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# Application for Certification
(15-AFC-01)

## Puente Power Project (P3)
Oxnard, CA

## Responses to City of Oxnard Data Requests Set 4


December 2015

Submitted to:
**The California Energy Commission**

Prepared by: sierra research AECOM

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## RESPONSES TO CITY OF OXNARD DATA REQUESTS SET 4



**TABLES**



**FIGURES**



**APPENDICES**

## LIST OF ACRONYMS AND ABBREVIATIONS USED IN RESPONSES

| | |
|---|---|
| AFC | Application for Certification |
| Cal-EMA | California Emergency Management Agency |
| CARB | California Air Resources Board |
| CEC | California Energy Commission |
| JALBTCX | Joint Airborne LiDAR Bathymetry Technical Center of Expertise |
| CIRGIS | Channel Islands Regional GIS Collaborative |
| FEMA | Federal Emergency Management Agency |
| GE | General Electric |
| GEV | generalized extreme value |
| LiDAR | Light Detection and Ranging |
| MGS | Mandalay Generating Station |
| OCP | Ocean Protection Council |
| NAVD88 | North American Vertical Datum of 1988 |
| NOAA | National Oceanic and Atmospheric Administration |
| OCM | Office for Coastal Management |
| OEHHA | Office of Environmental Health Hazard Assessment |
| P3 | Puente Power Project |
| SAFRR | Science Application for Risk Reduction |
| SLR | sea-level rise |
| USACE | United States Army Corps of Engineers |
| USGS | United States Geological Survey |

**Technical Area:** Air Quality

## BACKGROUND:

The applicant has substantially revised the air quality and public health analysis to address new information obtained from GE related to emissions from the proposed new turbine, including new gas turbine performance runs that will impact emissions of all pollutants and new exhaust parameters, which will impact all air quality modeling. Please provide the requested information regarding these changes.

## DATA REQUEST

**80.** ***The OEHHA guidelines for performing health risk assessments were amended in March 2015 to reflect advances in the field of risk assessment including new more conservative methods to accommodate infants and children and their associated inhalation rates. Please indicate whether these new guidelines have been incorporated into the revised health risk assessment.***

## RESPONSE

As discussed in the Applicant's November 30, 2015, Responses to California Energy Commission (CEC) Data Request Set 2 (TN# 206791, Appendix 49-1, Section 4.9), the revised Puente Power Project (P3) Screening-Level Health Risk Assessment was performed using the latest version of the California Air Resources Board's (CARB's) HARP2 model (version 15197). This version of the HARP2 model was developed by CARB to implement the updated risk assessment procedures discussed in the Office of Environmental Health Hazard Assessment's (OEHHA's) Air Toxics Hot Spots Program *Guidance Manual for the Preparation of Risk Assessments*, February 2015 (adopted on March 6, 2015). The risk assessment procedures incorporated in the HARP2 model include the OEHHA updates to the methodology for deriving cancer-potency factors, and adjusting cancer potency to account for the increased sensitivity of early-in-life exposure to carcinogens.

## DATA REQUEST

**81.** ***The applicant's November 30, 2015 responses to CEC Date Request Set 2 states that the applicant altered the air quality and public health modeling "due to new information received from the gas turbine vendor [GE]." Please provide all new information that the applicant received from GE regarding the gas turbine emissions, including, but not limited to, an explanation of the revised particulate matter emission rate as stated in GE's October 28, 2015 letter.***

## RESPONSE

As discussed in the Applicant's November 30, 2015, Responses to CEC Data Request Set 2 (TN# 206791), the new information from General Electric (GE) for the 7HA.01 combustion turbine generator comprises an October 28, 2015, letter from GE regarding a new lower maximum particulate hourly emission rate (Appendix 49-1, Table C-2.3, Revised November 18, 2015), and a set of updated gas turbine performance runs (Appendix 49-1, Table C-2.1, Revised November 18, 2015). The Applicant does not have any further explanation for this information other than to say that it represents the most up-to-date data currently available from GE for the 7HA.01 combustion turbine generator proposed for P3.

