Solar Renewable Energy Reuse Assessment

February 2024

Old Navy Dump/Manchester Laboratory Superfund Site, Manchester WA

Introduction

The Environmental Protection Agency (the EPA) Region 10 and the EPA Superfund Redevelopment Program sponsored a renewable energy assessment in 2023 to identify the potential for renewable energy generation at the Old Navy Dump/Manchester Laboratory Superfund Site (the Site) in Manchester, Washington.

Based on site research, document review and stakeholder discussions held in Fall 2023, this report outlines remedial features, inspection and maintenance requirements and suitability considerations to support renewable energy development at the Site.

Stakeholders Involved

The stakeholders listed below participated in reuse discussions via teleconference in 2023.

- EPA Region 10
- EPA Superfund Redevelopment Program
- EPA Facilities
- U.S. Army Corps of Engineers (USACE)
- National Renewable Energy Laboratory (NREL)

Fig. 1 Location of Manchester Laboratory in Manchester, WA.

Contents

Background and Site Context

Site Location

The 53 acre Old Navy Dump/Manchester Laboratory Site is located north of Manchester, Washington, along the western shore of Clam Bay in Puget Sound.

Site History

The Site has been under federal ownership since 1898. From the 1940s to the 1960s, the Navy used the Site for construction and repair of submarine nets and boats. A portion of the Site was also used as a firefighter training area and as a dump for waste generated at the Site.

Former firefighter training activities contaminated the soil with dioxins and petroleum hydrocarbons. The Navy dumped demolition debris and industrial waste, including asbestos, into a former tidal lagoon, causing contamination of soil, sediment, seeps and shellfish in Clam Bay with polychlorinated biphenyls (PCBs) and heavy metals[1].

Portions of the Site extend onto an adjacent state park, a Navy fuel supply depot, and the marine tidelands of Clam Bay. Clam Bay has been used primarily for recreational shell fishing and has been inhabited by the bald eagle and chinook salmon, federally threatened species designated under the Endangered Species Act. In the early 1970s, the EPA and the National Oceanic and Atmospheric Administration (NOAA) acquired portions of the property. The Site is currently occupied by an EPA owned and operated analytical laboratory facility and a NOAA fisheries research laboratory. This project focuses solely on northern portions of the Site owned by the EPA.

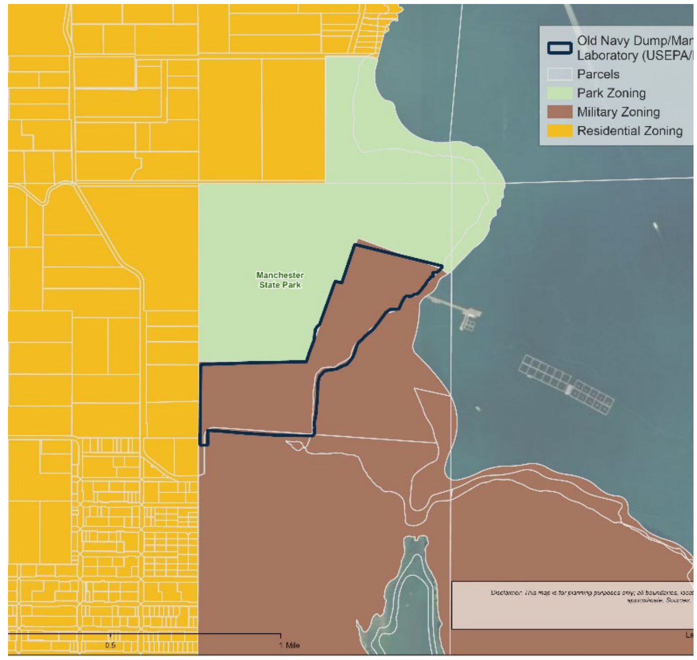

Fig. 2 Ownership and zoning of Manchester Laboratory and surrounding areas

Fig. 3 Location of landfill and laboratory

Site Remedial Status

In 1997, the EPA issued a Record of Decision (ROD) and a long-term cleanup plan to address contamination at the former firefighter training area (FFTA), landfill area and Clam Bay. It included removing contaminated soil and structures in the FFTA, constructing a landfill cap and shoreline protection system, placing clean sediment in the nearshore area and issuing a temporary ban on subsistence shellfish harvesting. The plan also included long-term monitoring.

