kiln fuel. Feasibility of a regional waste-to-energy facility is being evaluated independently by the CRD and other potential participating agencies.

4.2 Site Constraints

Although there are numerous criteria that influence the acceptability of a site for biosolids facilities, the principal site constraint is availability of adequate room for all required processes. At the McLoughlin site for Option 1A Prime2, no land is available for co-location of biosolids facilities. Preliminary site layouts indicate adequate space is available only for the required liquid treatment facilities. The CRD has selected Hartland landfill as the site for the biosolids treatment facilities. A pipeline and four lift stations are required to pump the thickened sludge to the proposed biosolids treatment complex located at the Hartland landfill. The CRD is continuing investigations of alternative sites for the biosolids facility.

4.3 Resource Recovery from Biosolids Processing

Resources recovered from solids processing could include biogas, phosphorus (struvite) and a dried fuel product. The biogas produced from digestion would be scrubbed to natural gas quality and sold to the local natural gas utility. This approach provides significant GHG offsets. Also, dried biosolids can be sold as a fuel to industries burning solid fuel, such as cement kilns, paper mills, and energy facilities.

A more detailed explanation of biosolids resource recovery processing and utilization is included in Section 6.0.

4.4 Description of Solids Treatment for Option 1A Prime A

Under Option 1A, the solids treatment and energy facilities are consolidated at Hartland landfill. Solids processes would include thermophilic anaerobic digestion, thermal drying, biogas scrubbing to pipeline quality, and integration of FOG waste to enhance gas production.

Section 5 Conveyance Systems

5.1 Description of Existing Conveyance System

The existing CRD sewage collection system consists of two major catchment areas: Clover Point and Macaulay Point. The Northeast Trunk system drains to Clover Point and the Northwest Trunk system drains to Macaulay Point. The system utilizes several wastewater trunk mains to convey sewage through several municipalities and discharge to Clover Point and Macaulay Point pump stations, where the sewage is screened and discharged to the outfalls. The existing conveyance system is shown in **Figure 5.1**.

5.1.1 Clover Point Pump Station and Outfall

The East Coast Interceptor trunk main intercepts the Saanich Municipal trunk main, the Victoria City trunk main, and the Northeast trunk main at the Victoria Municipal Boundary prior to discharging to Clover Point pump station. The Clover Point service area includes several bypasses or overflow sewers located at Finnerty Cove, McMicking Point, Rutland Pump Station, Humber Pump Station, Harling Point Lift Station and Broom Road overflow. These bypasses or overflow sewers were designed to release the excess flow during extreme storm events.

The existing screens at Clover Point pump station screens solids greater than 6 mm and the solids are collected for transport to the landfill. The 1050mm diameter outfall extends 1154 m into the ocean at an average depth of 67m and terminates with a 196 m long diffuser. A 330 m emergency bypass outfall allows flows exceeding 4 x ADWF to be discharged to the outfall.

5.1.2 Macaulay Point Pump Station and Outfall

Several trunk sewers are serviced by the Macaulay Point Pump Station and Outfall. The Esquimalt/Western Communities trunk sewer collects flow from the municipalities of Colwood, Langford, View Royal and Esquimalt, and pumps the wastewater to Macaulay Point through the pump stations located at Lang Cove and Craigflower. The Northwest trunk main convey sewage from four Saanich Municipal subtrunk mains to Macaulay Point. The subtrunk mains collect sewage from North and West Saanich areas. A pump station located at Marigold lifts the sewage from the three northern Saanich subtrunk mains to the Northwest Trunk main, while a pump station located at Gorge Road pumps the sewage to Macaulay Point pump station and outfall. The Macaulay Point outfall screens solids, plastics and floatable material larger than 6mm; the solids are transported to the landfill approximately twice weekly. The outfall extends 1.7 km into the ocean at a depth of 60 m. The 1050 mm diameter outfall has a diffuser 150 m long with 28 ports.

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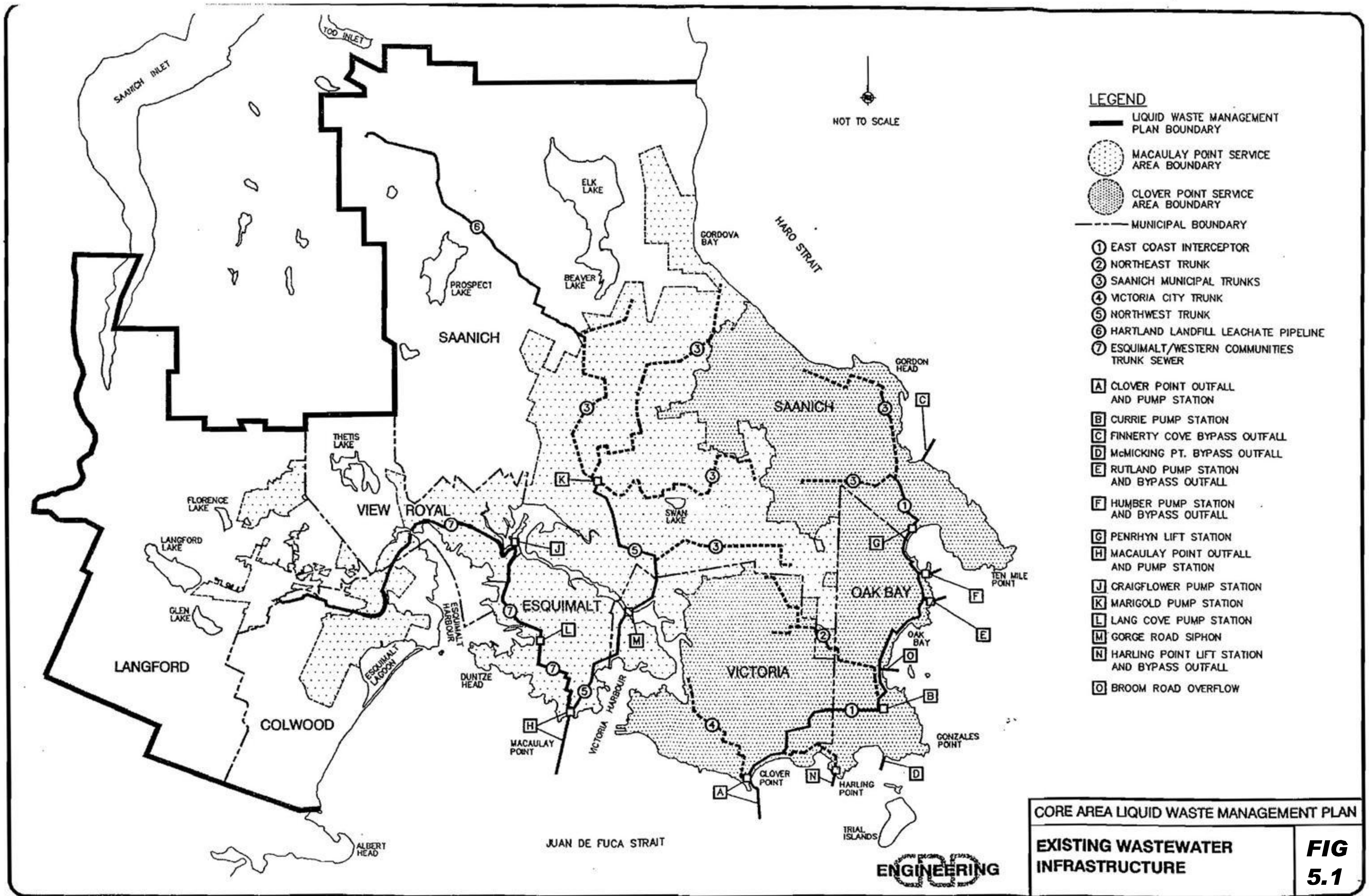


5.2 Conveyance System Upgrading Requirements

The proposed CRD wastewater treatment options will require modifications of the existing conveyance system. The flow from the existing two sewage catchment areas will be redirected to the plant at McLoughlin Point.

5.3 Option 1A Prime2 - Conveyance System

Option 1A Prime2 system is composed of a secondary treatment plant at McLoughlin Point and two pump stations to transfer the flow from Clover Point and Macaulay Point. Preliminary treatment consisting of 6 mm screens (existing) and grit removal will be provided at both pump station.

5.3.1 Saanich East - North Oak Bay Wet Weather Flow Storage

Excess wastewater from the Saanich Municipal trunk sewer in the Saanich East - North Oak Bay region will be redirected towards storage tanks. The proposed storage tanks will provide storage for wet weather flows generated by storms with a return period of 5 years. This will greatly reduce raw wastewater overflow discharges along the East Coast Interceptor. The wet weather flow will be released back into the East Coast Interceptor at a controlled rate after the storm event.

5.3.2 Clover Point Pump Station

Flow from the East Coast Interceptor, Northeast trunk and Victoria City trunk mains will be intercepted at Clover Point. All incoming flow will be screened utilizing existing 6 mm screens; grit removal will be added; flow up to three times ADWF will be pumped to McLoughlin Point WWTP. The forcemain will be 1200 mm in diameter and 4.6 km long. It will run along Dallas Road from Clover Point to Ogden Point. The crossing of the 0.9 km wide Victoria Harbour between Ogden Point and McLoughlin Point will be done either as a tunnel of by directional drilling techniques. Flow above three times ADWF will bypass treatment and discharge after screening into the outfall for discharging into the Straights of Juan de Fuca using the existing outfall pipe.

5.3.3 Macaulay Point Pump Station

Flow from the Saanich Municipal trunk, Northwest trunk and the Esquimalt portion of the Esquimalt/Western Communities trunk main will be intercepted at Macaulay Point pump station. All incoming flow will be screened utilizing existing 6 mm screens; grit removal will be added; flow up to four times ADWF will be pumped to McLoughlin Point. The forcemain will be 1500 mm in diameter and 1 km long. It will run along internal DND Road: Anson St., Bewdly Ave., Peter St and Victoria View Road. Flow above four times ADWF will bypass treatment and discharge after screening into the outfall for discharging into the Straights of Juan de Fuca using the existing outfall pipe.

5.3.4 McLoughlin Point WWTP

All flows pumped from Clover Point and Macaulay Point pump stations will go through the primary treatment process and of this flow, two times or less the ADWF will undergo secondary treatment prior to discharge through the a new McLoughlin outfall which will terminate near the existing Macaulay outfall. Sludge collected after primary and secondary treatment will be discharged to trunk sewer for the treatment of the Hartland, BC.

5.4 Marine Pipeline Crossing

Preliminary investigations were carried out for the 0.9 km long marine pipeline crossing of Victoria Harbour between Ogden Point and McLoughlin Point. An underwater geophysical survey was carried out to map the seafloor and the profile of the bedrock. The bathymetry data indicates the water depth to the seafloor increases from the shoreline towards the middle to a maximum depth of approximately 12 m to 14 m. The soil sediment thickness above bedrock increases significantly to a maximum of approximately 60 m in the middle of the channel. The depth to bedrock from sea level is nominal along the shorelines, but increases to a maximum of 70 m.

The preliminary geotechnical information available from a desktop study and the geophysical survey suggests that both a tunnel installation and horizontal directional drilling (HDD) are possible for the forcemain crossing of Victoria Harbour.

Several concerns that may be present for laying the pipeline on the seafloor are distance, marine traffic, underwater archaeological features and marine life. Large ships, such as the Coho ferry present additional concerns to installing the pipe on the seabed. If large ships lose power while entering the harbour their emergency plan is to typically drop anchor. This poses an immediate threat to the pipeline if the anchor drags or lands on the pipe. Due to the nature of the pipe location and amount of flow passing through the pipes it is recommended that this risk be eliminated by tunneling or HDD under the harbour rather than laying pipe on the harbour seabed.

The HDD method would involve drilling a pilot hole along a predetermined drill path, and then enlarging the pilot hole to a size sufficient to install the forcemain. Assuming no unforeseen issues, the total schedule would be up one year. The advantages of HDD include the limited impact to the surrounding area caused by construction and the lower cost.

The conventional tunnel option tunnel requires a tunnel boring machine (TBM). Based on the geophysical survey, preliminary suggestion would be to drill the tunnel at least 10 m to 20 m between the bottom of the harbour and the top of the tunnel. Portal shafts will be required at either ends of the tunnel for access. In order to limit the depth of the access shaft, it is proposed to drill the tunnel primarily through soil material. Drilling the tunnel entirely through rock would require access shaft in excess of 50 m to 65 m deep. A 6m diameter shaft shall be sufficient for access. Installation time for tunneling is approximated at 13 m per construction shift. Assuming no unforeseen issues, the total schedule would be up two years including mobilization, shaft construction, tunneling and carrier pipe installation.

A detailed geotechnical investigation with offshore boreholes along the proposed alignment should be completed in subsequent phase of the project before selecting the preferred crossing method. Additional investigations should include risk assessment, environmental impact assessments, earthquake impact assessment and an archaeological impact assessment for both land and underwater at a minimum.

The final harbour crossing methodology will be determined following geotechnical investigation. For the purpose of cost estimates, *conventional tunneling is assumed.*

5.5 Outfalls

The CRD operates two sewage outfalls and several overflow outfalls as briefly described in section 5.1 and a new outfall is required for the McLoughlin Point plant. A conceptual design of the outfall has indicated that an 1800 mm diameter pipe will be required with a length of approximately 2.3 km. The outfall terminus would be located near the end of the existing Macaulay Point outfall and would include a diffuser section approximately 200 m long. Modelling is underway as part of the Stage 2 Envirnomental Impact Study to confirm the terminus of the proposed outfall.

High density polyethylene (HDPE) pipe is available in size up to 1800 mm diameter; alternatively the outfall could be built using epoxy coated steel pipe. HDPE offers several advantages as a pipe material for outfalls because it is durable and can withstand large loads. As well HDPE pipe is relatively simple to float and sink into place during installation and does not require specific bedding material. The depth of the diffuser section will be approximately 55 m to 60 m based on existing marine charts.

The installation of the outfall will require trenching and excavation of the inter-tidal near shore section. Excavation and burial of the pipe will require an excavator working the tides from the beach and the pipe is to be covered with native materials. HDPE pipes will be weighted with conventional concrete ballasting (cylindrical or block shaped) weights for the float and sink procedure. Additional weighting of the pipe with concrete mattresses may be required to further protect the installed pipeline from wave and ocean currents.

Depth of pipe installation will directly affect the risk factors and costs during construction. Depths below 50 m are standard and can be conducted with regular diving procedures. Depths greater than 50 m lead to expensive mixed gas diving and increased risk factors. The Macaulay Point outfall is currently at a depth of 60 m.

Additional items to consider for outfall installation that are difficult to allow for are location details specific to site conditions, towing distance from joining site to installation site, wind, waves, tidal levels, alignment accuracy, vessel traffic in area (boats running over pipe) and project timing. Macaulay Point and McLoughlin Point are located within busy shoreline areas near Victoria Harbour and it can be expected that ship traffic will have to be redirected while carrying out the float and sink method. Ship moorage/anchorage may also pose future risks if anchors graze the installed pipeline; therefore, concrete mattresses would be recommended in areas where ships anchor.

