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MEMORANDUM

To:	Rob Holmlund (Humboldt Bay Harbor, Recreation, and Conservation District)
From:	Jeremy Patapoff
Date:	April 16, 2024
Subject:	Off-Site Drainage
Project:	Redwood Marine Multipurpose Terminal Replacement Project
Location:	Eureka, California
M&N Job No.:	212991-03
Cc:	Shane Phillips & Michael Jokerst Jared O'Barr and Cole Collins

Disclaimer: *This draft technical memorandum is a work-in-progress and is intended to be an internal document for use by the Humboldt Bay Offshore Wind Heavy Lift Marine Terminal Project team as a part of the conceptual design process and the ongoing permitting process. This memorandum is meant to be read as a part of a comprehensive packet of technical analyses. It is not written to be a standalone document and it is assumed that the reader has substantial project knowledge and context to understand the memorandum's content. All aspects of this memorandum are subject to change and may become less accurate over time. To better understand the project, please review the more comprehensive and up to date documents posted to the Humboldt Bay Harbor District's website at https://humboldtbay.org/humboldt-bay-offshore-wind-heavy-lift-marine-terminal-project-3.*

The purpose of this memorandum is to document Moffatt & Nichol's (M&N's) evaluation process that led to the selection of the sizes and quantities of pipes to provide storm water conveyance across the site, which is deemed necessary to maintain the natural flow paths of the off-site flow. This memorandum is organized as follows:

1. Introduction
2. Design Criteria
3. Off-Site Drainage Evaluation
4. Conclusion
5. Limitations
6. Next Phase Considerations

1. INTRODUCTION

The proposed Redwood Multi-Purpose Marine Terminal includes two wharves and a wet storage tie-up pier to meet the operational needs of a heavy-lift marine terminal facility to support the offshore wind energy industry and other coastal-dependent industries. The main function of the delivery wharf is to provide berthing, mooring, and offloading capabilities for the delivery vessels and launching of WTD foundations. The assembly berth's main functions include staging, and assembly of WTDs.

The "North Wharf" will be built in two phases. The first phase wharf will be 800 linear feet (LF) and will be wide enough to be able to accommodate a large crane that will be used for assembly of the Wind Turbine Devices (WTD). The second phase will extend the North Wharf 800 LF and would be used primarily as a delivery berth. The second wharf will be the "South Wharf," and will similarly be able to accommodate both delivery and assembly operations with a total length of 1600 LF. See Attachment 1 for permitted layout.

The roughly 170 acres of backland will be graded to provide protection against future sea level rise, provide laydown area for the windfarm components, be compacted to sustain the loads of the WTD components and cranes/SPMTs that move the components around, and provide positive drainage to the proposed stormwater collection facilities.

- Existing Off-Site Drainage Conditions

  The project site is bordered by the Town of Samoa, which currently consists of approximately 110 single-family houses to the north-west, 80 units of multi-unit housing to the south-west, and industrial sites and undeveloped land at various points along the project site. A ridge with slopes from west to east borders much of the west side of the project site, and the land to the east of this ridge drains toward the project site or onto Vance Ave, which borders the project site to the west. Additional areas have been identified as producing runoff that drains toward the project site. All areas draining toward the site have been broken up into six hydrology boundaries, see Attachment 2 for reference.

  There is a local low point adjacent to the west boundary of the north half of the project site where there are four drainage inlets which connect to a bay outfall location, as identified on an old photo atlas map, see Attachment 3 and Figure 1. It is unknown if this storm drain system is currently functioning, and eyewitness accounts have confirmed ponding at this location. A profile taken along the project site boundary has led to the assumption that much of the off-site drainage from the west flows toward this low point. There are other various high and low points along the project boundary, see Attachment 2 for locations, where off-site drainage currently either sheet flows or collects and discharges onto the project site. Additional off-site drainage infrastructure includes a culvert of unknown size and location in CM-1 that outfalls to the bay, and a pump station located in CM-2. Please refer to the "Access Road Technical Memo" and "Timber Heritage Site Technical Memo" by SHN for further information regarding existing off-site drainage conditions for CM-1 and CM-2, respectively.