The U.S. Army Corps of Engineers (USACE) constructed the remedy between 1999 and 2001. The Navy and the EPA completed a formal review of the effectiveness of the remedy in 2004 and concluded that the remedial

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[1] PFAS was not a Chemical of Concern (COC) at this site.

components achieved the intended goal of reducing risks to human health and the environment. Long-term monitoring at the Site is ongoing.

Remedy Features

Remedy features at the Site include:

- Excavation of landfill debris from Clam Bay intertidal zone and placement in the upland fill area prior to capping.
- Installation of a 30 inch cap on top of a Geocomposite layer to intercept and drain water.
- Construction of hydraulic cutoff system along the upgradient edge of the landfill area to divert captured water around the landfill.
- Construction of a stable shoreline protection system including spawning beach aggregate material (design fill).
- Placement of a thin layer (six inches) of clean sediment in the intertidal Clam Bay sediments which exceed cleanup levels (roughly five acres).

Institutional Controls

An Institutional Controls Plan (ICP) was completed by USACE in March 2012 with input from NOAA and the EPA. The plan includes three objectives: 1) to prevent human contact with total petroleum hydrocarbon (TPH) contaminated soils; 2) to protect the integrity of the landfill cap, hydraulic cutoff system, and shoreline protection system; and 3) to prevent human consumption of unsafe levels of contaminated shellfish.

The ICP outlines the following controls for the landfill cap, hydraulic cutoff system, and shoreline protection system:

- No excavation or drilling below the topsoil layer except for maintenance/repair.
- No construction unless it will not impact the integrity of the cap.
- No excavation of the shoreline protection system except for maintenance/repair.
- Inspection and maintenance of cap, hydraulic cutoff system, shoreline protection system in accordance with the I&M manual.
- Property will not be used for future residential uses.

Inspection and Maintenance Requirements

Inspection and maintenance at the Site are ongoing. This includes routine activities such as landscaping and non-routine repairs as needed. The landfill cap requires the following:

- Inspection for differential settlement, wet or saturated area, sloughing, tension cracks, bugling, erosion, exposure of geosynthetic materials, signs of burrowing animals, distressed grasses and volunteer plants with potential to establish deep root systems.
- Special attention to slope stability.
- Fill layer of at least 18 inches (survey monuments installed in July 2014).
- Six passive gas vents – three-inch diameter PVC pipe rising approximately one foot to two feet above the ground surface and terminating in an inverted "U."
- Inspection of laboratory access road (920 feet traverse cap) and service road (<50 feet traverse cap) overlying the cap for depression, cracking, debris and vegetation.

- Inspection of the perimeter surface ditch and swale drainage system for ponding, sloughing, erosion, signs of burrowing animals and distressed vegetation.
- Inspection of drainage ditches for excessive sediment or debris and annual flushing of perimeter drainage pipe with water.

Key Suitability Considerations

The landfill cap requires the following components:

- Vegetation (grasses and shrubs) planted in a 12 inch topsoil layer to resist wind and water erosion.
- 18 inch layer of clay.
- Geocomposite layer to intercept and drain water.
- 50 millimeter polyvinyl chloride (PVC) geomembrane.
- 12 inch granular vent and bedding layer.

Solar siting requires slope considerations for installation. This analysis assumes that only the landfill's top deck, which is minimally graded, will be used for the solar footprint. Other landfill cap system components that should be taken into consideration include the subsurface and perimeter drainage systems, hydraulic barrier wall for groundwater and passive venting system.

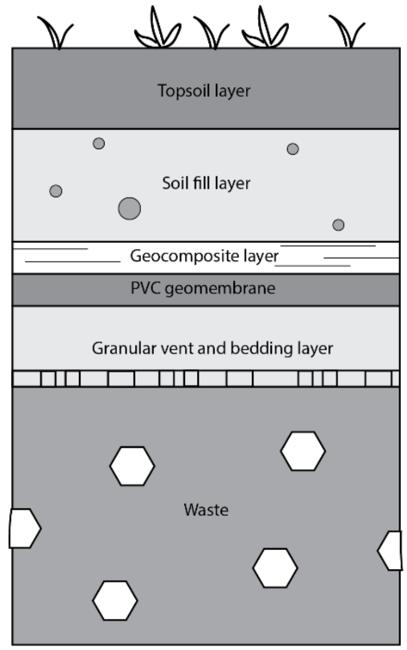

Fig. 4 Landfill cap diagram

Solar Suitability

Analysis to Identify Solar Footprints

The site team identified two potential solar footprints, shown in Figure 5: the landfill cap (A) and the parking lot (B). The team discussed but ruled out a third footprint, the shoreline protection system, because sea level rise projections show that the area near the shore will be impacted and may be the site of a berm in the future.

