APPENDICES

D) SANITARY SEWER FLOW ESTIMATES AND MODELING (RMC)

Technical Memorandum - DRAFT

Subject: **Alameda Point Sanitary Sewer Flow Estimates and Modeling**

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Date: June 28, 2013

This Technical Memorandum (TM) summarizes the results of hydraulic modeling of the proposed Alameda Point sewer system as developed for the Draft Alameda Pont Master Infrastructure Plan (MIP) prepared by Carlson, Barbee & Gibson (CBG) for the City of Alameda. The modeling was conducted pursuant to an agreement between RMC and the City of Alameda dated April 3, 2013. The purpose of the modeling work is to confirm the design wastewater flow projections for the proposed Alameda Point redevelopment and estimate the flows at interim stages of development. The information in this TM will also provide information for the assessment of downstream flow impacts to be addressed in the Alameda Point Draft Environmental Impact Report.

1 Model Network

The model of the proposed Alameda Point sewer system was developed in InfoWorks™ CS, the same hydraulic modeling software used for the City's system-wide Sanitary Sewer System Hydraulic Analysis (May 2010) previously prepared by RMC. The configuration and alignment of the proposed Alameda Point sewer system and the proposed land uses and their associated "load points" to the sewer network were provided by CBG in the form of an AutoCAD map showing the proposed sewer network, and an Excel spreadsheet listing the sewer network data (pipe diameters, lengths, slopes, rim and invert elevations) and associated loading (land uses) to each manhole in the network. The model only includes the "trunk system" network, i.e., smaller diameter pipes and manholes that were not indicated as loading nodes on the CBG map were not included in the model. CBG also provided information (approximate pumping capacities and wet well dimensions) as needed for modeling of the six proposed lift stations in the system.

The CBG map divides the system into "blocks" with associated land uses and acreages. Since some of these blocks load to more than one model node, those blocks were further subdivided as necessary to create individual "subcatchments" for model loading.

Figure 1 depicts the modeled sewer network. Note that all flow in both the existing and proposed Alameda Point sewer system is conveyed to the pump station owned and operated by the East Bay Municipal Utility District (EMBUD) on the north side of the site, from where the flow is pumped through a 20-inch force main to the inlet structure of EBMUD's Alameda siphons. The siphons, which convey all flow from the City of Alameda, cross the Oakland Estuary and connect to EBMUD's South Interceptor, which conveys flow to EBMUD's Main Wastewater Treatment Plant located near the eastern terminus of the San Francisco-Oakland Bay Bridge. Note that EBMUD's Alameda Point pump station, known as Pump Station R, is called Pump Station 1 in the MIP. See Figure 30 of the Draft MIP for a depiction of the off-site EBMUD wastewater conveyance facilities.

Figure 1: Alameda Point Proposed Sewer System - Modeled Network

J:\Projects\0232-009 Alameda Point Sewer Evaluation\G. GIS_MXD\AlamedaPoint_Overview.mxd

2 Model Scenarios

The development of Alameda Point is expected to take place in stages, with the portion identified as the “Development Area”, largely located on the eastern side of the site, being developed first with all new sewer infrastructure (see Draft MIP Figure 31). Development of the remainder of the site, called the “Reuse Area,” would proceed incrementally over time, initially making use of the existing infrastructure with some rehabilitation to address existing deficiencies and reduce infiltration/inflow (I/I) (see Draft MIP Figure 32). Ultimately, new sewer infrastructure would also be constructed in the Reuse Areas as well (Draft MIP Figure 33).

Accordingly, three modeling scenarios were analyzed for this TM:

- **Scenario A –** Full development in the Development Area with new sewer infrastructure conveying flow to Pump Station 1; existing uses in the Reuse Area utilizing existing sewer infrastructure but tying into major trunks constructed as part of the Development Area to convey flow to Pump Station 1.
- **Scenario B –** Scenario A plus additional development in the Reuse Area, but still utilizing existing sewer infrastructure with some rehabilitation to address deficiencies and reduce I/I.
- **Scenario C -** Full development and all new sewer infrastructure in both the Development and Reuse Areas.

Note that although there is existing mapping for the existing Alameda Point sewer system, there is not sufficient sewer attribute information (e.g., rim and invert elevations, etc.) to hydraulically model the system. Therefore, for Scenarios A and B, the Reuse Area model subcatchments were loaded at the nodes on the Scenario A new trunk system to which the flows from those subcatchments would ultimately be conveyed. This was considered a reasonable approximation for purposes of estimating the total flow in the system conveyed to Pump Station 1 under each scenario.