5.6 Pumping Facilities

As part of the overall plan, major pumping facilities will be required. This section summarizes the facilities necessary for the project.

5.6.1 Currie Pump Station

The Currie pumping station will have to be upgraded in conjunction with the twinning of the conveyance (forcemain and siphon) between the Currie Pump Station and Clover Point. The upgraded Currie Pump Station will be needed for the future flows from the East Saanich and Oak Bay areas. The proposed wet-weather storage tanks at Arbutus will ensure that the East Coast Interceptor does not overflow during storms with a five-year return period.

5.6.2 Clover Point Pump Station

The Clover Point Pump Station will pump up to 3 x ADWF to McLoughlin Point WWTP, while the wet weather flow in excess of 3 x ADWF will be screened prior to discharging to the ocean outfall. Further hydraulic modeling will be required to confirm the peak overflow to the ocean. Currently, the existing station is equipped with four vertical sewage pumps of 250 HP each with extended drive shafts connected to motors mounted on the top operating floor. The existing station is also equipped with mechanical screens.

There are several options that are available for the existing pump station upgrading. One likely option is described below.

The existing station piping would be modified to separate the two pumping functions: one for bypass pumping to the ocean outfall and the other for pumping to McLoughlin WWTP. The following design criteria have been developed for preliminary sizing of the facility.

- Flow to McLoughlin WWTP: 3 x ADWF = 1870 L/s
- Overflow to ocean: 2,100 L/s (peak overflow for 5-year storm)

- Firm pumping capacity for pumping to McLoughlin (excluding standby pump): 161.7 ML/d
- Six (6) pump system. Dedicated pumps for plant pumping and overflow pumping
- Three pumps (2 for duty, 1 standby) for pumping to McLoughlin WWTP. Each pumps rates for 935 L/s at 22 m head with 400 HP motors
- Three pumps (2 for duty, 1 standby) for pumping overflow to ocean. Each pumps rates for 1,050 L/s at 12 m head with 300 HP motors
- Replace existing 4 pumps and motors and modify existing piping
- Station discharge and forcemain pipe size: 1200 mm
- Expand existing pump station and wet well
- Relocate existing screen and add new grit removal
- Expand existing building for electrical, standby power, and odour control
- Approximate length of discharge line (forcemain): 4,600 m

5.6.3 Craigflower Pump Station

The Craigflower Pump Station will have to be upgraded in order to convey the flows from the West Shore to Macaulay Point. The current pump station will soon reach its capacity most of the equipment has reached their lifespan.

5.6.4 Macaulay Pump Station

The Macaulay Point Pump Station will pump up to 4 x ADWF to McLoughlin Point WWTP, while the wet weather flow in excess of 4 x ADWF will be screened prior to discharging to the ocean outfall. Further hydraulic modeling will be required to confirm the peak overflow to the ocean.

The existing station is also equipped with mechanical screens. New grit removal equipment will be installed between the screen and the pump wet well. There are several options that are available for the existing pump station upgrading. One likely option is described below.

The existing station piping would be modified to separate the two pumping functions: one for bypass pumping to the ocean outfall and the other for pumping to McLoughlin WWTP. The following design criteria have been developed for preliminary sizing of the facility.

- Flow to McLoughlin WWTP: 4 x ADWF = 2,480 L/s
- Overflow to ocean: 450 L/s (peak overflow for 5-year storm)

- Firm pumping capacity for pumping to McLoughlin (excluding standby pump): 215.6 ML/d
- Five (5) pump system. Dedicated pumps for plant pumping and overflow pumping
- Three pumps (2 for duty, 1 standby) for pumping to McLoughlin WWTP. Each pumps rated for 1240 L/s at 28 m with 600 HP motors.
- Two pumps (1 for duty, 1 standby) for pumping overflow to ocean. Each pumps rated for 450 L/s at 6 m with 50 HP motors..
- Station discharge and forcemain pipe size: 1500 mm
- Expand existing pump station and wet well
- Relocate existing screen and add new grit removal
- Expand existing building for electrical, standby power, and odour control
- Approximate length of discharge line (forcemain): 1000 m

5.6.5 Pump Station Control

The pumps will be run by VFD's to adjust the pump output to closely match the influent while maintaining the self cleansing velocity in the discharge forcemain system. Advantages of VFD would also include smaller active wet well volume (i.e. lower wet well structural cost), lower pump starting (locked rotor) current, and reduced hydraulic upsurge during normal pump starting and stopping sequences. The pumps will be controlled on the basis of sewage level in the wet well measured by an ultrasonic level controller backed up with float switches for high and low level alarms. The pump station operating status including alarms will be centrally monitored.

5.7 Sludge Conveyance

The sludge conveyance system will transport sludge from the McLoughlin wastewater treatment plant to the Harland Landfill for treatment. A 17.7 km – 200 mm pipeline and four pumping stations are required to transport sludge from McLoughlin Point to the proposed biosolids facilities which will be located at Hartland landfill. The 180 metres of static head requires the use of multiple pump stations in series to lift sludge to the proposed biosolids treatment facilities at Hartland landfill. A second pipeline will be installed in the same trench for the return centrate from the dewatering facility.

Section 6 Resources from Wastewater

6.1 Gas Recovery

The biogas produced by the digesters will be upgraded through the gas scrubbing system to high quality biomethane and injected into the natural gas pipeline. Some of the biogas produced can also be used to provide heat to the digesters and the dryers. The biogas upgrading process has multiple stages of compression and purification. Hydrogen sulfide and bulk water are removed at the beginning of the process at low pressure. A scavenging media will remove hydrogen sulfide. The sweetened biogas is then compressed and run through a two stage Pressure Swing Adsorption (PSA) system to remove carbon dioxide, water and other impurities (e.g. siloxanes). The second stage PSA system upgrades the waste gas of the first stage PSA system to recover approximately 95% of the methane, and the combined process produces a fuel with an energy value equivalent to natural gas. A schematic of the biogas scrubbing system is shown in **Figure 6.1**.

Since the biosolids processing and energy facility is proposed to be located at Hartland, approximately one third of the biogas produced will be required to heat the digesters and the biosolids dryers. The CRD continues to investigate alternative sites for the biosolids facility that would be closer to the liquid plant at McLoughlin Point. Depending on the site, it may be possible to use heat extracted from the effluent for digester heating and drying and all of the biogas could be scrubbed and injected into the natural gas pipelines.

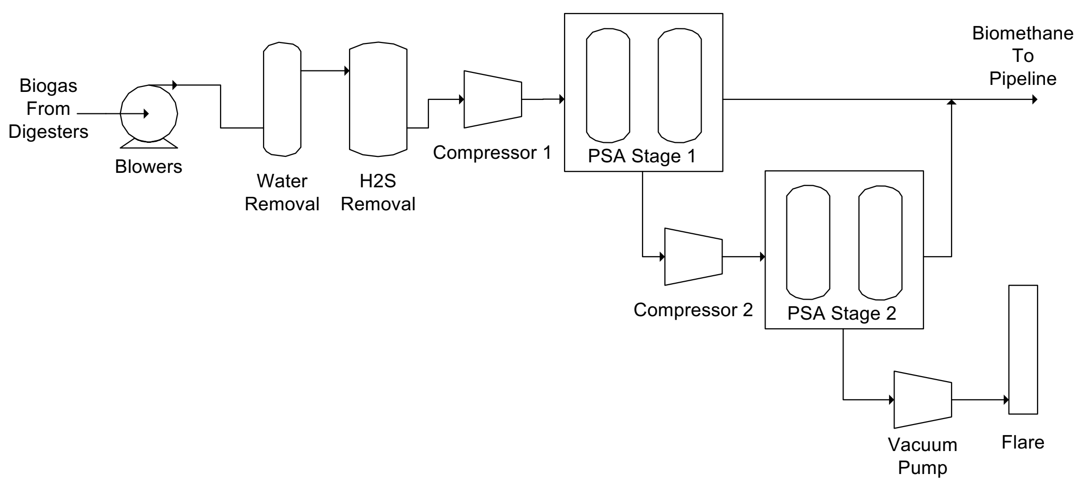


Figure 6.1
Biogas Scrubbing System Schematic

6.2 Phosphorus Recovery

Phosphorus is released as volatile solids are destroyed in the anaerobic digestion process (mesophilic and thermophilic). The released phosphorus is typically recycled to the liquid stream process for removal but can be recovered for beneficial reuse. Phosphorus is a non-renewable, irreplaceable resource (and as the elemental basis essential for all life forms) phosphates are a vital compound to key on for sustainable development, and for this main reason, good environmental stewardship suggests that phosphate should be recovered from waste streams for recycling, rather than continued mining of the existing (and now increasingly more low grade) and depleting phosphate rock. Phosphorus recovery from wastewater recycle streams offers an additional benefit of offsetting carbon dioxide equivalent emissions relative to conventional fertilizer manufacturing (CO_2 emissions associated with phosphate rock mining and transportation to market).

The consulting team assessed the potential for phosphorus recovery from anaerobic digester return streams using struvite crystallizers as part of the evaluation. Our initial evaluation indicates that CRD should be able to recover approximately 272 tonnes of struvite fertilizer product per year from anaerobic digester return streams. The net revenue (sales revenue minus annual operating and maintenance costs) from phosphorus recovery via struvite crystallization is estimated at approximately $54,000/year. The environmental benefits of phosphorus recovery will include the offset of approximately 2,700 tonnes of carbon dioxide equivalent emissions per year relative to conventional fertilizer manufacturing.

6.3 Dried Fuel Product

Energy recovery is a productive end use option for biosolids. In cement manufacturing, the biosolids are burned as fuel and the ash is used for raw material substitutes. The heating value of dried biosolids is typically 18,000 kJ/kg. This is only slightly lower than soft coal, which typically have a heating value of 26,000 kJ/kg (Forgie et al, 2008). Dried biosolids fuel products provide an alternative renewable energy source to fossil fuels such as coal. The noncombustible components of solids can provide the chemical components (CaO, SiO2, Al2O3, and Fe2O3) which are traditionally supplied by lime, clay and iron ore. The replacement of these materials can offset transportation costs of bringing these raw materials to the cement plant. Other industries such as paper mills and waste to energy facilities can also benefit from using a dried biosolids product as fuel.

6.4 Heat Recovery

<u>Biosolids Energy Facility</u>

The biosolids facility will require a large amount of heat for the digesters, biosolids, drying and space heating. Heat recovery at the biosolids facilities would include recovery of heat from the hot digested sludge using sludge-to-water-to-sludge heat exchangers. The heat recovery system will minimize heating requirements of the raw sludge being fed to the digesters. The heat recovery system will recover approximately 50% of the heat required to heat the digestion system. Additional heat demands for the biosolids facility could be provided by the biogas produced by the digesters and the balance of the biogas could be scrubbed and injected into the natural gas distribution system. A biogas rated boiler would be required to use the biogas for in-plant heating. It is estimated that approximately one third of the biogas generated will be required for digester heating and biosolids drying. Should the CRD be successful in finding a site closer to the McLoughlin Point plant, heat extracted from the effluent could be used for digester heating and biosolids drying instead of using biogas.

Wastewater Treatment Plant

Heat can be extracted from the treated effluent and this heat can be used for in-plant uses such as hot water and space heating. This can be accomplished by water source heat pumps extracting heat from treated effluent. An internal hot water heating loop will provide the heat required in the various buildings and locations within the McLoughlin Point wastewater treatment plant.

In the future, electrically powered heat pumps could be added to supply heat to an external hot water loop by using the available heat in the effluent discharged from the treatment plants. The external hot water loop could supply heat to adjacent buildings in the DND Work Point area and in high demand areas in Esquimalt and Victoria West. An allowance for the external hot water loop is included in the project cost estimates but heat pumps are not included.

6.5 POTENTIAL REVENUES

Potential revenues from the biosolids stream including biogas, struvite and dried fuel are summarized in Table 6.1.

Table 6.1
Biosolids Treatment Facility Potential Revenues

Revenue Stream	Unit	Total Revenue
Biomethane Recovery		
Digester gas production [1]	m^3/day	19,600
Average biomethane produced [2]	N m^3/hr	374
Unit biomethane value [3]	$/GJ	$8.00
Potential revenue	***$/yr***	***$1,050,000*** [4]

Dried Fuel Product		
Digested biosolids produced	kg/day	15,350
Unit dry biosolids value [5, 6]	$/GJ	$1.60
Potential revenue	***$/yr***	***$162,000***
Co-digestion Substrate Tipping Fees		
Average daily co-digestion substrate delivery [7]	L/day	69,000
Tipping rate [8]	$/L	$0.07
Number of trucks [9]	Trucks/day	10
Potential revenue [10]	***$/yr***	***$1,763,000***
Struvite		
Potential revenue	***$/yr***	***$54,000***

Notes:

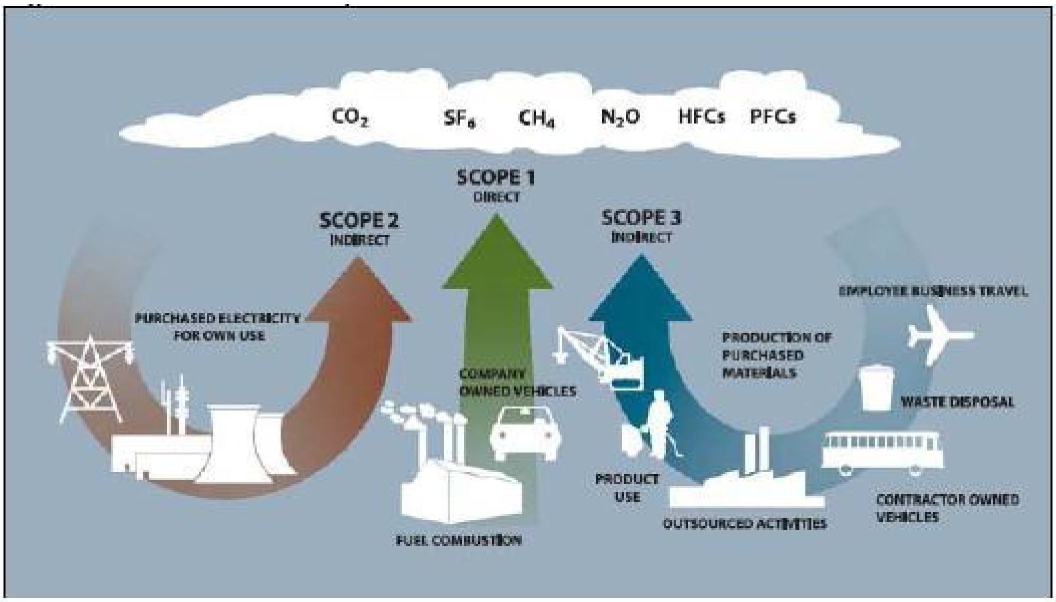
1. Annual average gas production with co-digestion substrate addition, 30% by VS load.
2. Biomethane produced assumes 92.5% recovery of biogas CH_4 and 95% equipment availability to produce a final gas product of 98% CH_4 and 2% CO_2. Normalized at 0ºC and 1 atm. Biomethane recovery rate presented in Table 6.1 represents the biogas generated with four digesters in operation.
3. Fortis BC (formally Terasen) has expressed interest in a long-term contract for biomethane at $6 to $10 per GJ. An average of $8 per GJ is assumed here, but the revenue may be higher or lower based on final contract negotiations with Fortis BC. Higher heating value for 98% methane by volume is 38,971 kJ/Nm^3.
4. Approximately 1/3 of the biogas will be required for digester heating if the digesters are located at Hartland landfill. However if the biosolids facility is located close to the McLoughlin plant, heat extracted from the effluent could be used instead.
5. Price of biosolids fuel is based on 80% of average cost of equivalent coal energy ($2.00/GJ). Price for coal energy is based on $53.09/tonne and 26.7 MJ/kg (U.S. DOE).
6. Higher heating value of dried biosolids, 18,000 kJ/kg.
7. Excess capacity in digester is assumed to be used to accept FOG and other trucked liquid food waste, assuming approximately 80% capture of FOG available in CRD.
8. Tipping fee is assumed equal to septage receiving tipping fee at Metro Vancouver's Iona Island WWTP.
9. Co-digestion substrate truck volume assumed is 10 m^3 and truck number calculated assuming trucks deliver co-digestion substrate at 3/4 of capacity (7.5 m^3/truck). This includes FOG and other food trucked liquid waste.
10. Revenue for accepting co-digestion substrate assumes receiving substrate 365 days per year.