Solar Photovoltaic System Size Estimates

The approximate area available for each solar footprint is shown in Figure 5. The landfill cap is approximately 3.2 acres large, and the parking lot is approximately 2.7 acres. The parking lot is currently in use and therefore will not be entirely repurposed for solar. The calculations in this report are merely a demonstration of the maximum production capacity for each area. A detailed diagram of the landfill can be found in Appendix A.

Fig. 5 Potential solar footprints

Based on the available acreage of each footprint, the landfill has the capacity to generate an estimated 1868.3 kilowatts (kW) and the parking lot has the capacity to generate 1711.6 kW (Table 1).[2]

	Size (acres)	Estimated Capacity (kW)
Landfill	3.2	1868.3
Parking Lot	2.7	1711.6

Table 1: Estimated Capacity of Solar Footprints

Mounting Systems

Photovoltaic (PV) modules are held in place by mounting systems that are either directly anchored into the ground or ballasted above the surface. Mounting systems should be designed to withstand maximum local wind conditions. According to a 2023 Draft Climate Resilience Assessment report, the facility is in an area with estimated 78-80 mile per hour (mph) winds.[3] Depending on the region, snow and ice loads are also considered. For the Manchester Laboratory, a ballasted system could be used to support the PV project. Ballasted systems are compatible with multi-layer landfill cap systems. Construction includes placing a gravel bedding layer on top of the cap surface to create a level compact surface to support concrete ballast blocks. In some cases, minor excavations into the topsoil layer may be needed to accommodate ballast blocks as shown.[4]

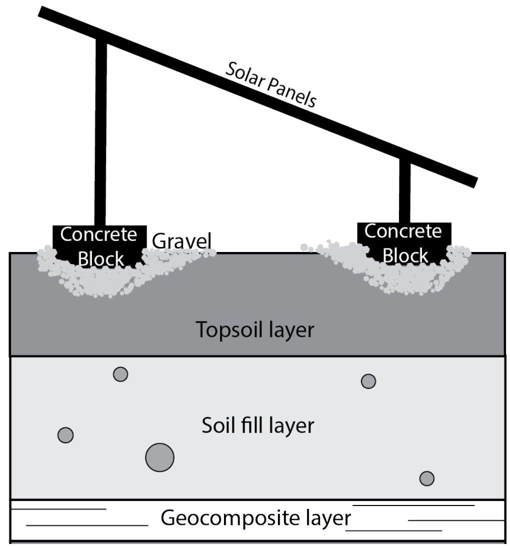

Fig. 6 Solar panel mounting system

Ballasted Systems

Ballasted systems are the most common anchoring method for PV systems on landfills. They typically consist of a flat tray or large concrete block placed on the landfill cap, with the array support structure attached. The weight of the ballast material prevents the PV system from shifting due to wind uplift and horizontal sliding. Ballasted systems do not penetrate the landfill cap and can provide good structural support for the PV array. Ballasted systems typically require either shallow excavation in the topsoil layer to establish gravel filled trenching or placement of gravel bedding on top of a vegetated cover. Shading from panels, gravel placement and trenching will likely alter vegetation management practices. Modified vegetated cover management, like the use of shade tolerant grass species and soil stability inspections at the footings, will likely need to be considered.

Fig. 7 Ballasted solar system. Source: NREL.

Stormwater Management

The PV project design should consider the interaction between the PV system components and the existing stormwater management system. The design of the stormwater management system, including the design storm, runoff and stage-storage calculations, should be understood before proceeding with the design of the solar project. The PV system will likely affect the operation of the existing stormwater management system because it will increase the area of impervious surface of the landfill and create changes in rainfall infiltration and runoff

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[2] Solar output estimates were modeled NREL pvWatts Calculator. https://pvwatts.nrel.gov/pvwatts.php.