## DATA REQUEST

**82.** ***The November 30 responses updated the emission calculations and modeling used to support the application. Please provide all correspondence, notes of conversations, and any other communications between the applicant and Sierra Research and/or GE regarding the emission information and air quality and public health modeling that is currently used to support the application.***

## RESPONSE

As discussed in the response to Data Request 81, the Applicant's November 30, 2015, Responses to CEC Data Request Set 2 includes a copy of an October 28, 2015, letter from GE regarding a new lower maximum particulate hourly emission rate, and a set of updated gas turbine performance runs. The new gas turbine performance runs were generated by the NRG Engineering Group by accessing GE's proprietary GTP Website, and running GE's proprietary Cycle-Deck gas turbine performance model for the 7HA.01 combustion turbine generator proposed for P3. There are no other communications between the Applicant, Sierra Research, and/or GE regarding the revised gas turbine emissions and revised air quality/public health modeling discussed in the Applicant's November 30, 2015, Responses to CEC Data Request Set 2.

**Technical Area:** Environmental Hazards

## BACKGROUND: TSUNAMI INUNDATION AND SEA-LEVEL RISE

The City's Data Requests, Set 2 requested that the applicant provide additional information related to sea level rise, tsunami, and other coastal hazards which threaten the project site. On October 8 and November 6, 2015, the applicant submitted responses to these requests. The following data requests seek additional information and clarification regarding the applicant's initial responses to the City's data requests for the environmental hazards analysis.

## DATA REQUEST

**83.** ***Applicant's Table 56-1 contains records of dredging operations at Ventura Harbor. The beach width in front of the Mandalay Generating Station is influenced not just by upcoast sediment supply from Ventura Harbor dredging, but also by downcoast dredging operations at Channel Islands Harbor. Please update Table 56-1 to provide records of dredging at Channel Islands Harbor.***

## RESPONSE

In concept, downcoast dredging can impact beach width upcoast. However, the impact diminishes with distance upcoast from the location of the dredging. The beach width as estimated from the historical aerial photographs shown in Figure 89-1 has not indicated any impact at Mandalay Beach from dredging at Channel Island Harbor. As requested, the available records of dredging at Channel Islands Harbor are summarized in Table 83-1.

**Table 83-1 (Updated Table 56-1)**
**Volume of Material Dredged from Ventura and Channel Island Harbors and Sediment Discharged from the Santa Clara River**

| Year | Volume Dredged from Ventura Harbor[1, 2] (cubic yards) | Volume Dredged from Channel Islands Harbor[1] (cubic yards) | Sediment Discharged from Santa Clara River[3] (cubic yards) |
|---|---|---|---|
| 1960 | NA | 5,335,450 | NA |
| 1961 | NA | 0 | NA |
| 1962 | NA | 0 | NA |
| 1963 | NA | 2,000,000 | NA |
| 1964 | 191,000 | 0 | 8,877 |
| 1965 | 180,000 | 3,526,668 | 24,166 |
| 1966 | 143,000 | 0 | 2,600,577 |
| 1967 | 239,000 | 0 | 953,824 |
| 1968 | 257,000 | 1,620,000 | 29,098 |
| 1969 | 1,883,000 | 2,824,000 | 24,436,445 |
| 1970 | 325,000 | 0 | 326,490 |
| 1971 | 1,113,000 | 2,407,000 | 747,672 |

**Table 83-1 (Updated Table 56-1)**
**Volume of Material Dredged from Ventura and Channel Island Harbors and Sediment Discharged from the Santa Clara River (Continued)**