Section 7 Carbon Footprint Analysis

A carbon footprint analysis was performed as a part of the evaluation of the environmental impacts of selected Option 1A Prime2 treatment strategy. A carbon footprint measures the amount of greenhouse gases (GHG) released or stored as a result of a process or activity. To separately account for direct and indirect emissions, GHG inventory protocols categorize direct and indirect emissions into "scopes" as follows:

- **Scope 1:** All direct GHG emissions (with the exception of direct CO2 emissions from biogenic sources).
- **Scope 2:** Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling.
- **Scope 3:** All other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity (e.g., employee commuting), outsourced activities, waste disposal, etc.

This analysis included Scope 1, 2, and 3 emissions associated with the proposed design. The emissions associated with the entire wastewater treatment process were evaluated (i.e., liquid stream treatment, solids processing and disposal and resource recovery) to the extent feasible at this preliminary design analysis stage. In addition, a limited analysis of the embodied emissions associated with the concrete and steel used in the construction of the new wastewater treatment facilities was also included. **Figure 7.1** illustrates the emission scope categories.



Source: WRI/WBCSD *GHG Protocol Corporate Standard*, Chapter 4 (2004).

Figure 7.1
Emission Scope Categories

7.1 Basis of Methodology

Carbon footprint analysis is a relatively new method of quantifying environmental impacts. Therefore, the analysis methodologies can vary widely. The major sources for this analysis include Associated Engineering (AE) report previously prepared for this project as well as relevant scientific literature. Where possible, consistency with the previous consultant's reports was maintained. However, the carbon footprint analysis was altered to comply with the new design criteria and assumptions.

The three GHGs relevant to wastewater treatment plant operation are carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). The direct and indirect emissions and offsets of these GHGs associated with the alternatives are included in the carbon footprint analysis.

- Carbon Dioxide: CO2 enters the atmosphere by burning carbonaceous substances such as fossil fuels (oil, natural gas, and coal), solid waste, and trees, and as a byproduct of chemical reactions (e.g., the manufacture of cement). CO2 is also removed from the atmosphere (or "sequestered") when it is absorbed by plants or stored in the soil as part of the biological carbon cycle.
- Methane: CH4 is emitted during the production and transport of coal, natural gas, and oil. CH4 is also produced from the anaerobic digestion of waste at wastewater treatment

facilities, through livestock, and by the decay of organic waste in municipal solid waste landfills.

- Nitrous Oxide: N_2O is emitted by agricultural and industrial activities, combustion of fossil fuels and solid waste and secondary biological nutrient removal wastewater treatment processes.

In addition to the above three GHGs, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) are also GHGs regulated under the Kyoto Protocol. These GHGs are not expected to be emitted in significant quantities from the wastewater treatment process and estimates of emissions of these GHGs associated with the alternative design options are not currently available, therefore these GHGs are not included in the analysis.

Once greenhouse gases are emitted into the atmosphere, they absorb and re-radiate heat with varied levels of effectiveness. The global warming potential (GWP) quantifies the contribution of each gas over a specific time interval in terms of CO_2. The GWP of CO_2, by definition, is 1. The 100-year GWP values of CO_2, CH_4, and N_2O are shown below, based on the 2001 Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report.

- CO_2 GWP = 1 equivalent kilogram of CO_2
- CH_4 GWP = 23 equivalent kilograms of CO_2
- N_2O GWP = 296 equivalent kilograms of CO_2

The results of this carbon footprint analysis are reported in equivalent tonnes of CO_2. A summary of the emissions factors used to calculate the GHG emissions associated with the alternatives is provided in Table 7-1. A list of guiding assumptions is also provided below.

Greenhouse gas emissions can occur from anthropogenic or biogenic sources. Anthropogenic emissions are produced by human activities that remove sequestered carbon from the earth's crust and release it to the atmosphere (e.g., through the burning of fossil fuels). Biogenic carbon occurs in plants and animals that intake and dispense of carbon cyclically. Biogenic sources do not increase the amount of greenhouse gases in the atmosphere, but merely represent the "natural" cycling of carbon. Therefore, emissions of biogenic CO_2 are generally not accounted for in greenhouse gas inventories for wastewater treatment. In fact, biogenic carbon sources can be considered an offset when utilized in place of an anthropogenic source (for example, when using biogas from a wastewater treatment process as a fuel source in place of natural gas).

The carbon footprint analysis was performed using estimates for the operation of the facilities in the design year of 2030. The construction-related GHG emissions were analyzed for a single year. The purpose of this carbon footprint analysis was to evaluate if there are significant differences in the GHG emissions associated with each design alternative. Therefore, a single year analysis of the operation-related GHG emissions and a single year analysis of the construction-related GHG emissions were considered appropriate for the comparative alternative evaluations. A full lifecycle carbon footprint analysis combining the construction-related GHG emissions and the lifecycle operation-related GHG emissions was not performed at this time. As additional detailed design data is developed, a full lifecycle carbon footprint analysis could be conducted in the future.

Table 7.1
Greenhouse Gas Emissions Factors

Components	Literature Value	Units	Conversion to tonne CO2	Units	Source
Construction					
Concrete	0.3	ton Co_2e/m^3	0.272154	tonne Co_2e/m^3	Flower & Sanjayan.2007
Steel (re-bar, piping, equipment)	0.0032	ton C/ton product	0.0032	tonne C/tonne product	EPA, 2003
Excavation (diesel fuel emissions)	0.1	gal/m3	0.000981	tonne/m3	Wilson, personal communication
Conveyance	-	-	-	-	-
Liquid Stream Treatment					
Power for Treatment (electricity)	72	g CO_2e/kw-hr	0.000072	tonne/kwhr	BC Hydro, 2004 report
Treatment Chemicals					
Alum	0.539	kgCO2-e/kg dry	0.000539	tonne/kg Alum	de Haas et al 2008
Chlorine	1.124	kgCO2-e/kg dry	0.001124	tonne/kgCL	de Haas et al 2008
Direct Emissions (CH_4 & N_2O)					
Methane during Treatment and Outflow	0	0	0	0	Willis, personal communication
Nitrous Oxide (outfall)	0.0005-0.25	kg N20-N/kg N	0.000148	tonneCO_2/kg N	IPCC, 2006
Solids Treatment & Disposal					
Power for Treatment (Biosolids treatment & Scrubbing)	72	g CO_2e/kw-hr	0.000072	tonne/kwhr	BC Hydro, 2004 report
Treatment Chemicals (Polymer)	1.182	kg CO_2-e/kg dry	0.001182	tonne/kgPolymer	de Haas et al 2008
Direct Emissions (CH_4 & N_2O)					
Methane from scrubbing	1	% of volume	23	units CO_2/unit methane	
Nitrous Oxide from Combustion of Solids	1520-6400	g-N_20/ton DT	1.063360109	tonneCO_2/tDT	Suzuki et al 2003
Transportation (Diesel Fuel)	2637	g CO_2/L	0.002637	tonne/L	Brown, Biocycle 2004; EIA; GRP

Components	Literature Value	Units	Conversion to tonne CO2	Units	Source
Resources from Wastewater					
Saleable Heat for District Heating Offset	50.3	kg/GJ	.0503	tonne CO_2/GJ (based on natural gas)	EIA
Struvite Fertilizer Offset					
Avoidance P fertilizer	1.76	kg CO_2/kg P	0.00176	tonne/ kg P	ROU, 2006
Dried Product Fuel Offset (Cement kiln, etc.)	94.14	kg CO_2/GJ	0.09414	tonne/GJ	Abu-Orf etal 2008; EIA

Assumptions:

- Building heat, digester heat and biosolids drying are typically offset by digester gas and were therefore, not considered an offset of fossil fuels
- No methane is emitted from the digester.
- No methane is emitted from the conveyance system.
- One percent of methane is lost as fugitive emissions from the scrubber.
- The 2004 average annual emissions factor for electricity from BC Hydro was used. A heating season emissions factor was not included due to the fact that the actual usage for 2005 was much lower than the BC hydro projection for that year. The 2008 projection is assumed to also be too high.
- The biosolids results in this analysis are based on preliminary design assumptions and are subject to refinement after determination of actual solids characteristics and analysis of design options under Canadian regulations.
- Emissions associated with treatment chemicals used in liquid stream treatment were not included due to lack of data available at this time on chemical quantity usage.

7.2 Carbon Footprint Impact

The estimated annual carbon footprint in tonnes of CO_2 associated with each treatment option in the design year of 2030 is summarized in **Table 7.2**. This analysis is based on initial design assumptions for the proposed system configuration. Further refinement of this analysis will be conducted in the future as the alternatives analysis and design process proceeds.

The results of this analysis indicate that the overall net carbon footprint of all three alternatives is negative due to the extensive utilization of wastewater resources such as biosolids, biogas, and heat recovery in the system design, which offsets the use of fossil fuels. A negative carbon footprint indicates a beneficial environmental impact related to GHG emissions.

Table 7.2
Summary of GHG Emissions Associated with Alternatives in 2030 design year (Tonne CO2e/yr)

Components	Option 1A
Construction: (Emissions associated with concrete and steel production and site excavation) **One time** emission during construction period. Therefore, not included in 2030 design year total	6,224
Conveyance:	
• Power for Conveyance (pumping)	193
Liquid Stream Treatment:	
• Power for Treatment	3,510
• Chemicals (Liquid and Solids)	252
• Direct Emissions (CH_4 & N_2O) for Liquids and Solids	61
Biosolids / Resource Recovery:	
• Biomethane	-7,409
• Cement Kiln Offset	-1,742
• Struvite offset	-250
Total Annual Emissions Design Year 2030 **(Excluding onetime construction-related emissions)**	**-5,385**

7.3 Recovery of Saleable Products & Greenhouse Gas Offsets

The potential saleable products included in the proposed design include: methane biogas, struvite and dried fuel product. For a discussion of the production and benefit of these products refer to Section 6 of this report. Each of these products is derived from the renewable source of wastewater residuals. A subsequent benefit is that renewable sources of energy and nutrients can provide an offset of equivalent GHG emissions associated with nonrenewable sources of energy and nutrients. A brief overview of the GHG offsets incorporated in this analysis related to these products is provided in this section.

Table 7.1 summarizes the emissions factors associated with the offsets described in this section. The emissions factors associated with the offsets are based on professional judgment of the best available data and research at this time. As additional data and research becomes available, emissions factors associated with offsets may be modified in the future.

For the purposes of this carbon footprint analysis, GHG offsets refer to the amount of anthropogenic greenhouse gases avoided by utilizing alternative renewable resources. For example, digester gas captured during anaerobic digestion of solids can be scrubbed and sold as a biogas product. The digester gas is used in lieu of natural gas or other fossil fuels. Because the burning of natural gas releases anthropogenic GHG, the amount of natural gas not burned due to the capture and use of digester gas is considered an offset for the purposes of this analysis. When food sources such as brown grease are added to the digester to boost gas production, the offsets associated with use of the digester gas are increased.

Heat recovery at the wastewater treatment facilities involves recovery of heat from the digester effluent with heat pumps, and the use of recovered heat to provide in-plant process heating and building heating at the McLoughlin Point plant. Although heat recovery requires the input of electricity, the electrical equivalent of the heat that is recovered is greater than the input, resulting in a net reduction in electricity or fuel usage for heating purposes.

Struvite is other resource that provides a source of GHG offsets. This product can be land applied in place of chemical fertilizers, offsetting the industrial production of phosphorous. A dried biosolids fuel product can be used in lieu of burning of coal as a heat/energy source in cement manufacturing or waste to energy facilities.

Section 8 Opinion of Probable Capital Costs

8.1 Cost Basis

Detailed capital and life cycle cost estimates have been prepared for the selected option and are included in Appendix A. the cost estimate is considered a Class c estimate and includes appropriate allowances and contingencies for a project of this magnitude. The percentages used in the estimate for direct and indirect costs are based on experience with other highly complex projects.

The cost estimates are comprised of the following and include factors appropriate for a project at this stage:

Direct Costs

- Capital construction costs including project general requirements.
- Construction contingency costs at 15% of construction costs.

Indirect Costs

- Engineering at 15% of direct costs.
- Administration and program management costs at 6% of direct costs.
- Miscellaneous at 2% of direct costs.

Financing Costs

- Interim Financing at 4% of direct and indirect costs.
- Inflation to Midpoint of construction 2% per annum to 2014.
- Net HST at 1.75%

It is noted that capital costs could vary depending on market conditions at time of tender, the overall procurement strategy and the risk profile of a particular project.

8.2 Capital Costs

To arrive at preliminary capital costs conceptual level layouts were prepared for facilities and sited on the potential sites under consideration. Representative technologies were selected for the purposes of preparing cost estimates at each site. Drawings and cost estimates are appended to this report. The capital costs (rounded to nearest $1 million) for the proposed system configuration are summarized in **Table 8.1**.

Table 8.1
Capital Costs

Capital Costs	Option 1A Prime2
Total Capital Costs	$791,000,000

Capital costs are subject to some modification depending on the degree of mitigation and further more detailed engineering works.