[3] Draft Facility Climate Resilience Assessment Report. Manchester Environmental Laboratory. 2023.

[4] Best Practices for Siting Solar on Landfills. NREL. 2022.

patterns. The PV system design should include the necessary alterations to the stormwater management systems affected by the predicted changes in rainfall infiltration and runoff patterns. Design considerations could include the construction of drainage features, resizing detention ponds and upgrading stormwater treatment systems.[5]

Hazard Vulnerability

The Site is subject to flooding and high winds semi-frequently. A 2023 Draft Climate Resilience Assessment indicated that the Site is in an area that will be increasingly impacted by sea level rise, storm surge and wind speeds as climate changes.[6] Therefore, a PV project should consider hazard vulnerability of the Site.

Coastal Flooding – Flooding occurs at the Site with some frequency. The Federal Emergency Management Agency's (FEMA) projected coastal and inland flood maps show that sea level rise is likely to be a significant issue at the Site in the future. The landfill is in a low-lying shoreline area, likely to be impacted by rising tides. Additionally, the Site has a high likelihood of exposure to storm surge through 2052.

Wind Speeds – PV mounting systems should be designed to withstand maximum local winds, which range from 90-120 mph in most areas. The Site is in an area with estimated 78-80 mph winds. It is not in a hurricane-prone region. According to the American Society of Civil Engineers (ASCE) Hazard Tool, design wind speed for the Site ranges between 92-108 mph.[7] For ballasted systems, wind loading impacts the determination of the panel tilt angle. Designing a PV system to withstand local wind speed requires considerations related to array tilt angle, structural support and foundation systems. The design should also consider how alternatives for accommodating wind speed could impact landfill maintenance.[8]

Figs. 8 and 9 Photos of the landfill cap at Manchester Lab

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[5] Best Practices for Siting Solar on Landfills. NREL. 2022.
[6] Draft Facility Climate Resilience Assessment Report. Manchester Environmental Laboratory. 2023.
[7] ASCE Hazard Tool. American Society of Civil Engineers. https://asce7hazardtool.online/. 2023.
[8] Best Practices for Siting Solar on Landfills. NREL. 2022.

Renewable Energy Analysis

Building on the solar suitability analysis discussed above, the following pages evaluate the potential for solar renewable energy to help offset the Manchester Laboratory's electricity consumption. The information below includes utility billing analyses and potential solar project cost estimates to help inform future project decision-making.

Facility Electric Usage

The Manchester Laboratory's total annual energy consumption in fiscal year (FY) 2023 was 2,277,699 kilowatt hours (kWh). The total electrical costs to the Laboratory were $245,331.[9] The electricity usage and potential solar generation from the 3.2 acre landfill and 2.7 acre parking lot are outlined in Table 2.

Based on the utility billing records compiled and utilized in this analysis, the Manchester Laboratory purchased electricity at a blended rate of approximately $0.093/kWh. Table 2 lists monthly electricity consumption and cost data, along with estimated generation capacity for two potential solar PV project footprints (landfill and parking lot). Further analysis compared the electricity used at the facility to the generation capacity for a hypothetical solar project. This analysis predicts the percentage of the Manchester Lab's energy use that would be offset by a solar PV project. The potential solar generation was estimated using solar footprint sizes and National Renewable Energy Laboratory's (NREL) pvWatts calculator. Based on these estimates, panels have the potential to offset up to 171.6% of the lab's energy consumption. The landfill footprint alone has the potential to offset 89.5% of the lab's energy use. Based on the analysis above, the landfill area alone could potentially offset as much as 89.5% of the lab's annual electricity usage. A potential solar PV system could be installed at the Site and connected directly to the lab using a behind-the-meter connection. These estimates are approximate and intended for the purposes of preparing for a full renewable energy feasibility study.