FIGURE 1

- Proposed Off-Site Drainage Conditions

  Due to the proposed grading of the backland, off-site runoff is anticipated to collect and pool along low points of the project site boundary where it previously flowed across the project site, either ponding or discharging to the bay. To relieve drainage collection at certain points along the raised project boundary, 10-yr and 100-yr overflow pipes through the site are proposed. Drainage from catchment area 5 (CM-5) is currently collected by Vance Avenue and conveyed off-site, and these drainage conditions will be maintained in the proposed grading of Vance Ave. See "Access Road Technical Memo" by SHN for existing and proposed profiles for Vance Ave. Refer to the "Access Road Technical Memo" and "Timber Heritage Site Technical Memo" by SHN for further information regarding proposed off-site drainage conditions for CM-1 and CM-2, respectively.

  As part of the Great Redwood Trail Project, which will be developed by this project, the undeveloped rail property adjacent to the western boundary of the project will undergo conversion to a pedestrian and cycling trail. The proposed grading of the project site requires that the trail be raised up to 3.5 feet from current elevation, which will be achieved either by slope or retaining wall. The raised nature of the trail in addition to how the trail will be graded will have impacts on the off-site drainage design which have been evaluated at this phase of the design to require additional outfalls to the bay, but will need more detailed design during subsequent phases of the project.

2. DESIGN CRITERIA

Table 1 provides a summary of relevant stormwater design criteria.

Table 1 – Summary of Stormwater Design Criteria

Design Storm	10-yr with 100-yr overflow protection
Intensity (in/hr)	10-yr, 10-min with 100-yr, 10-min protection
Depth (in)	10-yr, 24-hr with 100-yr, 24-hr protection
Runoff Coeff	0.24 to 0.85
Time of Concentration	5 to 22 minutes
Min pipe slope flowing half full @ 3 fps	24" (0.0018 ft/ft), 36" (0.0011 ft/ft)
Max pipe capacity at min slope	24" (10.12 cfs), 36" (21.09 cfs)

3. OFF-SITE DRAINAGE EVALUATION

A hydrology map for the off-site area adjacent to the project was prepared as part of the Off-Site Drainage Plan based off the topography of the Town of Samoa. The catchment boundaries were delineated in the north-south direction, broken up by local high and low points and other topographical features that were assessed to cause storm runoff toward the project site. Six catchment areas were created.

The off-site areas were first evaluated for the 10-yr, 24-hr storm with a rainfall depth of 4.14-in as provided by NOAA14 data for the project location. Based on the project area, flow path distance, slope and runoff coefficient (see Table 3 for the former values) a volume and runoff rate were calculated for each subarea. Calculations were also performed for the 100-yr, 24-hr storm with a rainfall depth of 6.18-in. A summary of the volume and runoff rates is provided in Table 2.

Table 3 below provides a summary of the number of pipes necessary to relieve 10-year, 10-minute flow volumes as well as 100-year, 10-minute overflow volumes for each hydrology catchment area (CM). See

Attachment 2 for the preliminary locations of storm pipes, which have been placed at low points where runoff is anticipated to accumulate against the raised site boundary.

The pipe sizes were selected based on capacity requirements and constructability constraints. The 24-inch pipe, having less capacity than a 36-inch pipe, would require some catchment areas with higher flow volumes to have multiple pipes, while (1) 36-inch pipe would generally suffice to handle the capacity of the 10-year storm as well as the 100-year overflow volume in those areas. However, the project boundary elevation is low in comparison to the bay outfall elevations, which places constraints on pipe depth, pipe cover, and pipe drop. Due to these constraints, multiple 24-inch pipes are better suited for most locations, except for the storm drains in CM-4. To avoid using (5) 24-inch pipes in CM-4, (2) 36-inch pipes have been selected instead.

When performing flow volume calculations, the selection of the coefficient of runoff values were conservative to account for future developments by separate projects planned for the Town of Samoa.

Table 2 – Off-Site Volume and Runoff Summary

Subarea	10-yr		100-yr	
	Volume (cu-ft)	Runoff (cfs)	Volume (cu-ft)	Runoff (cfs)
1	36,082	11.60	64,267	17.94
2	66,127	10.25	109,268	18.05
3	38,697	10.90	68,168	18.58
4	184,957	22.6	309,029	41.4
5	55,076	7.37	94,896	13.63
6	24,141	4.4	36,796	6.63

* Values are based on preliminary subarea boundaries and will be refined in futures phases of design

Table 3 summarizes the number of pipes that will be necessary to convey each area's 10-yr and 100-yr flow volumes for various pipe sizes at the minimum required slope to maintain a velocity of 3 fps in the pipe. See Attachment 2 for flow path and area breakdowns. See Attachment 4 for coefficient of runoff (CN) calculations.