| Year | Volume Dredged from Ventura Harbor[1, 2] (cubic yards) | Volume Dredged from Channel Islands Harbor[1] (cubic yards) | Sediment Discharged from Santa Clara River[3] (cubic yards) |
|---|---|---|---|
| 1972 | 17,000 | 0 | 165,218 |
| 1973 | 1,193,820 | 2,500,000 | 2,499,966 |
| 1974 | 420,000 | 0 | 454,226 |
| 1975 | 160,000 | 1,809,523 | 416,250 |
| 1976 | 152,000 | 0 | 98,637 |
| 1977 | 911,000 | 2,370,000 | 16,768 |
| 1978 | 496,000 | 0 | 14,458,772 |
| 1979 | 1,021,500 | 1,980,244 | 997,718 |
| 1980 | 320,000 | 0 | 5,391,524 |
| 1981 | 812,900 | 1,522,699 | 112,940 |
| 1982 | 1,186,000 | 0 | 130,201 |
| 1983 | 1,427,000 | 1,260,553 | 11,214,093 |
| 1984 | 1,332,900 | 0 | 118,858 |
| 1985 | 0 | 1,850,000 | 14,302 |
| 1986 | 910,000 | 0 | 1,565,870 |
| 1987 | 363,100 | 1,993,956 | 493 |
| 1988 | 800,000 | 0 | 128,229 |
| 1989 | 230,314 | 1,720,000 | 493 |
| 1990 | 217,913 | 0 | 2,959 |
| 1991 | 377,183 | 1,429,157 | 869,489 |
| 1992 | 524,702 | 0 | 3,652,545 |
| 1993 | 486,478 | 1,100,000 | 11,798,520 |
| 1994 | 470,000 | 0 | NA |
| 1995 | 271,357 | 876,666 | NA |
| 1996 | 833,000 | 0 | NA |
| 1997 | 449,128 | 1,309,000 | NA |
| 1998 | 741,975 | 1,638,018 | NA |
| 1999 | 639,173 | 1,117,406 | NA |
| 2000 | 818,477 | 0 | NA |

**Table 83-1 (Updated Table 56-1)**
**Volume of Material Dredged from Ventura and Channel Island Harbors and Sediment Discharged from the Santa Clara River (Continued)**

| Year | Volume Dredged from Ventura Harbor[1, 2] (cubic yards) | Volume Dredged from Channel Islands Harbor[1] (cubic yards) | Sediment Discharged from Santa Clara River[3] (cubic yards) |
|---|---|---|---|
| 2001 | 624,931 | 1,222,934 | NA |
| 2002 | 669,749 | 0 | NA |
| 2003 | 669,566 | 2,050,116 | NA |
| 2004 | 578,357 | 0 | NA |
| 2005 | NA | NA | 6,000,000[4] |
| 2006 | NA | NA | NA |
| 2007 | NA | NA | NA |
| 2008 | 355,000 | NA | NA |
| 2009 | 379,000 | NA | NA |
| 2010 | 386,000 | NA | NA |
| 2011 | 316,000 | NA | NA |
| 2012 | 227,000 (USACE)<br>273,000 (local sponsor) | NA | NA |
| 2013 | 240,000 | NA | NA |
| 2014 | 440,000 | NA | NA |
| 2015 | 780,000 | NA | NA |

Notes:

1 Ventura Harbor and Channel Island Harbor dredging volumes for 1964-2004 from Patsch and Griggs, 2007.

2 Ventura Harbor dredging volumes for 2008-2015 from personal communication with the U.S. Army Corps of Engineers (USACE; see Appendix 56-1).

3 Santa Clara River sediment discharge volumes based on metric tonnes from Warrick, 2002, converted to cubic yards per year. Sediment discharge records are available starting in 1928; however, to be consistent with data available for Ventura Harbor dredging, only data for the Santa Clara River starting in 1964 are included in this table. Other than episodic reporting, sediment discharge data collection ceased after 1993.

4 Source: Patsch and Griggs, 2007.

NA = not available

## Reference

Patsch, Kiki, and Gary Griggs, 2007. Development of Sand Budgets for California's Major Littoral Cells. January. Available online at: http://www.researchgate.net/publication/240635473_LITTORAL_CELLS_AND_SAND_BUDGETS_ALONG_THE_COAST_OF_CALIFORNIA_Proposal_to_the_California_Coastal_Sediment_Management_Working_Group_And_California_Department_of_Boating_and_Waterways.