	Electric Demand	Electric Costs	Potential Solar PV Footprint Capactiy Estimates			
Month	**Manchester Lab Total Consumption (kWh)**	**Manchester Lab Total Cost ($)**	**3.2 acre Landfill Solar Footprint (kWh)****	**2.7-acre Parking Lot Solar Footprint (kWh)**	**Total from All Areas (kWh)**	**% Load Offset*****
January	189,472	$ 21,530	66,833	61,227	128,060	67.6%
February	175,129	$ 21,605	114,329	104,740	219,069	125.1%
March	174,465	$ 21,392	177,440	162,557	339,997	194.9%
April	194,754	$ 21,793	215,937	197,826	413,764	212.5%
May	193,878	$ 21,047	238,809	218,779	457,588	236.0%
June	195,960	$ 21,145	244,362	223,867	468,228	238.9%
July	205,849	$ 19,617	268,193	245,699	513,892	249.6%
August	225,365	$ 21,600	261,719	239,768	501,487	222.5%
September	164,660	$ 16,694	195,597	179,192	374,789	227.6%
October	193,739	$ 19,962	119,802	109,754	229,555	118.5%
November	176,689	$ 19,311	72,547	66,463	139,010	78.7%
December	187,739	$ 19,634	64,331	58,935	123,266	65.7%
Annual	**2,277,699**	**$ 245,331**	**2,039,899.4**	**1,868,807.3**	**3,908,707**	**171.6%**

*** Manchester Lab consumption data based on 12-month electricity dataset provided by EPA facilities office on 9/13/23**
****Solar output estimates were modeled using estimated footprint sizes and NREL's pvWatts calculator**
***** Percentage of Manchester Lab facility's electricity usage that could potentially be offset by solar PV facilities at the site**

Table 1: Summary of Electricity Demands, Costs and Potential Solar Generation

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[9]Based on 12-month electricity dataset provided by the EPA facilities office on 9/13/23. Electrical usage data reported include blended costs. See Appendix B. Utility Billing Records.

Estimated Greenhouse Gas Reduction Potential

As a renewable source of energy, solar power helps to reduce greenhouse gas emissions and mitigate climate change. Solar panels generate electricity and avoid producing the greenhouse gas emissions that are released when fossil fuels are burned for electricity generation. The Manchester Laboratory uses 2,277,699 kWh of energy annually[10]. This amounts to 985 Metric Tons of Carbon Dioxide (CO_2) equivalent.[11] A potential solar PV system could generate more electricity than the Laboratory uses and could therefore reduce greenhouse gas emissions by at least 985 Metric Tons of Carbon Dioxide (CO_2) equivalent. Table 3 shows the estimated reduction in CO_2 that could be produced by solar power generation at the Site.

	3.2 acre Landfill Solar Footprint	2.7 acre Parking Lot Solar Footprint	Both Footprints
Generation Potential (kWh)*	2,039,899	1,868,807	3,908,707
Estimate of CO2 Reduction (metric ton equivalent)**	1,425	1,306	2,731
Solar output estimates were modeled using estimated footprint sizes and NREL's pvWatts calculator. **From: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator. Used generation potential, kWh avoided.*			

Table 3: Summary of Generation Potential and CO2 Reduction for Both Footprints

Potential Solar PV System Costs

Potential cost estimates associated with the potential solar PV footprints discussed are outlined in Table 4. The cost of solar PV development includes installation costs and annual costs of operations and maintenance (O&M). O&M includes inverter replacement, operations administration, module replacement, property tax and other factors.[12] Table 3 outlines the estimated costs for each solar footprint based on NREL's System Advisor Model (SAM). SAM costs are from the NREL Annual Technology Baseline (ATB) report. Combined, the footprints have an estimated installed cost of $4,653,870 and annual costs of $46,539.

Reuse Zone	Available Acreage (acres)	Estimated Capacity (kW)	Installed Costs ($1.30/Wdc)	Annual O&M Costs
Solar Footprint A (Landfill)	3.2	1868.3	$2,428,790.0	$24,287.9
Solar Footprint B (Parking Lot)	2.7	1711.6	$2,225,080.0	$22,250.8
Notes: *Based on System Advisor Model (SAM)* *Assumes that the installed costs = $1.30/Watts, Direct Current (Wdc) (includes 25% because of ballasted system) and annual O&M cost = $13/kilowatts (kW) per year*				

Table 4: Estimated Costs for Installation and O&M

[10] Based on 12-month electricity dataset provided by the EPA facilities office on 9/13/23. Electrical usage data reported include blended costs. See Appendix B. Utility Billing Records.