8.3 Operations and Maintenance Costs

Table 8.2 provides operations and maintenance costs for the proposed system configuration.

Table 8.2
Annual O&M Costs

	Option 1A Prime2
Annual O&M Costs	$14,571,000

Annual operation and maintenance costs are considered similar for all options and do not consider offsets from potential revenue from resource recovery.

8.4 Life Cycle Costs

Life cycle costs were prepared using a net present value approach and a 6% discount rate. The life cycle costs include capital and operating costs and repair and replacement costs over a 25 year period.

Table 8.3
Life Cycle Costs

Costs	Option 1A Prime2
Life Cycle Costs	$991,537,000

Section 9 Risk Assessment

9.1 Methodology

Many communities are using risk assessment to identify and quantify the severity of risk associated with capital projects. Each project has a different risk profile. Quantification of risks can assist decision makers in the selection of options and identification and mitigation of project specific issues. For the CRD CAWTP the use of risk assessment provides a good technique to highlight the risks that are known at this time. As the project develops and more information becomes available the risk assessment can be updated and mitigation strategies can be developed for each of the identified risk factors.

Section 9.3 provides an outline of risks which are known at this time. This risk matrix is preliminary only and will be further developed as the project proceeds.

9.2 Risk Matrix

A preliminary risk matrix (Table 9.1) has been prepared for Option 1A Prime2. A number of risk factors have been considered. These include siting risks, construction cost risk, constructability and a number of others. Each of these risks is ranked using a simple probability of occurrence using a 1 to 3 ranking. The risk impact is also ranked 1 – 3 with 1 being low impact and 3 being high impact. The factor of the probability and impact provides an overall risk factor. This technique is useful in providing a high level screening of risk factors. As the project develops more detailed risk assessment and workshops can be completed with various stakeholders and CRD staff.

9.3 Risk Ranking

The project was ranked in consideration of the risk categories applicable to each of the major project components. The risks associated with each site under consideration for construction of facilities have been assessed. It also considers the risk associated with the various conveyance systems, social risks and construction risks.

RISK IDENTIFICATION			RISK ASSESSMENT			RISK MITIGATION
CATEGORY	RISK	DATE IDENTI-FIED	PROB. HIGH = 3 MED = 2 LOW = 1	IMPACT HIGH = 3 MED = 2 LOW = 1	RISK FACTOR HIGH > 5 MED 4 - 5 LOW < 4	RISK CONTROL STRATEGIES / ACTIONS
RISK – OPTION 1A						
Site	McLoughlin Point					
	• Timing of Environmental Clean-up not within the project schedule		3	3	9	
	• Rezoning may not be approved		2	3	6	
	• Imperial Oil decides the site is too costly to remediate and does not sell		1	3	3	
	• Site Remediation Costs		3	2	6	
	• Access agreements with DND		1	1	1	
	• Aesthetics		2	2	4	
	• Rock Excavation		3	3	9	
	• Need for special foundations		3	3	9	
	• Constructability		3	3	9	
	• Space		3	3	9	
	• Traffic		1	1	1	
	• Community Use		1	1	1	
	• Noise		1	1	1	
	• Odour Control		1	2	2	
	• Impacts on Adjacent Residents		1	1	1	
Site	Clover Point					
	• Community Use		3	3	9	
	• Visual Impact		3	2	6	
	• Space		3	2	6	
	• Odour		1	2	2	
	• Noise		1	2	2	
	• Traffic		1	2	2	
	• Constructability		3	2	6	
	• Impact to Adjacent Residents		2	2	4	
Site	Macaulay Point					
	• Community Use		1	1	1	
	• Visual Impact		1	1	1	
	• Space		3	1	3	
	• Odour		1	2	2	

RISK IDENTIFICATION			RISK ASSESSMENT			RISK MITIGATION
CATEGORY	RISK	DATE IDENTI-FIED	PROB. HIGH = 3 MED = 2 LOW = 1	IMPACT HIGH = 3 MED = 2 LOW = 1	RISK FACTOR HIGH > 5 MED 4 - 5 LOW < 4	RISK CONTROL STRATEGIES / ACTIONS
	• Noise		1	1	1	
	• Traffic		1	1	1	
	• Constructability		2	2	4	
	• Impact to Adjacent Residents		2	2	4	
Site	Hartland Landfill Biosolids					
	• Community		2	2	4	
	• Visual Impact		2	2	4	
	• Space		1	1	1	
	• Odour		2	2	4	
	• Noise		2	2	4	
	• Traffic		2	2	4	
	• Constructability		2	2	4	
	• Impact to Adjacent Neighbours		1	1	1	
Stakeholders	Acceptance		2	2	4	
	Mitigation Strategies / Costs		2	2	4	
	Social Concerns		2	2	4	
Engineering	Treatment Technology Selection		2	1	2	
	Resource Recovery		2	2	4	
	Foundation / Site Conditions		2	1	2	
	Carbon Footprint		1	1	1	
	Biosolids Treatment		2	2	4	
Financial	Capital Cost / Affordability		2	3	6	
	Operations / Maintenance Costs		1	2	2	
	Revenues from resources		3	2	6	
	Available Funding		2	2	4	
	Funding Conditions / Restrictions		2	2	4	
	Cost Escalation		2	2	4	
	Contingency Items		2	2	4	
	Financing Costs		1	1	1	
Procurement	Procurement Strategy		2	1	2	
Construction	Cost		2	3	6	
	Market Conditions		1	3	3	
	Schedule / Delays		2	3	6	

RISK IDENTIFICATION			RISK ASSESSMENT			RISK MITIGATION
CATEGORY	RISK	DATE IDENTI-FIED	PROB. HIGH = 3 MED = 2 LOW = 1	IMPACT HIGH = 3 MED = 2 LOW = 1	RISK FACTOR HIGH > 5 MED 4 - 5 LOW < 4	RISK CONTROL STRATEGIES / ACTIONS
	Changes / Claims		2	2	4	
Other	Natural Disaster		1	3	3	
	Global Warming		1	1	1	
	Treatment System Failure		1	2	2	
	Sludge Pipeline		3	2	6	
	Archeological Conditions		2	2	4	

Section 10 Discussion of Analysis and Recommendation

10.1 Summary of Siting Investigations

Option 1A Prime2, with the main secondary plant at McLoughlin Point is a viable option because of its proximity to the Macaulay and Clover Point outfalls and the fact that the site is available for purchase. The McLouglin site is contaminated and will require remediation but the extent of contamination has been identified and cost estimates for remediation have been prepared. A site has been identified at Hartland Landfill for the biosolids treatment facilities.

The Saanich East North Oak Bay wet weather storage tank will be located on a parcel of land owned by the CRD or an adjacent parcel owned by the District of Saanich.

10.2 Siting of Biosolids Facilities

For Option 1A Prime2 biosolids treatment facilities will be located at a site remote from McLoughlin WWTP at the Hartland Landfill. This site is located approximately 17.7 km from the McLoughlin Point and will require construction of pumping stations and pipeline to transfer sludge from the McLoughlin site to Harland landfill. The opportunity for heating digesters from secondary effluent would likely not be economical for this option. It would also be a good location for acceptance of and processing of FOG to enhance digester gas production. In the future, waste-to-energy facilities could also be integrated into this site more readily.

10.3 Wet Weather Treatment Facilities

Under Option 1A Prime2 detailed investigation indicated that the Macaulay wet weather facilities can be incorporated into the McLoughlin Point plant, thereby resulting in cost savings. In order to accommodate the treatment of the wet weather flow at the McLoughlin Point plant, the available footprint on the McLoughlin site has been maximized by locating the headworks at the Clover Point and Macaulay Point pump stations.

10.4 Resource Recovery & Carbon Footprint

The potential for resource recovery has been investigated. The CRD has an opportunity to establish resource recovery facilities for heat recovery for in-plant use at McLoughlin Point, and for biomethane and struvite recovery and the production of dried fuel substitute at the Hartland biosolids processing and energy facility.

One of the key drivers for implementation of resource recovery will be the market potential for immediate use of these resources. Basic infrastructure can be configured to permit easy addition of an expanded heat recovery system and specific facilities can then be constructed at a future date to match market demands.

The design can be developed to offset greenhouse gases and provide a carbon positive project. By recovering biomethane and other resources the impact from operation at the plants and operating costs can be reduced.

10.5 Recommendation

Based on the work completed as part of the project, the project team recommends the following:

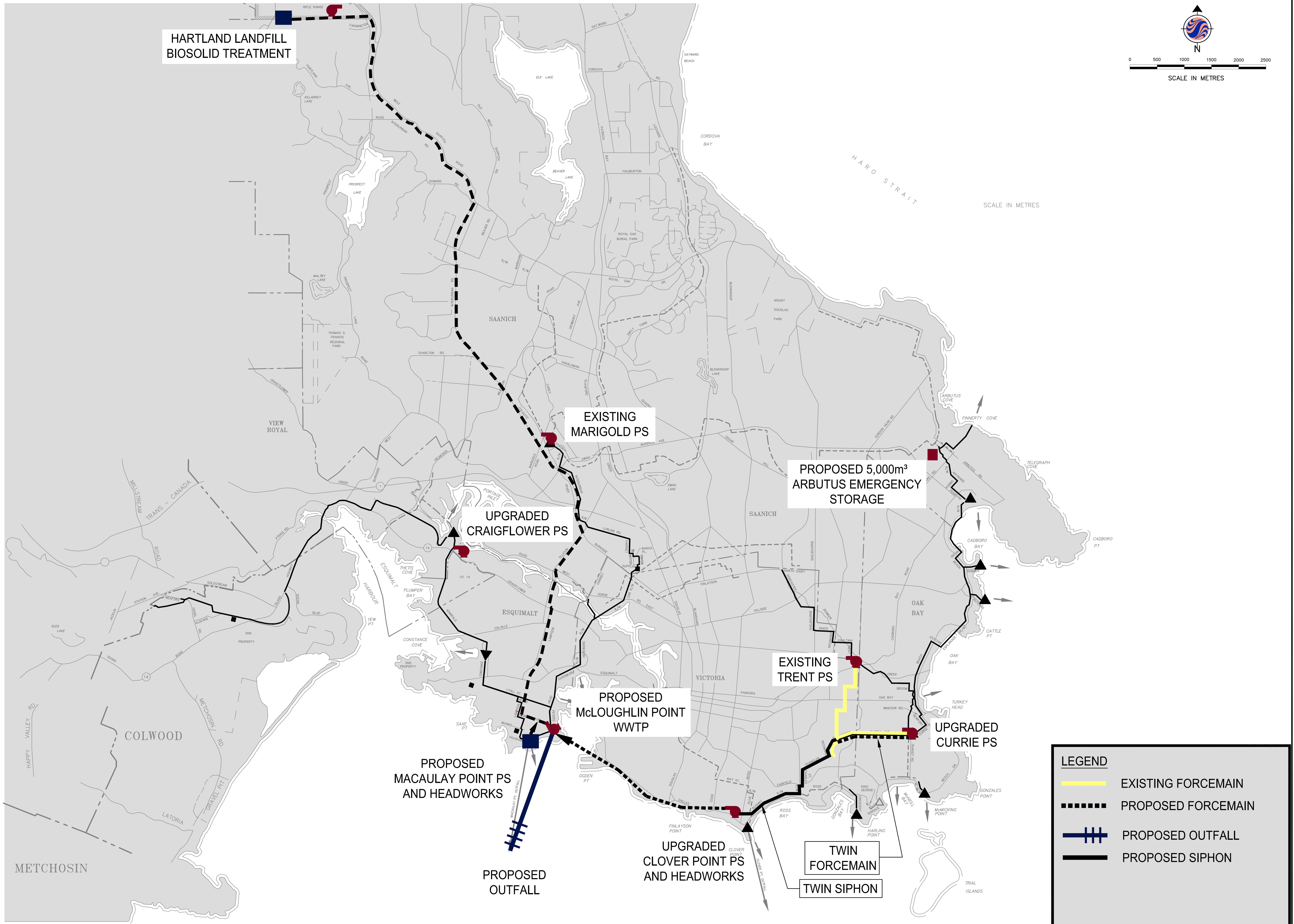
- Carry forward with the grant applications using Option 1A Prime2 configuration.
- Proceed with further technical development and public engagement for all facilities.
- Continue to further develop resource recovery opportunities and explore the market potential for use of recovered resources.

Appendix A

Detailed Cost Estimates - Confidential

Appendix B

Drawings



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SCALE HORIZONTAL	N.T.S	CHECKED	
SCALE VERTICAL	—	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

McLOUGHLIN OPTION 1A PRIME 2
KEY PLAN

CONTRACT NUMBER	DRAWING NUMBER	ISSUE	SHT. No. OF
—	FIGURE 1.1	—	— OF —

Xrefs: overall map.DWG; A1-CRD-TITLE.DWG;
Drawing: V:\1490\149009002\DRAWINGS\FIGURES\10.04.15\FIG 2 REV.DWG
June 07, 2011 11:38 a.m.

Drawing: V:\1490\149009002\C3D\MC LOUGHLIN 1A PRIME\FIGURE.DWG
June 08, 2011 8:33 a.m.

Stantec
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CORE AREA WASTEWATER TREATMENT PROGRAM

Figure No.

Title
McLoughlin Pt. Site, Option 1A Prime 2
3D Rendering

KEY PLAN
N.T.S.