## DATA REQUEST

**84.** ***In response to the City's Data Request 48, the applicant provided hyperlinks to LiDAR information that was used in the sea level rise technical memorandum. Please indicate the date and time of the LiDAR data used in this analysis. Additionally, one provided hyperlink http://coast.noaa.gov/dataviewer/index.html?action=advsearch&qType=in&qFld=ID&qVal=2612 produces an error message. Please provide a working hyperlink.***

## RESPONSE

The most current Light Detection and Ranging (LiDAR) data and bathymetry data, published in 2013, can be obtained from the following link:

https://www.coast.noaa.gov/dataviewer/#

Applicant merged recent topographic, bathymetric, and acoustic elevation data from approximately the 10-meter elevation contour out to California's 3-mile State Water boundary. Metadata for the LiDAR data are provided below.

Topographic LiDAR: The topographic LiDAR data used are from the 2009-2011 California Coastal Conservancy LiDAR Project. The data were collected between October 2009 and August 2011 under a joint effort by the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management (OCM); the California State Coastal Conservancy Ocean Protection Council (OPC); Scripps Institution of Oceanography; and the Joint Airborne LiDAR Bathymetry Technical Center of Expertise (JALBTCX). The data coverage extends landward 500 meters from the shoreline, along the entire California coastline. The LAS (LASer) is a public file format for 3-dimensional point-cloud data) classifications, are as the following: 1-Unclassified, 2-Ground, 7-Noise, 9-Water, 10-Mudflats, and 12-Overlap. The LAS points were manually re-classified from water, and unclassified to ground in offshore areas, where necessary.

Bathymetric LiDAR: The bathymetric LiDAR data used are from the 2009-2010 U.S. Army Corps of Engineers (USACE) JALBTCX LiDAR, provided by JALBTCX. The data were collected for the California Coastal Mapping Project. The original data were in ASCII format, and were converted to LAS v1.2. The LAS data were classified as follows: 21-Non-submerged Bathymetry, 22-Bathymetry, and 23-Ignored Submerged Bathymetry/Overlap.

Multi-beam Acoustic Data: The acoustic data used are from the California Seafloor Mapping Program Ocean Protection Council and NOAA's National Geophysical Data Center. The original data were in ASCII format and were converted to LAS v1.2. NOAA's VDatum software was used to vertically transform soundings from mean lower low water tidal datum to North American Vertical Datum of 1988 (NAVD88) orthometric datum, where necessary. The LAS data were classified as follows: 25-Submerged Acoustic, 26-Ignored Submerged Acoustic/Overlap. On receipt of the data, the NOAA OCM converted some of the classifications for data storage and Digital Coast provisioning purposes. The following are the classifications of data available from the NOAA Digital Coast: 1-Unclassified, 2-Ground, 7-Low Point (noise), 9-Water, 11-Bathymetry, 12-Overlap, 13-Submerged Acoustic, 14-Non-Submerged Bathymetry, 15-Ignored Submerged Bathymetry/Overlap, and 16-Ignored Submerged Acoustic/Overlap.

## DATA REQUEST

**85.** ***In response to the City's Data Request No. 47, the applicant discusses wave runup and dune erosion at the Mandalay Beach. Please provide the wave runup and erosion calculations used to support this response.***

## RESPONSE

Applicant's response to the City of Oxnard's Data Request 47 (TN # 206310) described calculations for wave runup and dune erosion at the Mandalay Beach. Table 47-2 provided the results for wave runup and dune erosion, but did not include results for Tsunami elevations. In Applicant's response to the City of Oxnard's Data Request 60 (TN # 206533), Applicant updated and supplemented the results presented in Table 47-2 with the Tsunami elevations.

Please see response to Data Request 93 for additional information on the calculations used to support the results presented in these tables.

## DATA REQUEST

**86.** ***Some of the figures included in the applicant's responses lack information that is necessary to interpret these figures. Please identify the source of the topographic data used in Figure 54-2. Please also reproduce Figure 56-1 with a legend describing the data points.***

## RESPONSE

The source of the topographic data used in Figure 54-2 is the Coastal LiDAR data described under the response to Data Request 84.