Table 3 – Pipe Number Evaluation Summary

Subarea (CM)	Area (acre)	Length (ft)	Slope	CN	Q10 (cfs)	Q100 (cfs)	No. Pipes Required (24" and 36" Scenarios)			
							24" Pipes (Q10, 0.2% Slope)	24" Pipes (Q100, 0.2% Slope)	36" Pipes (Q10, 0.11% slope)	36" Pipes (Q100, 0.11% slope)
1	5.41	284.0	0.03	0.24	11.60	17.94	2	0	1	0
2	7.68	855.0	0.01	0.46	10.25	18.05	2	0	1	0
3	5.60	390.8	0.06	0.27	10.90	18.58	2	0	1	0
4	22.34	1860.0	0.01	0.42	22.6	41.4	3	2	2	0
5	7.40	1908.0	0.01	0.33	7.37	13.63	NA	NA	NA	NA
6	2.00	194.0	0.02	0.85	4.4	6.63	1	0	1	0

* Dimensions, layout, and required number of pipes are preliminary and will be revised based on future site investigation data

The existing off-site low point condition has been approximated at EL 13’ at both the Timber Heritage Site and the Samoa Low Point (as identified in Figure 1) based on county lidar and contour data. This elevation is well above current sea level conditions, but below the site target elevation of 16’. If sea level rises above 13’ in the distant future (50+ yrs) any outfall pipes from Samoa risk flooding. It should be noted that this condition already exists and is not created by the proposed site.

4. CONCLUSIONS

Based on M&N assessment, it will be necessary to construct new storm drain systems to convey the off-site drainage from the town of Samoa to the bay to maintain existing drainage patterns would otherwise be blocked by raising project site.

Approximately 7 each 24” pipes and 2 each 36’ pipes are required to convey the offsite drainage volumes. These quantities and sizes have been determined as part of this schematic design phase and are based on the current known information of the site. As the project moves into the construction design phase the quantities and sizes of pipes may change.

5. LIMITATIONS

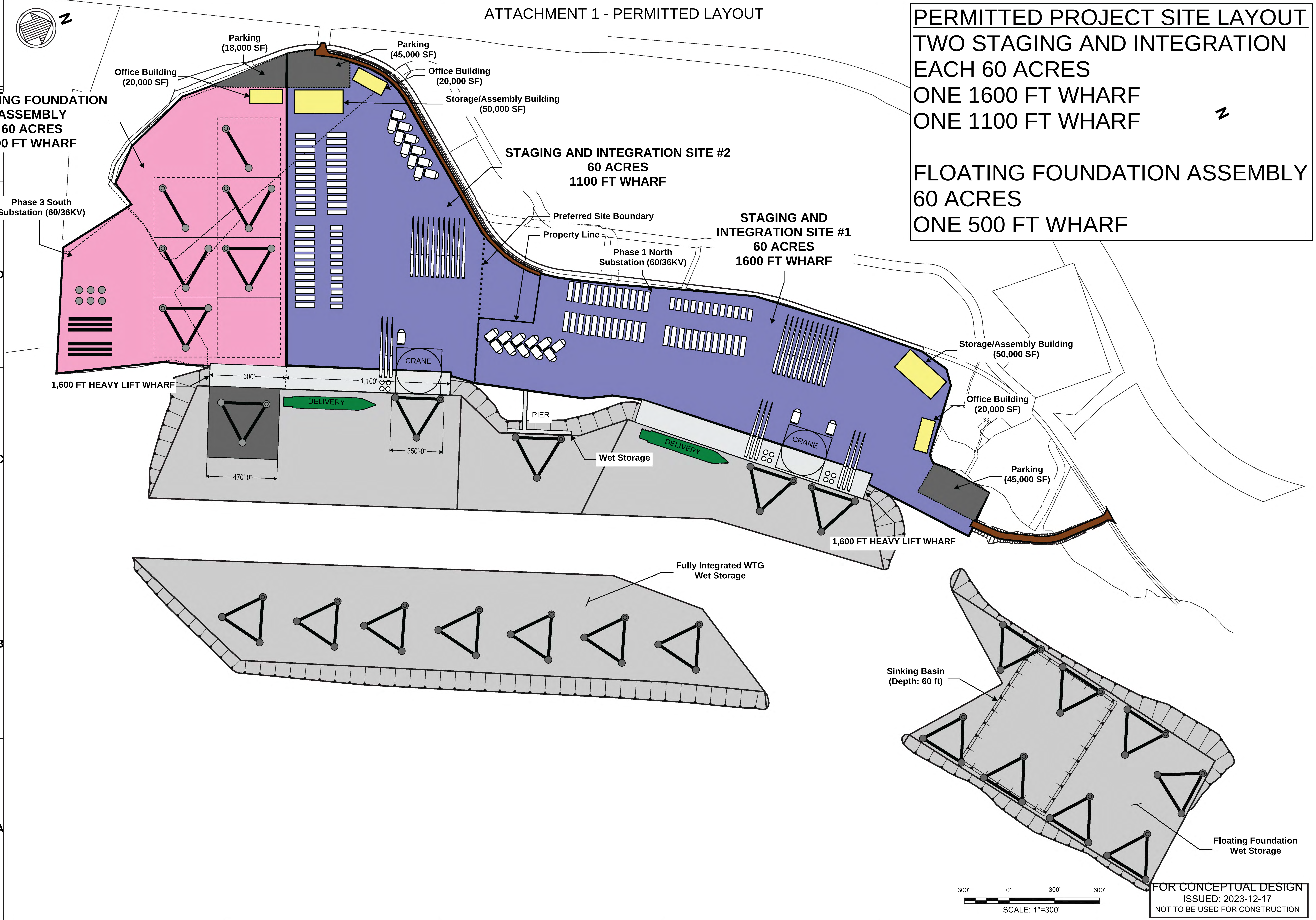
The purpose for the work conducted in this phase was to help advance a conceptual design for purposes of project planning, initiation of environmental permitting and regulatory processes, and to aid in development of an overall project narrative and budget estimate. This phase of work was limited by the off-site lidar information, which is not well suited for densely vegetated areas. Where lidar for off-site locations was unavailable, Humboldt County contours, which may be dated, were used to determine flow paths and topography along the project boundary. Additionally, information regarding existing drainage systems in the area was provided to M&N on a scan of a folded pdf (see Attachment 3), which may have resulted in inaccuracies. Additional off-site survey and analysis will be required in subsequent phases of work to refine and update the results and recommendations outlined in this memorandum.