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1:750

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CORE AREA WASTEWATER TREATMENT PROGRAM

HARTLAND LANDFILL SITE
OPTION 1A PRIME 2
BIOSOLIDS FACILITIES – SITE 1
SITE PLAN

CONTRACT NUMBER	DRAWING NUMBER	ISSUE	SHT. No. OF
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Xrefs: A1-CRD-TITLE.DWG;
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Xrefs: ContoursClipped.DWG; ML-A5-primary clarifiers.DWG; ML-A5-baf.DWG; ML-A5-effluent pump station.DWG; ML-A5-STANBY POWER.DWG; ML-A5-uv bldng.DWG; ML-A5-sludge thickening.DWG; xx-admin.DWG; A1-CRD-TITLE.DWG; ICF_Selection.DWG; ML-A5-odour control rm.DWG;
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SCALE HORIZONTAL	1:500	CHECKED	PP
SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A–PRIME 2 (107.8 ML/D)
BIOLOGICAL AERATED FILTRATION PROCESS (BAF)
SITE PLAN

CONTRACT NUMBER	DRAWING NUMBER	ISSUE	SHT. No. OF
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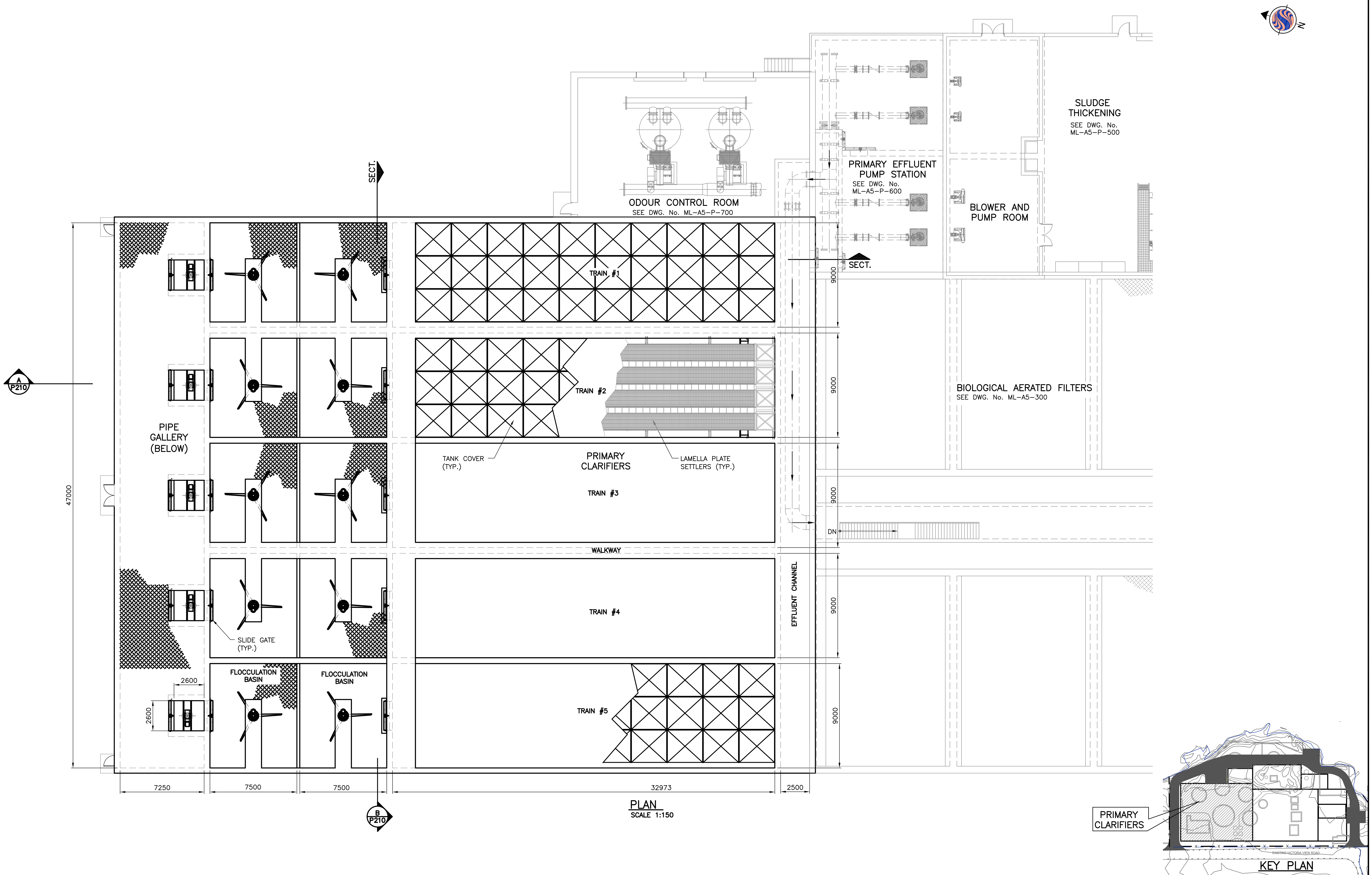

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CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A–PRIME 2 (107.8 ML/D)
PRIMARY CLARIFIERS (LAMELLA PLATE) WITH CEP
GENERAL ARRANGEMENT – PLAN

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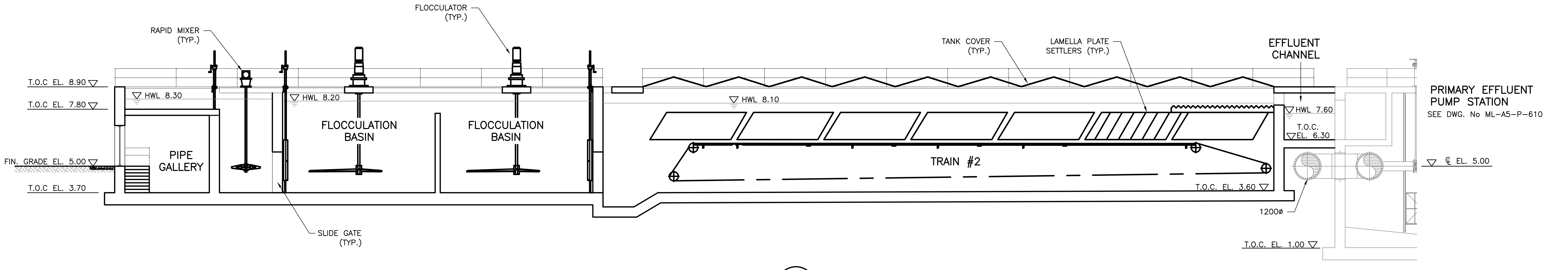

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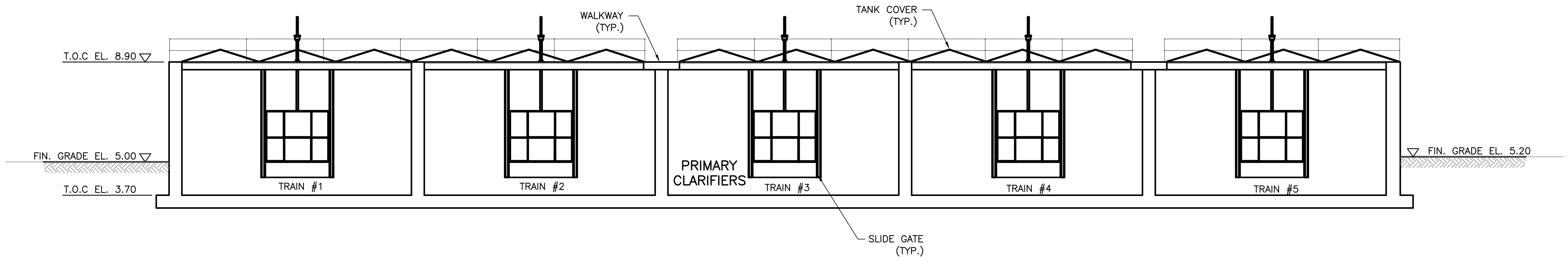

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SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
PRIMARY CLARIFIERS (LAMELLA PLATE) WITH CEP
GENERAL ARRANGEMENT – SECTIONS

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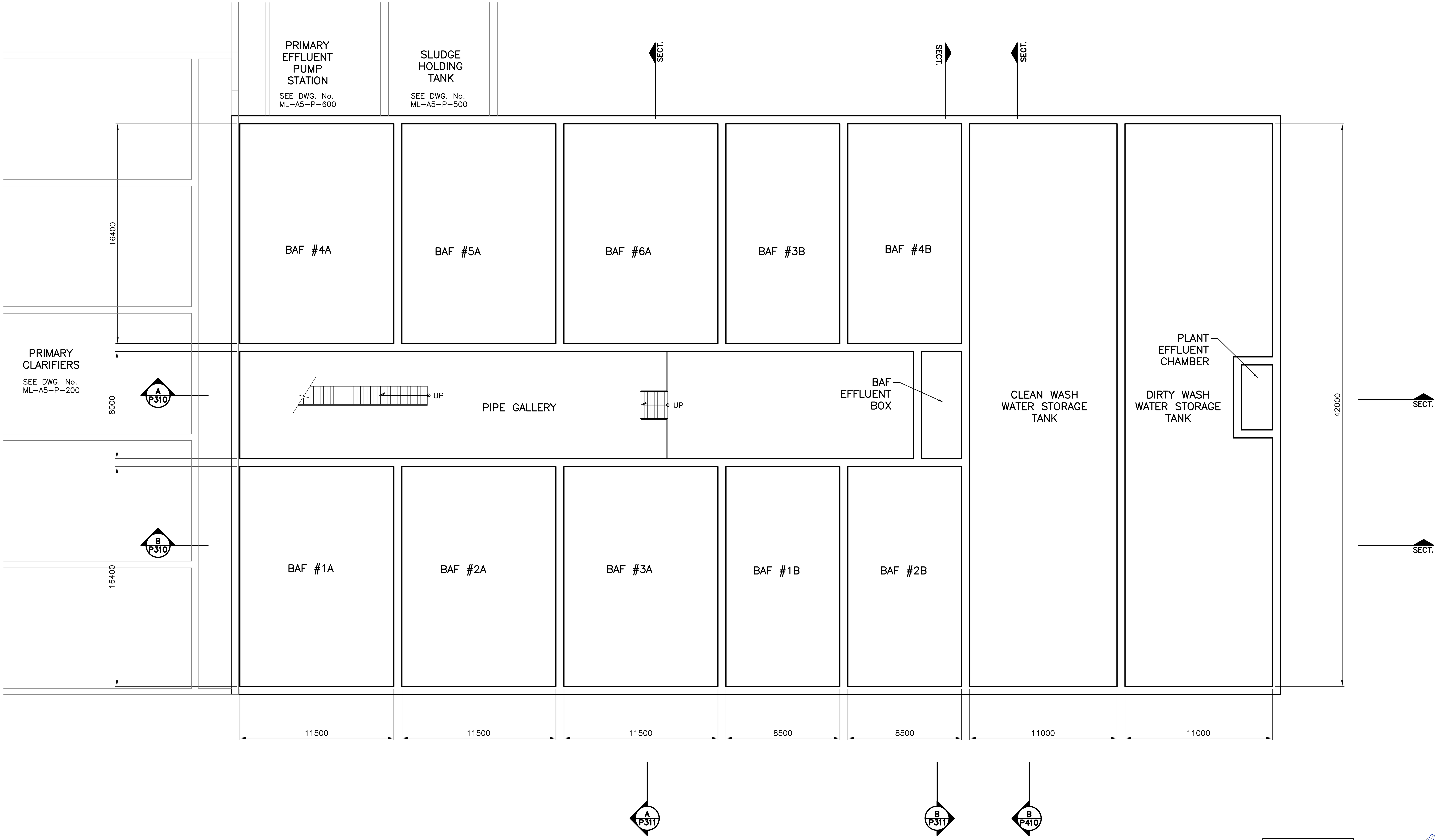

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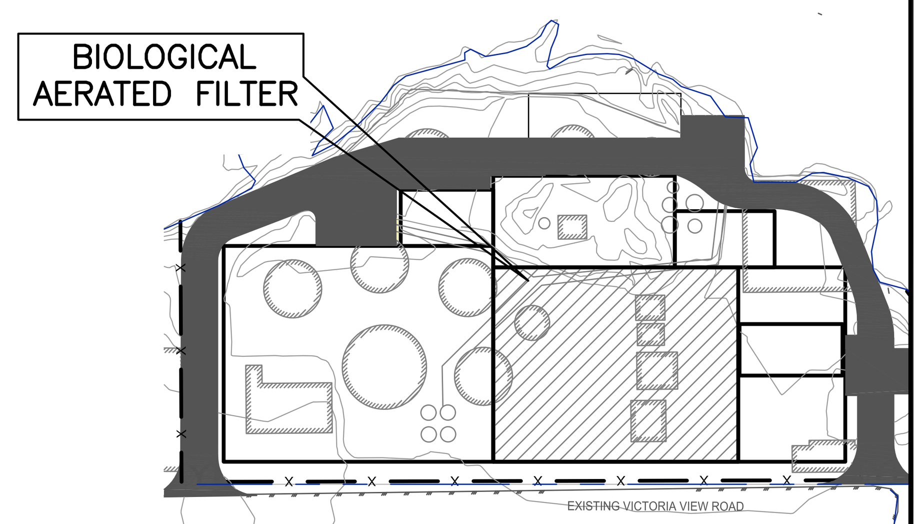

KEY PLAN

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SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A – PRIME 2 (107.8 ML/D)
BIOLOGICAL AERATED FILTER PROCESS (BAF)
GENERAL ARRANGEMENT – BOTTOM PLAN

CONTRACT NUMBER	DRAWING NUMBER	ISSUE	SHT. No. OF
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GROUND FLOOR & SECOND FLOOR PLAN
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DRAWN	BG	DATE	28/05/10
SCALE HORIZONTAL	1:150	CHECKED	PP
SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A – PRIME 2 (107.8 ML/D)
BIOLOGICAL AERATED FILTER PROCESS (BAF)
GENERAL ARRANGEMENT – GROUND & SECOND FLOOR PLAN

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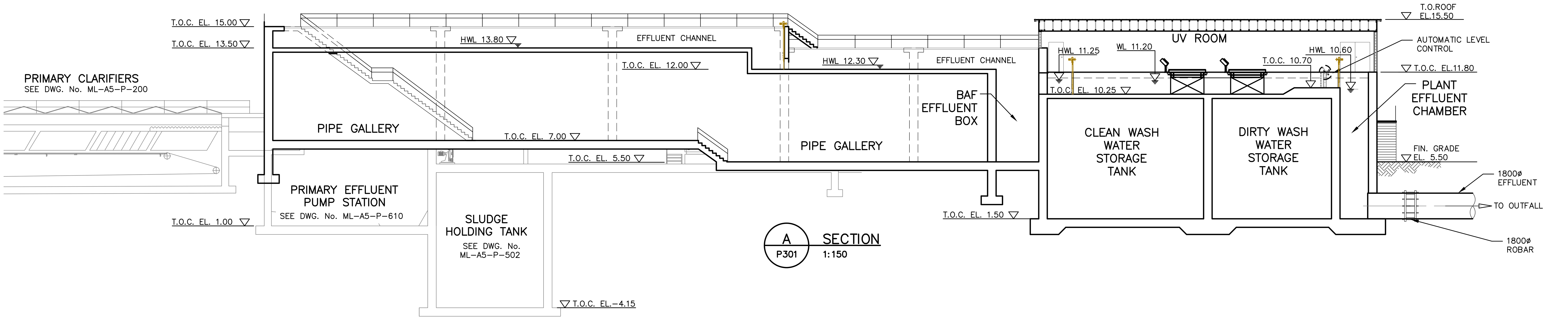