[11] Calculated using EPA's Greenhouse Gas Equivalencies Calculator. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[12] Best Practices for Siting Solar on Landfills. NREL. 2022.

Landfill Area Solar Footprint Considerations

Cost estimates calculated for Solar Footprint A above consider a 25% cost increase to account installation of solar arrays on ballasted, fixed axis mounting structures. Under these assumptions the installed costs are estimated at $1.30 Watts, Direct Current (Wdc). Annual system O&M costs, as noted above, are specific to maintenance of the solar PV system and infrastructure but do not include site O&M costs, such as vegetation maintenance.

Parking Area Solar Footprint Considerations

Fig. 10 Solar parking canopy. Source: Skeo Solutions.

The EPA has also identified potential surplus surface parking areas serving the Manchester Laboratory facility that could be utilized for solar. There are two options to consider for the parking area: solar canopies above the lot and direct installation into the asphalt. Solar canopies (or solar carports) could be used to mount solar panels. This option uses elevated structures that are installed over parking lots, providing shade while supporting solar generation. Solar canopies are more expensive than typical arrays due to the need for a dedicated structure. According to EnergySage, solar carport installation costs are approximately $3.31 per watt. The 2.7 acre 1711.6 kW laboratory parking lot would cost $5,665,396 to fully cover with a solar carport. Most solar canopy installations cover smaller areas; the average system size is 12.3 kW and costs $40,713.[13] Another alternative would be to install solar PV arrays directly into the asphalt using a fixed axis mounted on concrete blocks on top of the asphalt or anchored with driven piles.

[13] Energy Sage. Solar Carports Explained. https://www.energysage.com/solar/alternatives-to-rooftop-solar/what-is-a-solar-panel-carport/#comparing-commercial-and-residential-carports. 2023.

Key Considerations and Summary

This project evaluated two potential areas at the Site for solar renewable energy generation. The landfill solar footprint and parking lot solar footprint can produce enough power to offset the electricity costs of EPA's laboratory facility, and solar power at the Site could also potentially reduce the greenhouse gas emissions associated with the facility's current electricity usage. Preliminary costs are estimated for project design, installation and ongoing O&M and can serve as a starting point for evaluating the project's feasibility. Within the landfill footprint, ballasted solar arrays could be sited on top of the cap and designed for compatibility with the Site's remedy features and institutional controls. Solar panels in the parking lot footprint could be installed using a ballasted system or a solar canopy. Solar canopies are more expensive than typical arrays but allow the parking lot to be utilized to a greater extent.

Potential Next Steps

The Site would benefit from a more in-depth solar assessment. Additional solar reuse assessment recommendations are outlined below.

- Additional feasibility analysis prior to soliciting solar development proposals is warranted. Detailed cost analysis that includes evaluation of net present value of the investment under various scenarios, as well as potential return on investment and simple payback calculations would provide valuable data to support the financial feasibility of a solar project at the Site.
- Engineering analysis to refine the solar PV project siting are warranted and would likely include analysis of structural stability and potential for settlement, additional stormwater runoff volumes, wind shear and loading impacts, specific solar array layout and vegetation management modifications.

This report concludes the current regional support project funded by the EPA Superfund Redevelopment Program. EPA anticipates seeking additional resources and technical assistance to complete the next steps outlined above. For additional information, please see the EPA contacts listed.

Contact Information

Manchester Laboratory Site Profile:
www.epa.gov/superfund/old-navy-dump

EPA Region 10:
Patrick Hickey, Remedial Project Manager
hickey.patrick@epa.gov I (206) 553-6295

EPA Superfund Redevelopment Program:
Alexis Rourk, Manager
rourk.alexis@epa.gov | (202) 564-3179

Appendix A - Detailed Landfill Diagram

GENERAL NOTES:

1. AERIAL SURVEY INFORMATION – THE AERIAL TOPOGRAPHIC SURVEY WAS COMPLETED BY DEGROSS AERIAL MAPPING INC., BOTHELL, WASHINGTON. DATE OF AERIAL PHOTOGRAPH: SEPTEMBER 27, 2015
2. SUPPLEMENTAL SURVEY DATA – ADDITIONAL SURVEY DATA WAS PROVIDED BY PARAMETRIX, BREMERTON, WASHINGTON IN SEPTEMBER 27, 2015