6. NEXT PHASE CONSIDERATIONS

At the start of the next phase of work, the following are critical steps in the continuation of the planning, analysis, and design work:

- Conduct additional research and data collection for the current drainage situation of adjacent parcels for any information that may impact storm drain design, such as existing drainage easements and existing drainage infrastructure, and whether off-site drainage needs to be managed on a per-parcel basis.
- Determine if the rail right-of-way can be used as a drainage easement in CM-4 and CM-5 in the case that flow needs to be routed along the project boundary to a storm drain.
- Obtain a corridor of Vance Avenue to determine existing drainage.
- Obtain updated aerial and survey of the off-site area to aid in the further analysis and design of off-site drainage conditions and solutions.
- Obtain additional information about the existing grades of the Great Redwood Trail.
- Obtain more information regarding Nordic Aquafarm (CM-6). A portion of this parcel has been identified as draining toward a low point along the boundary of the project site, but more detailed topographical information is required to fully assess the situation.

ATTACHMENT 1 - PERMITTED LAYOUT



FOR CONCEPTUAL DESIGN
ISSUED: 2023-12-17
NOT TO BE USED FOR CONSTRUCTION

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

moffatt & nichol	1300 CLAY STREET, SUITE 350 OAKLAND, CA 94612
INSERT SUB-CONSULTANT OR CLIENT LOGO AND INFO HERE	

Designed by: DSGN		Date: DATE	Rev. REVNO
Dwn by: DRFT	Ckd by: CHKR	M&N Project No. 212991-03	
Reviewed by: REVR		Drawing code:	
Submitted by: SUBMITTER'S NAME MOFFATT & NICHOL		Drawing Scale: Plot scale: 1:1 (D SHEET)	

REDWOOD MULTIPURPOSE MARINE TERMINAL REPLACEMENT PROJECT

WATER SITE PLAN

Mark	Description	Date	Appr.

SEAL

DRAFT

Sheet Reference No.
CW100
INDEX: 22 OF 2

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Attachment 2 - Off-Site Drainage Plan

Off-Site Drainage from Adjacent Parcels

Parcel APN	Flow Type	Flow Direction
401-112-021-000	Self Contained	Away from project site
401-112-030-000	Surface Flow	Toward project site
401-031-039-000	Surface Flow	See Figure
401-323-001-000	Surface Flow	Toward project site
401-323-003-000	Surface Flow	Toward project site
401-031-077-000	Surface Flow	Toward project site
401-031-078-000	Surface Flow	Away from project site, excluding flow from CM-1