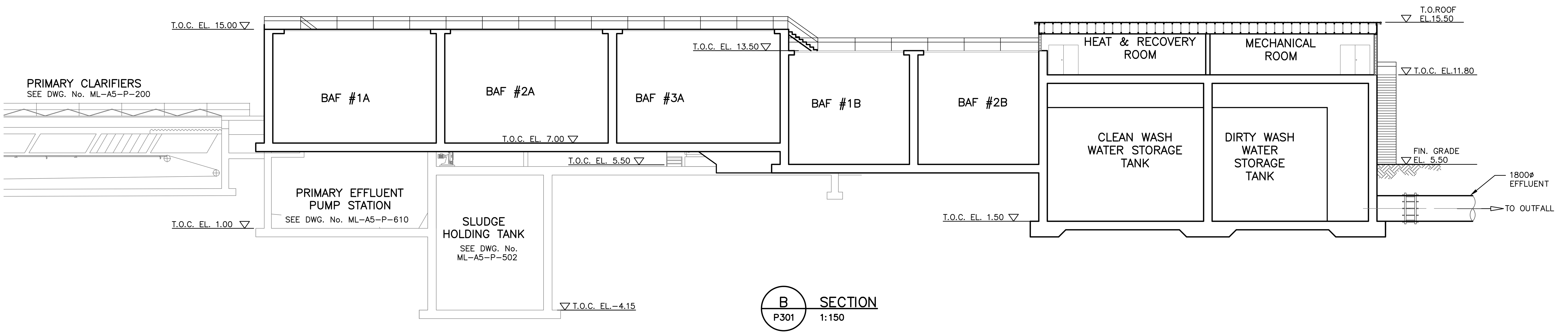

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CORE AREA WASTEWATER TREATMENT PROGRAM
Mc LOUGHLIN PT. SITE
OPTION 1A – PRIME 2 (107.8 ML/D)
BIOLOGICAL AERATED FILTER PROCESS (BAF)
GENERAL ARRANGEMENT – SECTIONS

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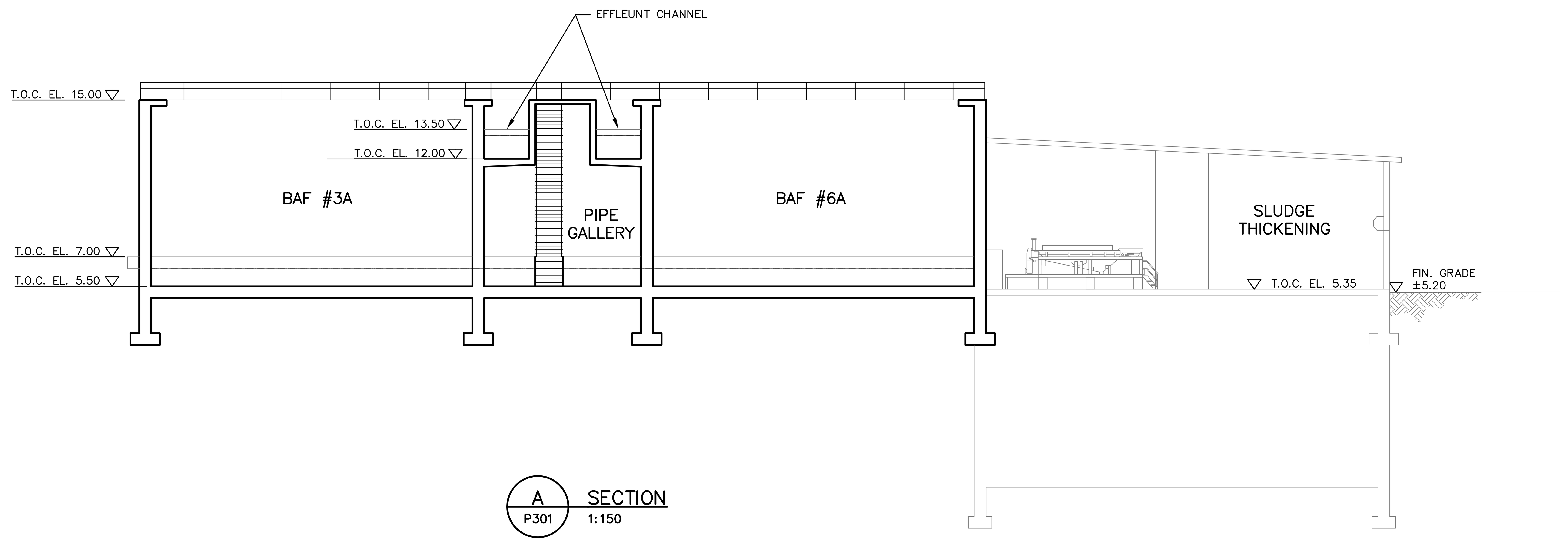

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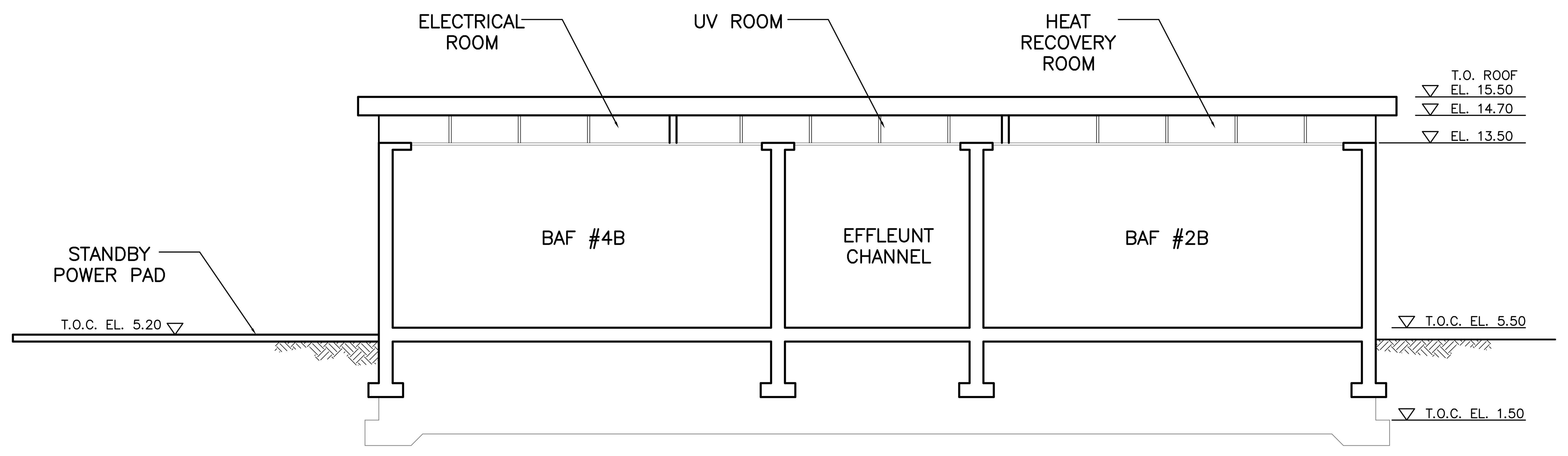

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CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A – PRIME 2 (107.8 ML/D)
BIOLOGICAL AERATED FILTER PROCESS (BAF)
GENERAL ARRANGEMENT – SECTIONS

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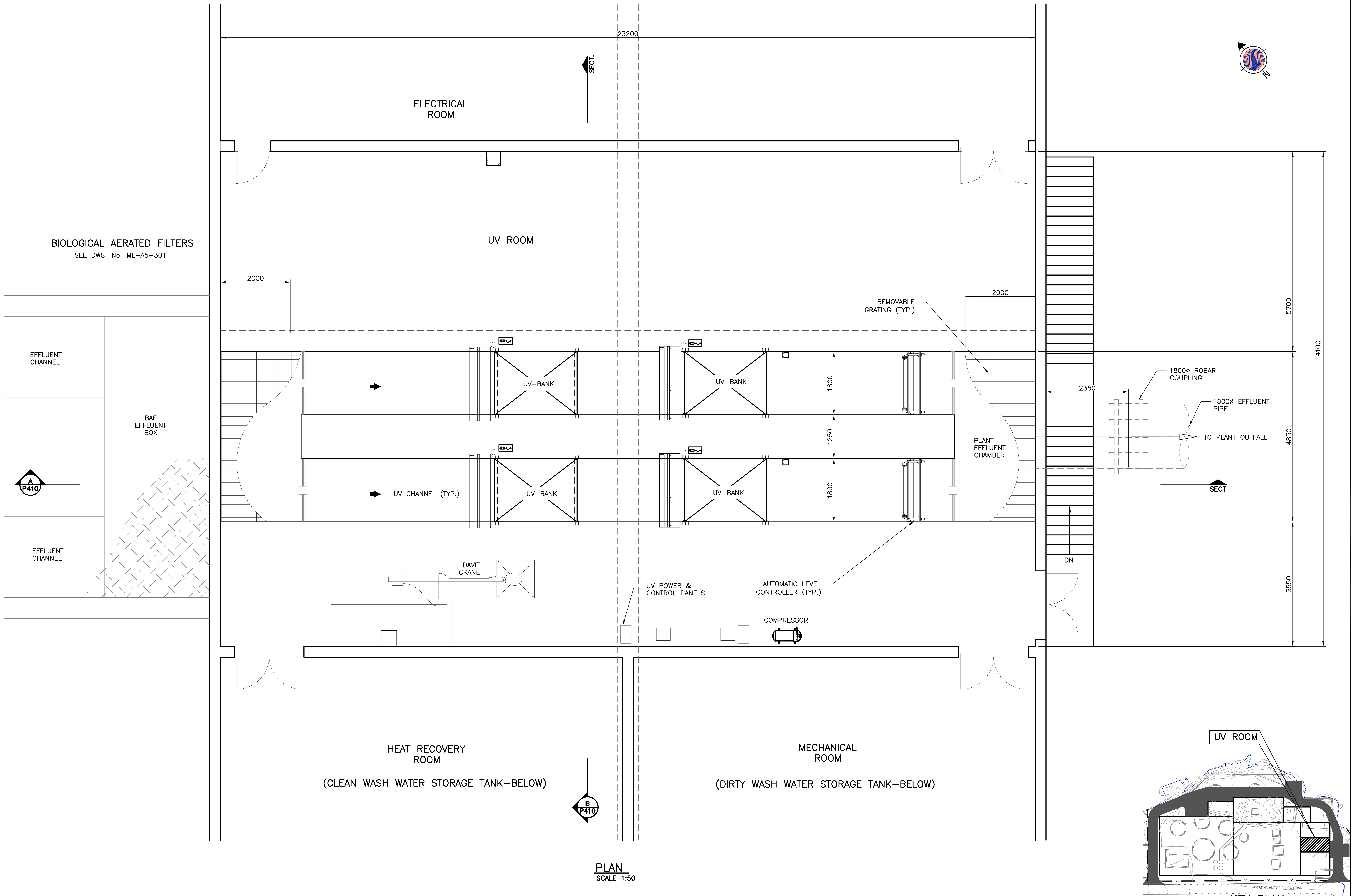

PLAN
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KEY PLAN

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January 13, 2011 9:39 a.m.

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SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
UV BUILDING FOR SECONDARY EFFLUENT
GENERAL ARRANGEMENT – PLAN

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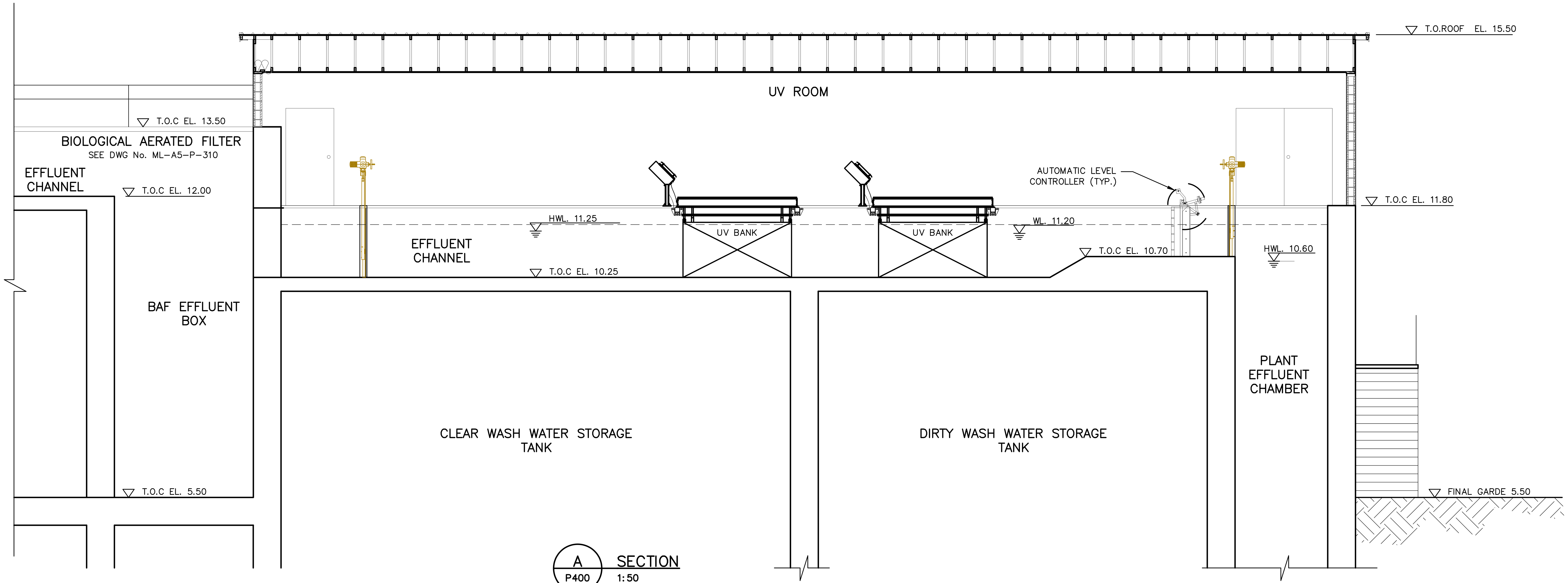