3 Model Loads

Flow inputs to the model are represented in terms of average base wastewater flow (BWF) for residential and non-residential land uses, groundwater infiltration rates, and rainfall-dependent I/I hydrograph parameters for each loading area, called “ subcatchments” in the model.

3.1 Base Wastewater Flow

Using the spreadsheet provided by CBG, the land uses loading to each subcatchment were quantified and converted to average BWF for residential and non-residential land uses. The unit flow rates as applied to the land use information were the same as those used for the City’s 2010 Hydraulic Analysis, except some flow was also allocated to parks. The average BWF unit factors are shown in **Table 1**.

In addition to the land use-based loads, the model also includes the proposed load from the proposed Veterans Affairs (VA) facility on the western end of the site (flows from the VA facility would be pumped east to the Alameda Point sewer system). CBG estimated the peak flow for the VA facility at 20,000 gallons per day (gpd). For purposes of the model, this was converted to an average BWF non-residential load of 12,000 gpd and was included in all three model scenarios.

Table 1: Average Base Wastewater Flow Unit Factors

Land Use	Zoning Designation	Unit	Average BWF Factor (gpd/unit)
Residential Reuse	RE	Dwelling unit	240
Very Low Density	R2	Dwelling unit	240
Single Family	R2	Dwelling unit	240
Office	O	Building square feet	0.1
Manufacturing/Warehouse	M	Building square feet	0.02
Retail	R	Building square feet	0.1
Service	S	Building square feet	0.5
Park	P	Each	3,000
Park w/Sports Complex	P	Each	45,000
VA Facility	VA	Each	12,000

The model computes the diurnal BWF for each subcatchment by applying diurnal profiles for residential and non residential uses, as shown in **Figure 2**. The non-residential diurnal profile was applied for parks and for the VA facility

3.2 Infiltration/Inflow

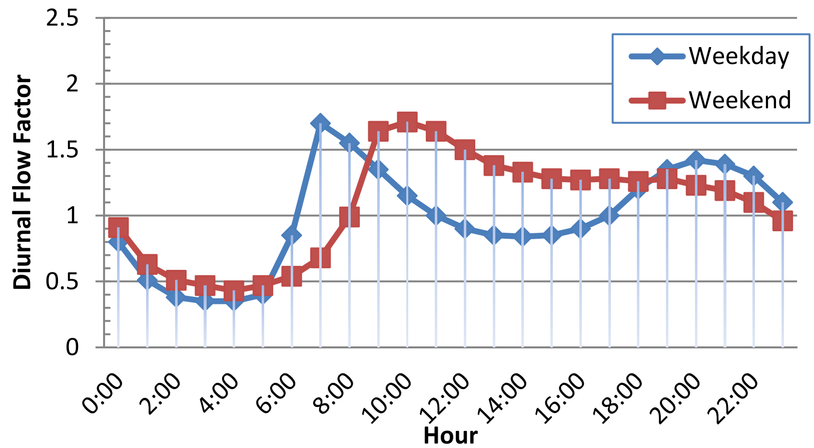
I/I flows include groundwater infiltration (GWI) and rainfall-dependent I/I (RDI/I). GWI is groundwater that enters the system from the ground through defects in sewer pipelines, manholes, and building laterals. GWI is typically greatest during the winter and early spring, and is represented as a constant flow during both non-rainfall and rainfall periods. RDI/I is stormwater that enters the sewer system through direct inflow connections (e.g., roof downspouts or area drains directly connected to the sanitary sewer system) or through infiltration through the soil to pipe and manhole defects. RDI/I is represented as a hydrograph that follows the pattern of rainfall, typically producing a peak flow response directly related to the rainfall intensity. For purposes of the analysis in this TM, I/I was quantified for a “design” condition assumed to represent maximum GWI and RDI/I for a 5-year design storm event falling under saturated soil conditions. The 5-year event is the specific storm event developed for EBMUD and its Satellite systems as part of studies conducted during the 1980s and known as the “EBMUD Design Storm” event.