SURVEY CONTROL DATA TABLE

POINT NO.	NORTHING	EASTING	ELEV.	DESCRIPTION
101	214485.37	1216769.12	16.33	CONTROL
102	214232.76	1217304.74	17.03	CONTROL
103	214144.97	1216132.54	28.20	CONTROL
204	213909.05	1216332.75	18.65	CONTROL
205	213758.57	1216769.96	16.75	CONTROL
106	213218.61	1215957.63	24.74	CONTROL
207	213471.65	1216548.27	16.46	CONTROL
208	213213.95	1216297.48	18.09	CONTROL

SURVEY UNITS - U.S. SURVEY FEET

HORIZONTAL DATUM - NAD 83/91 (2007 ADJUSTED), WASHINGTON STATE PLANE, NORTH ZONE

VERTICAL DATUM - MLLW (TIDAL BENCHMARK "SITAR RM1", PID# = SY0902)

TIDAL DATUMS - DATA TABLE

MEAN HIGHER HIGH WATER	MHHW	11.46 FT.
MEAN HIGH WATER	MHW	10.60 FT.
MEAN TIDE LEVEL	MTL	6.71 FT.
MEAN LOW WATER	MLW	2.82 FT.
NATIONAL GEODETIC VERTICAL DATUM	NGVD29	2.82 FT.
MEAN LOWER LOW WATER	MLLW	0.00 FT.

SOURCE: NOAA, STATION ID = 9445938, NOAA CHART = 18449
NAME = CLAM BAY, RICH PASSAGE, PUGET SOUND, WASHINGTON

Digitally signed by James R. Dickson
Date: 2016.02.05 11:44:14 -06'00'

SCALE 0' 30' 60' 120'

IF SHEET MEASURES LESS THAN 22" X 34" IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY.