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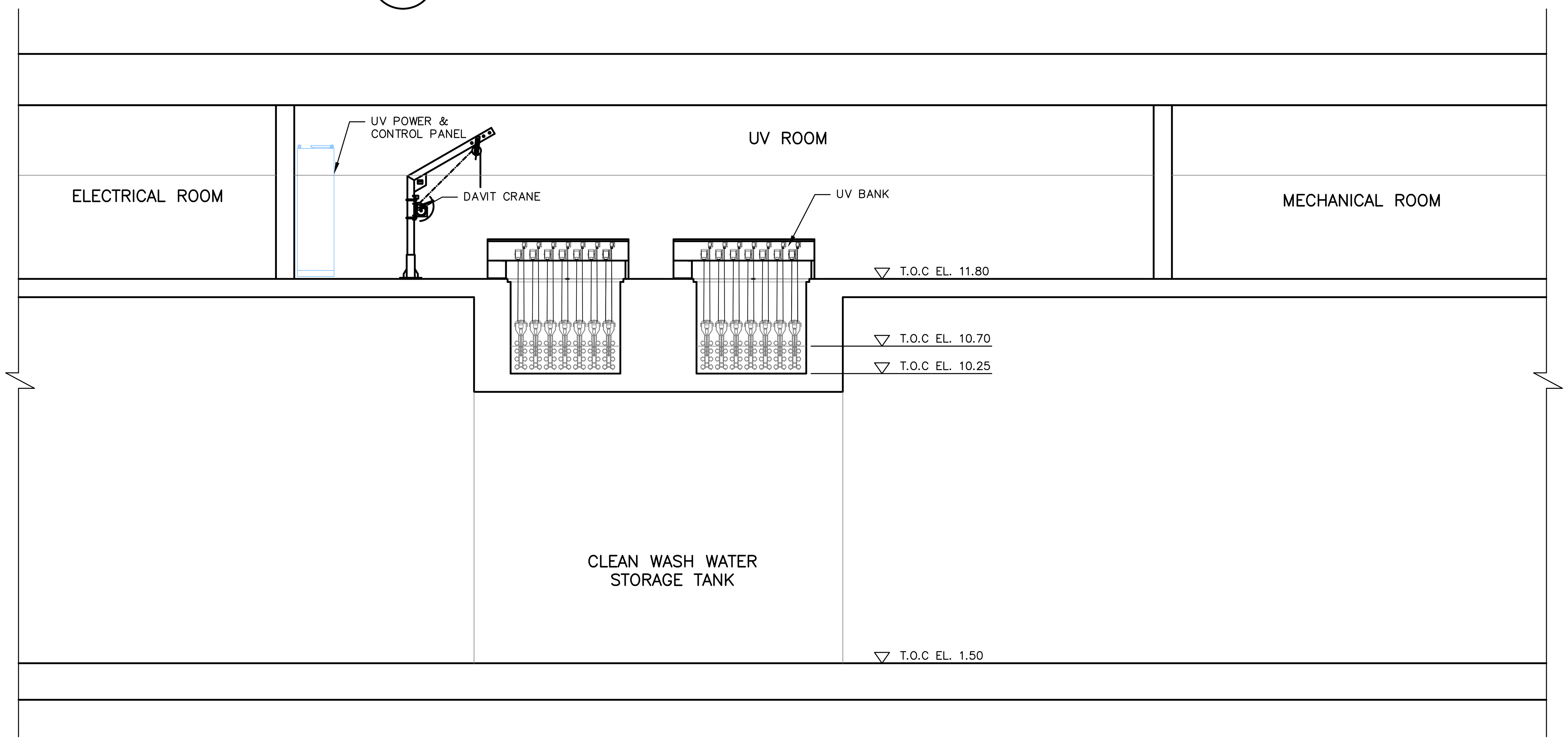

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January 13, 2011 9:53 a.m.

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SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
UV BUILDING FOR SECONDARY EFFLUENT
GENERAL ARRANGEMENT - SECTIONS

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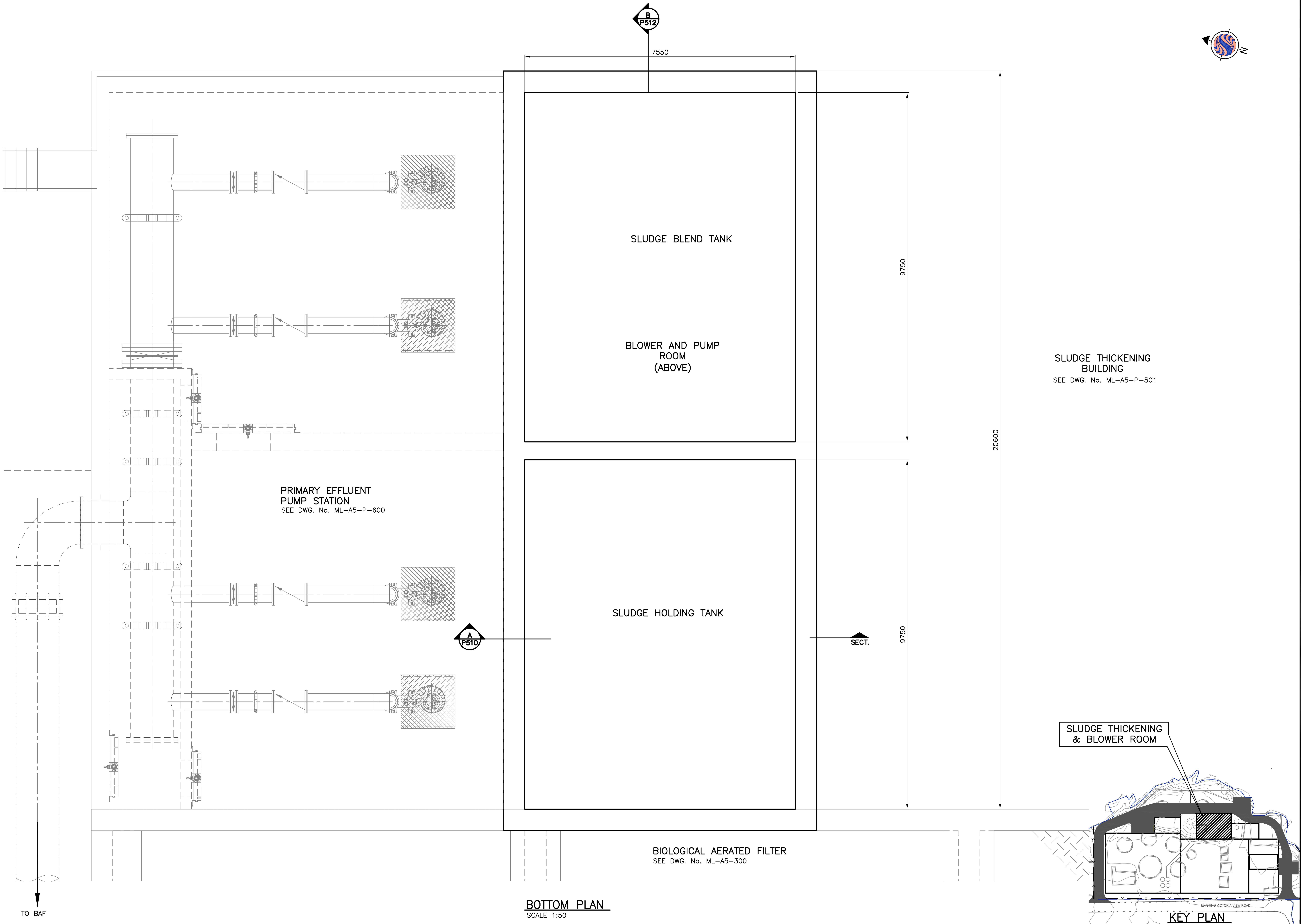

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SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
SLUDGE THICKENING / BLOWER ROOM
GENERAL ARRANGEMENT BOTTOM FLOOR PLAN

CONTRACT NUMBER – | DRAWING NUMBER ML-A5-P-500 | ISSUE – | SHT. No. – OF –

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DRAWN	HN	DATE	28/05/10
SCALE HORIZONTAL	1:50	CHECKED	PP
SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
SLUDGE THICKENING / BLOWER ROOM
GENERAL ARRANGEMENT – GROUND FLOOR PLAN

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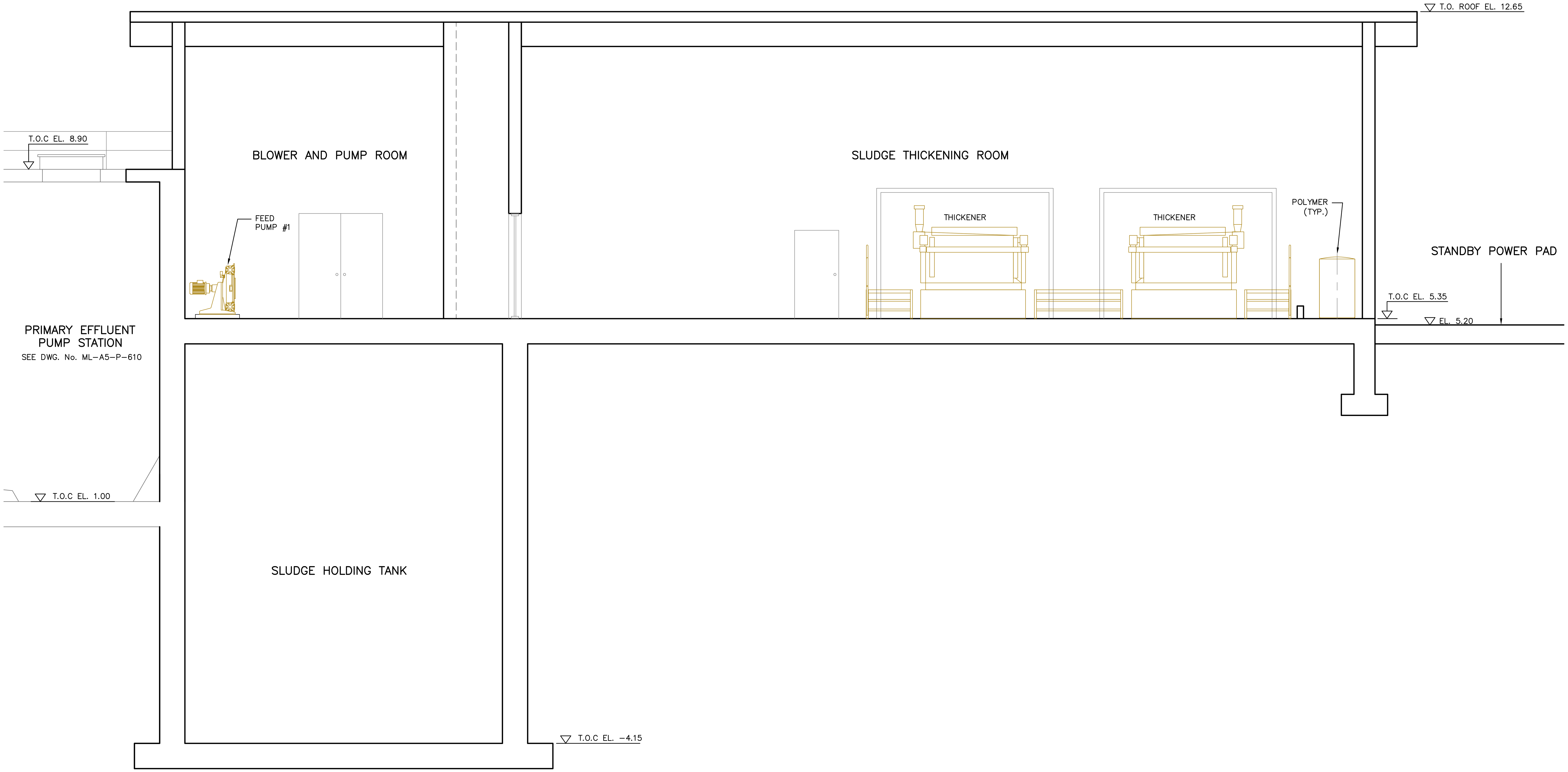

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January 12, 2011 11:33 a.m.

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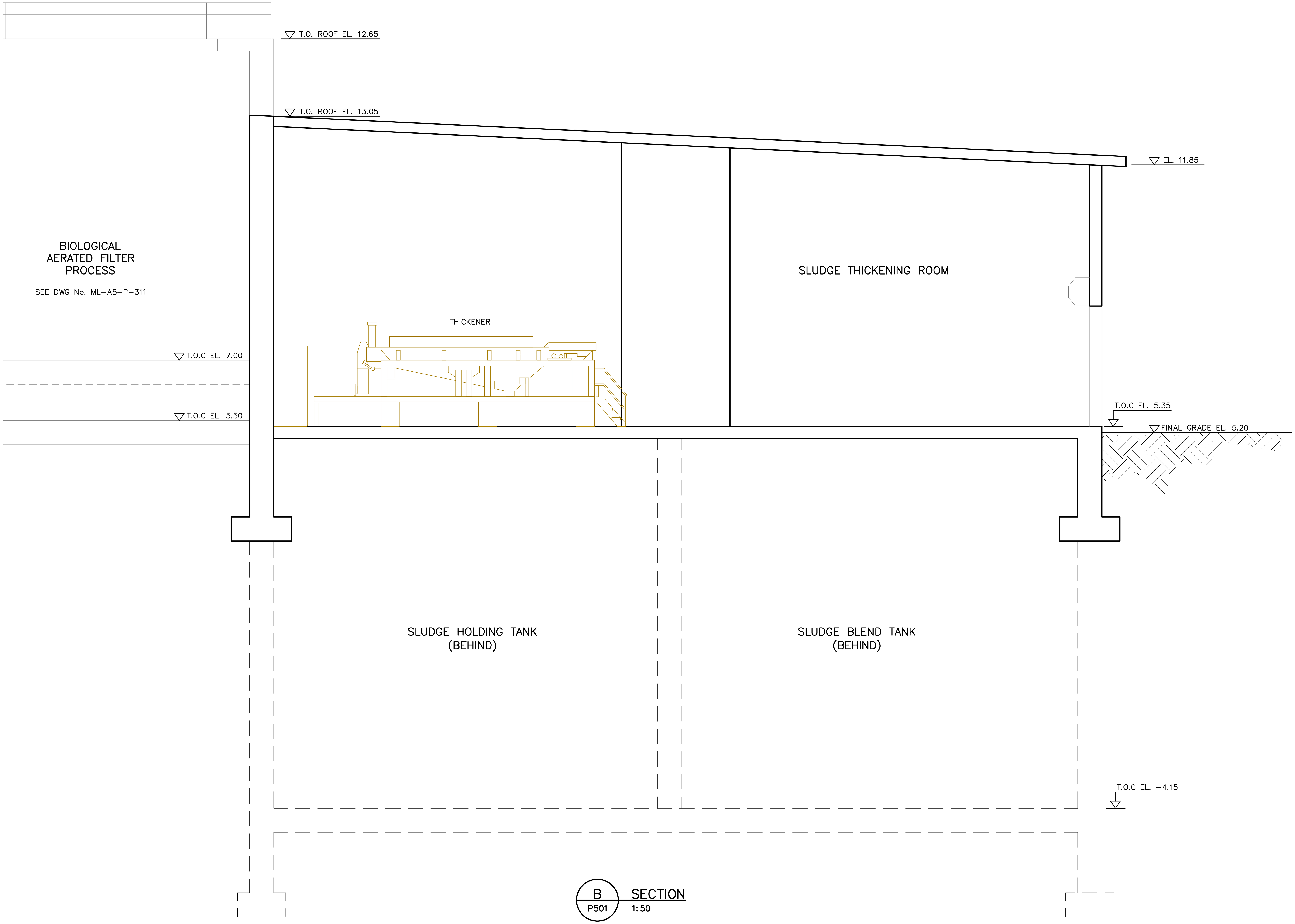
SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
SLUDGE THICKENING / BLOWER & PUMP ROOM
GENERAL ARRANGEMENT - SECTION

CONTRACT NUMBER –
DRAWING NUMBER ML-A5-P-510
ISSUE –
SHT. No. – OF –



B
P501
SECTION
1:50

Xrefs: ML-A5-sludge thickening.DWG; A1-CRD-TITLE.DWG; ML-A5-baf.DWG;
Drawing: V:\1490\149009002\8_DRAWINGS\8-1_TREATMENT PLANT\5_PROCESS\ML-A5-P-511.DWG
January 13, 2011 10:31 a.m.