HMT Off-Shore Wind Facility - Off-Site Drainage

Catchment #	A (acre)	Q10 (cfs)	Q100 (cfs)
1	5.41	1.60	17.94
2	7.68	10.25	18.05
3	5.60	10.90	18.58
4	22.34	22.60	41.40
5	7.40	7.37	13.63
6	2.00	4.40	6.63

Attachment 3 - Existing Bay Outfall Locations

NOTES

1. PURPOSE: THE PURPOSE OF THIS WORMAP IS TO SHOW THE APPROXIMATE LOCATIONS OF EXISTING SEWER MAINS AND STORM DRAIN MAINS AND THE APPROXIMATE LOCATION OF A NEW SEWER LIFT STATION.
2. PROPERTY LINE INFORMATION: CALCULATED PROPERTY LINES ARE SHOWN, BASED ON BOOK 25 OF MAPS, PAGES 127 - 141.
3. UNDERGROUND DISCLAIMER: NO RESEARCH OR INVESTIGATION REGARDING UNDERGROUND PIPES, ELECTRIC LINES, OR OTHER SUBSURFACE FEATURES HAS BEEN PERFORMED. NO LIABILITY IS ASSUMED FOR ANY UNDERGROUND INFORMATION.
4. BEFORE ANY EARTHWORK IS PERFORMED ON SUBJECT PROPERTY, PROPERT OWNER IS ADVISED TO CONTACT UNDERGROUND SERVICES ALERT (USA) FOR ACCURATE LOCATION OF UNDERGROUND UTILITIES (800-227-2600).
5. THE EXISTING BARK FILTER SEWER TREATMENT FACILITY, SEWER LIFT STATIONS AND DRAIN INLETS (DI) ARE FROM AERIAL MAPPING BY 3D1 IN APRIL 2001.

LEGEND

PERMANENT EASEMENT FOR SANITARY SEWER PIPE LINE AND SEWER LIFT STATION

TEMPORARY EASEMENT FOR INGRESS AND EGRESS DURING CONSTRUCTION

CURVE TABLE

	RADIUS	DELTA	LENGTH
C1	1622.09	12°24'48"	351.43
C2	1622.09	4°12'19"	119.05
C3	1622.09	3°47'29"	107.34
C4	709.65	11°29'13"	142.27

Attachment 4 - CN Value Selection

Values Used for Calculation:

Land Use	C
Residential, Single family	0.3
Apartment Dwelling Area	0.6
Unimproved areas	0.2
Roofs	0.95
Asphalt Street	0.85
Bare packed soil, smooth	0.4
Woodlands	0.1

Value Source:

Land Use	C	Land Use	C
Business: Downtown areas Neighborhood areas	 0.70 - 0.95 0.50 - 0.70	***Lawns:*** Sandy soil, flat, 2% Sandy soil, avg., 2-7% Sandy soil, steep, 7% Heavy soil, flat, 2% Heavy soil, avg., 2-7% Heavy soil, steep, 7%	 0.05 - 0.10 0.10 - 0.15 0.15 - 0.20 0.13 - 0.17 0.18 - 0.22 0.25 - 0.35
Residential: Single-family areas Multi units, detached Munti units, attached Suburban	 0.30 - 0.50 0.40 - 0.60 0.60 - 0.75 0.25 - 0.40	***Agricultural land:*** *Bare packed soil* *Smooth *Rough *Cultivated rows* *Heavy soil, no crop *Heavy soil, with crop *Sandy soil, no crop *Sandy soil, with crop *Pasture* *Heavy soil *Sandy soil Woodlands	 0.30 - 0.60 0.20 - 0.50 0.30 - 0.60 0.20 - 0.50 0.20 - 0.40 0.10 - 0.25 0.15 - 0.45 0.05 - 0.25 0.05 - 0.25

The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment State Water Resources Control Board 5.1.3 FS-(RC) 2011

Industrial: Light areas Heavy areas	 0.50 - 0.80 0.60 - 0.90	*Streets:* Asphaltic Concrete Brick	 0.70 - 0.95 0.80 - 0.95 0.70 - 0.85
Parks, cemeteries	0.10 - 0.25	Unimproved areas	0.10 - 0.30
Playgrounds	0.20 - 0.35	Drives and walks	0.75 - 0.85
Railroad yard areas	0.20 - 0.40	Roofs	0.75 - 0.95

Note: The designer must use judgment to select the appropriate "C" value within the range. Generally, larger areas with permeable soils, flat slopes and dense vegetation should have the lowest "C" values. Smaller areas with dense soils, moderate to steep slopes, and sparse vegetation should assigned the highest "C" values.