US Army Corps of Engineers
Seattle District

02/05/2016

FINAL

U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

CONSTRUCTION AS-BUILT DRAWINGS
HARD POINT RE-ALIGNMENT

AS BUILT SITE PLAN WITH 2015 AERIAL PHOTO

MANCHESTER PN# P2 149703 WASHINGTON

Plate number: 2

Sheet 2 of 8

Appendix B – Utility Billing Records

Fiscal Year	Fiscal Quarter	Month	Account #200002268163 (kWh)	Account #200002268163 ($)	Account #200020288557 (kWh)	Account #200020288557 ($)	Account #200010144729 (kWh)		Account #200010144729 ($)	Account #200001717186 (kWh)	Account #200001717186 ($)	Account #200000599296 (kWh)	Account #200000599296 ($)	Account #200016577807 (kWh)	Account #200016577807 ($)	Account #200011212574 (kWh)	Account #200011212574 ($)	Account #200013034414 (kWh)	Account #200013034414 ($)	Account #200006022566 (kWh)	Account #200006022566 ($)	Account #200004268906 (kWh)	Account #200004268906 ($)	Account #200007644970 (kWh)	Account #200007644970 ($)	Total Consumption (kWh)	Total Cost ($)
			Meter #P17164460	Meter #P17164460	Meter #U01242799	Meter #U01242799	Meter #U12427989		Meter #U1242798	Meter #P16633813	Meter #P16633813	Meter #U01425772	Meter #U01425772	Meter #U02562693	Meter #U02562693	Meter #B03938477	Meter #B03938477	Meter #J0631478	Meter #J0631478	Meter #P17164460	Meter #P17164460	Meter #Z0118039	Meter #Z0118039	Meter #U01242794	Meter #U0124279		
FY 2023	2	January	152,700	$ 16,381.83	2,341	$ 281.27	971	1	$ 153.43	0	$ 25.95	5,560	$ 653.99	0	$ 10.21	1,100	$ 137.57	6,440	$ 755.89	6,080	$ 729.92	14,280	$ 2,390.16	0	$ 10.21	189,472	$ 21,530.43
FY 2023	2	February	140,700	$ 16,555.52	1,481	$ 190.38	998	2	$ 162.98	0	$ 25.95	5,800	$ 715.67	0	$ 10.21	870	$ 116.02	6,760	$ 832.42	5,960	$ 750.85	12,560	$ 2,234.74	0	$ 10.21	175,129	$ 21,604.95
FY 2023	2	March	138,900	$ 16,204.93	1,845	$ 235.00	590	3	$ 113.49	0	$ 25.95	5,080	$ 629.25	0	$ 10.21	770	$ 104.04	6,960	$ 858.35	5,760	$ 727.84	14,560	$ 2,473.09	0	$ 10.21	174,465	$ 21,392.36
FY 2023	3	April	159,600	$ 16,942.04	1,249	$ 159.40	715	4	$ 126.97	0	$ 25.95	4,400	$ 535.59	0	$ -	870	$ 114.08	7,160	$ 865.16	5,560	$ 689.84	15,200	$ 2,323.73	0	$ 10.21	194,754	$ 21,792.97
FY 2023	3	May	173,100	$ 18,225.86	885	$ 111.57	163	5	$ 60.22	0	$ 25.95	2,200	$ 262.29	0	$ 10.21	410	$ 57.18	3,920	$ 459.35	4,320	$ 520.93	8,880	$ 1,303.71	0	$ 10.21	193,878	$ 21,047.48
FY 2023	3	June	177,600	$ 18,153.44	729	$ 93.12	161	6	$ 59.85	0	$ 25.95	2,440	$ 287.68	0	$ 5.21	150	$ 27.27	3,440	$ 401.41	4,440	$ 530.87	7,000	$ 1,549.66	0	$ 10.21	195,960	$ 21,144.67
FY 2022	4	July	192,956	$ 18,065.96	742	$ 88.78	137	7	$ 53.43	0	$ 25.95	1,360	$ 154.26	17	$ 12.02	60	$ 16.57	1,840	$ 205.11	3,137	$ 358.21	5,600	$ 626.40	0	$ 10.21	205,849	$ 19,616.90
FY 2022	4	August	211,800	$ 19,974.19	701	$ 84.48	141	8	$ 53.85	0	$ 25.95	1,680	$ 188.16	3	$ 10.53	80	$ 18.70	1,440	$ 162.74	4,800	$ 534.40	4,720	$ 536.45	0	$ 10.21	225,365	$ 21,599.66
FY 2022	4	September	153,000	$ 15,265.39	633	$ 77.27	137	9	$ 53.43	0	$ 25.95	1,360	$ 154.26	0	$ 10.21	690	$ 83.31	1,640	$ 183.94	3,840	$ 432.72	3,360	$ 397.43	0	$ 10.21	164,660	$ 16,694.12
FY 2023	1	October	174,600	$ 17,522.29	654	$ 81.79	132	10	$ 53.60	0	$ 25.95	2,520	$ 285.96	0	$ 10.21	150	$ 26.62	2,400	$ 272.82	4,680	$ 538.07	8,603	$ 1,134.43	0	$ 10.21	193,739	$ 19,961.95
FY 2023	1	November	147,300	$ 15,175.53	1,498	$ 175.74	124	11	$ 52.85	0	$ 25.95	6,320	$ 708.59	0	$ 10.21	90	$ 20.15	5,080	$ 571.55	5,560	$ 640.34	10,717	$ 1,920.24	0	$ 10.21	176,689	$ 19,311.36
FY 2023	1	December	147,300	$ 14,437.30	1,462	$ 171.76	707	12	$ 117.26	0	$ 25.95	7,000	$ 783.72	0	$ 10.21	1,070	$ 128.45	7,240	$ 810.24	6,640	$ 759.67	16,320	$ 2,379.29	0	$ 10.21	187,739	$ 19,634.06
12-Month Total:			*1,969,556*	*$ 202,904.28*	*14,220*	*$ 1,750.56*	*4,976*		*$ 1,061.36*	*0*	*$ 311.40*	*45,720*	*$ 5,359.42*	*20*	*$ 109.44*	*6,310*	*$ 849.96*	*54,320*	*$ 6,378.98*	*60,777*	*$ 7,213.66*	*121,800*	*$ 19,269.33*	*0*	*$ 122.52*	*2,277,699*	*$ 245,330.91*

*** Manchester Lab consumption data based on 12-month electricity dataset provided by EPA facilities office on 9/13/23**