Assumed I/I rates were based on the factors used for the City’s Hydraulic Analysis as well as existing flows developed by EBMUD as part of its Flow Modeling and Limits Report (FMLR) prepared in compliance with its Stipulated Order for Preliminary Relief with the U.S. EPA. The FMLR analyses were based on flow monitoring conducted by EBMUD during the 2009/10 and 2010/11 wet weather seasons in order to quantify flows from each area discharging to its interceptor system (called Interceptor Tributary Areas, or ITAs). The monitoring included a meter located on the influent pipe to Pump Station R (Pump Station 1), representing the existing flow from the Alameda Point area (identified by EBMUD as ITA 90-2). EBMUD also utilized winter water use data to help quantify base wastewater flows for the ITAs. Based on the FMLR analyses, the existing flows from ITA 90-2 were quantified as follows:

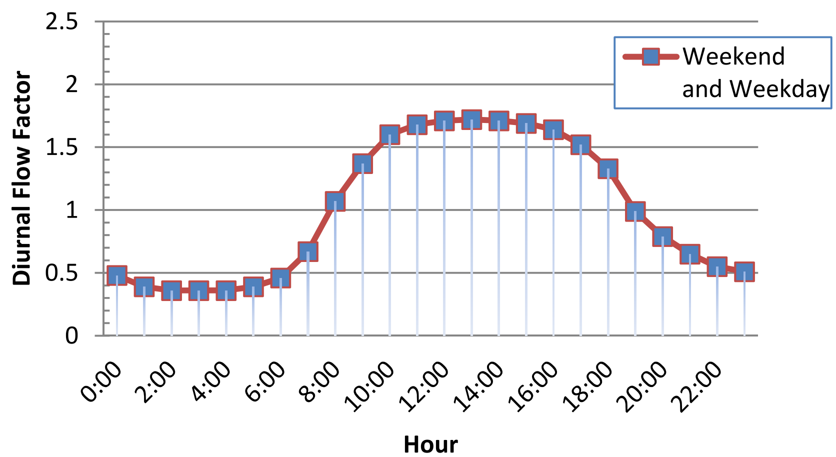
- Average BWF 0.20 mgd (~500 gpd/acre)
- Maximum GWI 0.27 mgd (~600 gpd/acre)
- Peak RDI/I (5-year design event) 1.32 mgd (~3,000 gpd/acre)

For purposes of modeling the flow contribution from the Reuse Area prior to redevelopment and construction of new sewer infrastructure, the existing BWF, GWI, and peak RDI/I flows were converted to unit flow rates (gpd/acre) based on the total Alameda Point non-park development acreage estimated by CBG (approximately 450 acres). The calculated unit flow rates (rounded up) are also shown above.

Figure 2: Base Wastewater Flow Diurnal Profiles



Residential BWF Profile



Non-Residential BWF Profile

Construction of new sewer infrastructure is expected to reduce I/I flows in the future. Under Scenario C, an assumed GWI rate of 300 pgd/acre was used, based on the value assumed for new development for the City's 2010 Hydraulic Analysis. For RDI/I, the rate documented in EBMUD's FMLR for a nearby, relatively newer area of the Alameda (ITA 90-3, which comprises the Marina Village area), was used. The 5-year design event peak RDI/I for this area was calculated to be approximately 1,000 gpd/acre.

For the Reuse Area under Scenario B, the following assumptions were made to reflect interim development and partial rehabilitation of the existing sewer infrastructure:

- BWF equivalent to 50 percent of buildout development
- GWI of 450 gpd/acre
- Peak RDI/I of approximately 2,000 gpd/acre

Note that for all scenarios, hydrograph parameters to represent the volume and rate of flow response to rainfall were developed for the model based roughly on those developed for the EBMUD FMLR. The parameters were set so as to generate the expected peak RDI/I rates noted above. Furthermore, as in the City's Hydraulic Analysis, the timing of the design storm was set to produce a peak RDI/I flow roughly coincident with the peak diurnal BWF.

4 Model Results

Table 2 summarizes the resultant flows to Pump Station 1 for each of the scenarios and for existing conditions. As indicated in the table, redevelopment of Alameda Point and construction of new sewer infrastructure is projected to result in a net 12 percent (0.23 mgd) increase in the design storm PWWF.

Table 2: Summary of Alameda Point Flows

Scenario	Alameda Point Flow to PS 1 (mgd)				
	Avg. BWF	Max. GWI	PDWF	Peak RDI/I	PWWF
Existing*	0.20	0.27	0.61	1.32	1.93
Scenario A	0.60	0.21	1.20	0.91	2.10
Scenario B	0.76	0.17	1.42	0.68	2.11
Scenario C	0.95	0.14	1.71	0.46	2.16
Overall change (mgd)	0.75	-0.13	1.10	-0.86	0.23
Overall change (%)	373%	-49%	180%	-65%	12%

* ABWF, Max. GWI, and Peak RDI/I from EBMUD FMLR for ITA 90-2
PDWF = Peak BWF + Max. GWI
PWWF = PDWF + Peak RDI/I