Stantec

SEAL

BY	DATE	No.	REVISION	ENG.	No.	DATE	ISSUE

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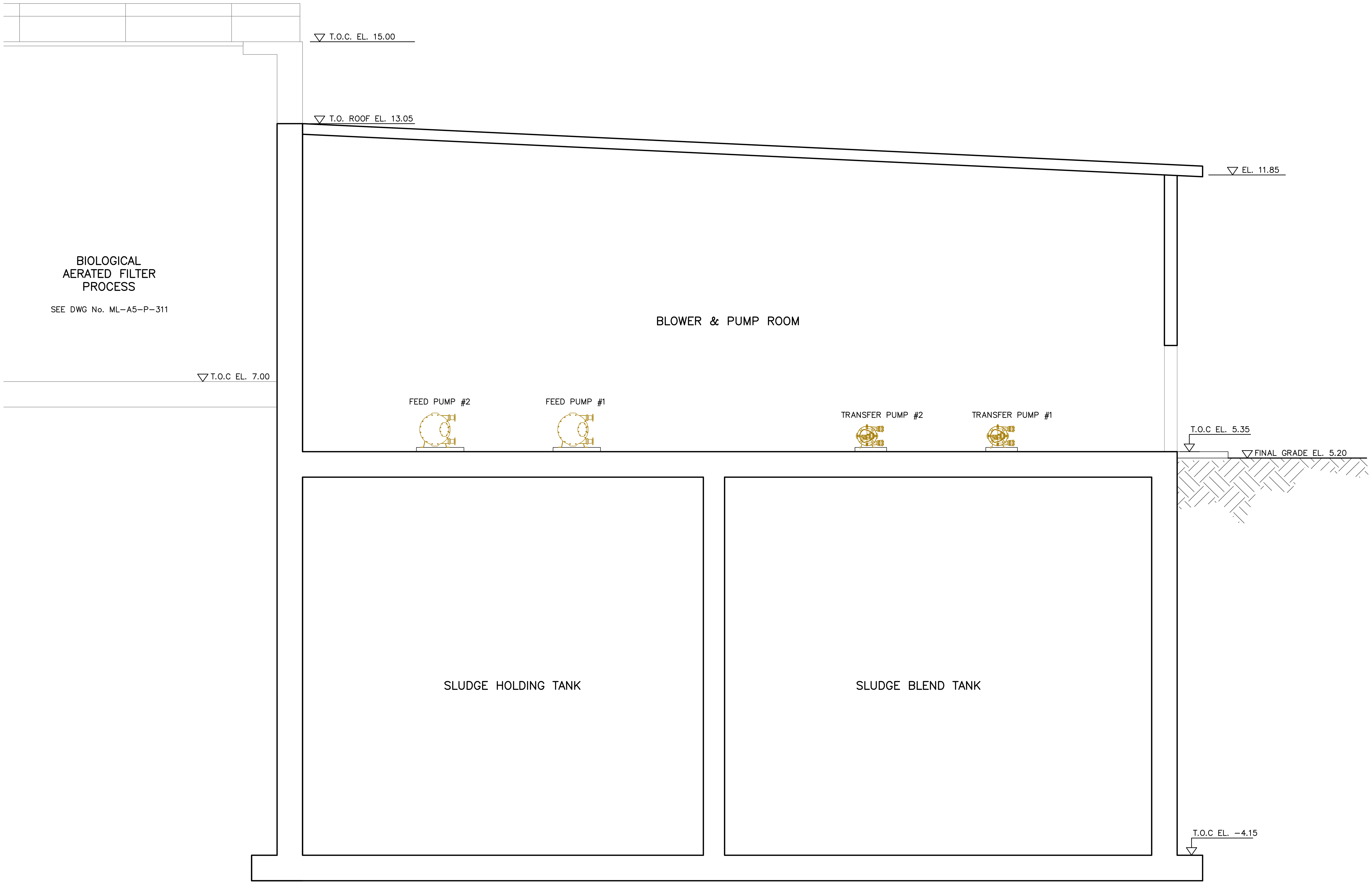
DESIGNED	MN/KC	SURVEYED	-
DRAWN	HN	DATE	28/05/10
SCALE HORIZONTAL	1:50	CHECKED	PP
SCALE VERTICAL	-	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
SLUDGE THICKENING ROOM
GENERAL ARRANGEMENT - SECTION

CONTRACT NUMBER	DRAWING NUMBER	ISSUE	SHT. No. OF
-	ML-A5-P-511	-	- OF -



B
P501
SECTION
1:50

Xrefs: ML-A5-sludge thickening.DWG; A1-CRD-TITLE.DWG; ML-A5-bof.DWG;
Drawing: V:\1490\149009002\8_DRAWINGS\8-1_TREATMENT PLANT\5_PROCESS\ML-A5-P-504.DWG
January 12, 2011 1:32 p.m.

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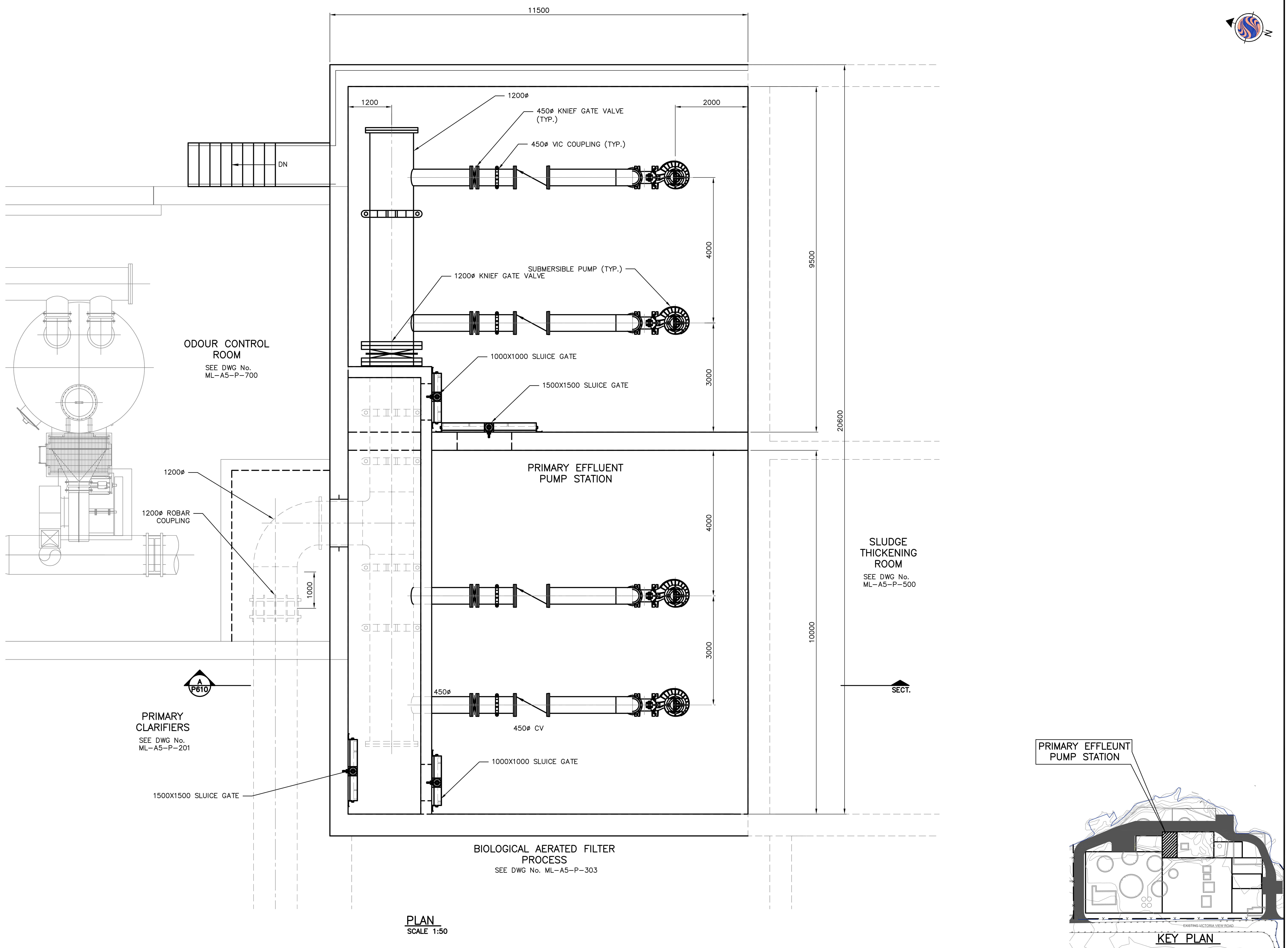
SCALE HORIZONTAL	1:50	CHECKED	PP
SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
BLOWER & PUMP ROOM AND SLUDGE TANKS
GENERAL ARRANGEMENT – SECTION

CONTRACT NUMBER	DRAWING NUMBER	ISSUE	SHT. No. OF
–	ML-A5-P-512	–	– OF –



PLAN
SCALE 1:50

Xrefs: ML-A5-effluent pump station-piping.DWG; ML-A5-effluent pump station.DWG; ML-A5-sludge thickening.DWG; ML-A5-baf.DWG; ML-A5-odour control rm.DWG; ML-A5-primary clarifiers.DWG; A1-CRD-TITLE.DWG;
Drawing: V:\1490\149009002\8_DRAWINGS\8-1_TREATMENT PLANT\5_PROCESS\ML-A5-P-600.DWG
January 13, 2011 11:31 a.m.

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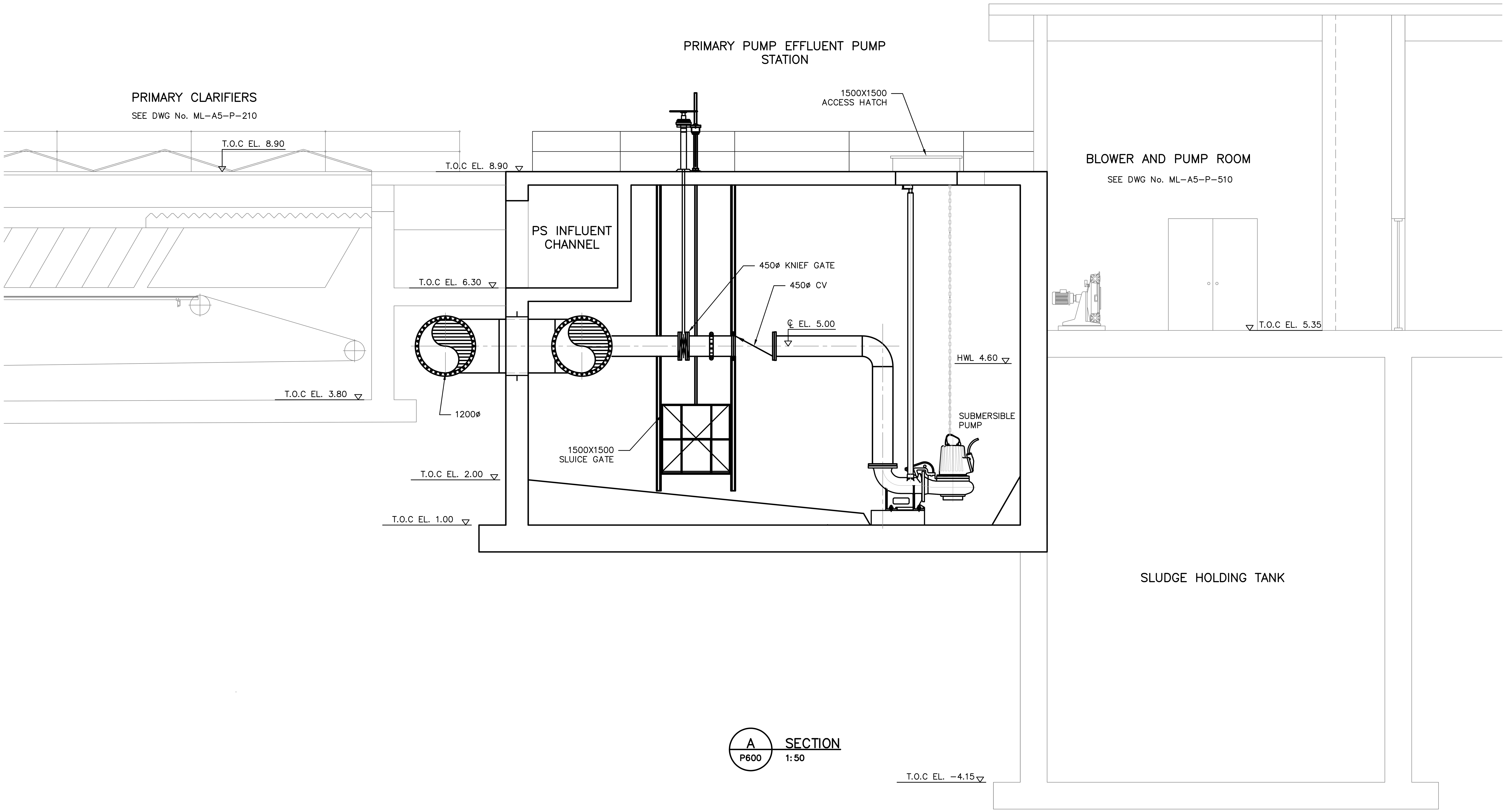
SCALE HORIZONTAL	1:50	CHECKED	PP
SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM
Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
PRIMARY EFFLUENT PUMP STATION
GENERAL ARRANGEMENT – PLAN

CONTRACT NUMBER	DRAWING NUMBER	ISSUE	SHT. No. OF
–	ML-A5-P-600	–	– OF –



A P600 SECTION 1:50

Xrefs: ML-A5-primary clarifiers.DWG; ML-A5-sludge thickening.DWG; ML-A5-effluent pump station-piping.DWG; ML-A5-effluent pump station.DWG; A1-CRD-TITLE.DWG;
Drawing: V:\1490\149009002\8_DRAWINGS\8-1_TREATMENT PLANT\5_PROCESS\ML-A5-P-610.DWG
January 14, 2011 8:04 a.m.

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SCALE HORIZONTAL	1:50	CHECKED	PP
SCALE VERTICAL	–	APPROVED	RAF

CORE AREA WASTEWATER TREATMENT PROGRAM

Mc LOUGHLIN PT. SITE
OPTION 1A-PRIME 2 (107.8 ML/D)
PRIMARY EFFLUENT PUMP STATION
GENERAL ARRANGEMENT – SECTIONS

CONTRACT NUMBER – | DRAWING NUMBER ML-A5-P-610 | ISSUE – | SHT. No. – OF –