Figure 56-1 used symbol types to distinguish photos that were included in the Application for Certification (AFC) Appendix N-2 (TN# 204220-14) and the additional photos that were included with the response to Data Request 64 (TN # 206310). As requested, Figure 56-1—with a legend describing the data points—is provided as Figure 86-1.

## DATA REQUEST

**87.** ***The applicant's responses to the City's Data Requests, Set 2 mention an average slope of Mandalay Beach calculated using beach profiles obtained from the 2013 LiDAR data. Please provide the beach profiles used to calculate the average slope of Mandalay Beach.***

## RESPONSE

Six profiles were developed from the most currently available LiDAR data. It should be noted that the LiDAR data were published in 2013, but the data are from 2009-2011, as explained in the response to Data Request 84. The locations of the profiles are shown on Figure 87-1. The individual profiles are shown on Figures 87-2 through 87-7. Figure 54-1 shows the idealized beach dune system assumed for calculation of dune erosion using the method described in Komar et al. (1999). The average beach slopes shown on Figures 87-2 through 87-7 were selected to be consistent with the conservative Komar et al. (1999) method, as explained in the response to Data Request 54. The average beach slope is approximately 3 percent, based on the six profiles. The LiDAR data used to compute the beach slopes for each profile are provided in Appendix 87-1.

## DATA REQUEST

**88.** ***It is unlikely that the photographs used for the referenced 2013 LiDAR data were actually collected in 2013. These photographs are likely from the 2009-2011 date coastal LiDAR. Please provide the date and timestamps of the overflight photos used in this LiDAR data.***

## RESPONSE

It is unclear to what this data request refers. The only response that includes both LiDAR and a photograph is Figure 50-1, included in Applicant's response to Data Request 50. For this figure, LiDAR topography was merged with a photograph of the site for presentation purposes. The LiDAR data and the photograph included in the figure are independent of each other. The LiDAR was from the 2013 Coastal LiDAR dataset (see response to Data Request 84 for description of the LiDAR). The photograph is from the Channel Islands Regional GIS Collaborative (CIRGIS) and was taken on April 19, 2013 (see response to Data Request 90). The date of the photo was inadvertently left off the figure. Although the photo and the LiDAR were collected on different dates, the changes to the dunes and facility between the two dates are minor, except on the active portion of the beach (the portion subject to daily tidal action and modified by flow from the Mandalay Generating Station [MGS] outfall).

## DATA REQUEST

**89.** ***The responses state that Figure 56-2 shows water lines observed in aerial photos of Mandalay Beach. Appendix 64-1 contains additional aerial photos of Mandalay Beach that were excluded from Figure 56-2. Please update Figure 56-2 to include the water lines from the photographs contained in Appendix 64-1.***

## RESPONSE

Figure 56-2 has been updated to include the water lines from the photographs contained in AFC Appendix N-2 (11 photos), Responses to City of Oxnard Data Requests Set 2, Appendix 64-1, and the 2013 photo in response to Data Request 90. The updated Figure 56-2 is included as Figure 89-1.

## DATA REQUEST

**90.** ***The responses state that the water lines represented in Figure 56-2 were developed by overlaying the water lines from historic aerial photos. Please fully describe the method used to register (georeference) the air photos used for Figure 56-2, and the requested revision to Figure 56-2.***

## RESPONSE

Most of the aerial photographs provided in the various Applicant submittals were obtained as aerial images or digital files that were not geo-referenced. The images were geo-referenced using the Geo-referencing toolbar in ArcGIS 10.2. All post-construction of the MGS images were geo-referenced to an ortho-rectified image created by the CIRGIS. Photos for the CIRGIS project were taken on April 19, 2013 (see Appendix 90-1). Metadata for the CIRGIS imagery can be found at:

http://www.esri.com/metadata/esriprofy80.html

The actual geo-rectified photo of the area containing the MGS facility was obtained from the United States Geological Survey (USGS) Earthexplorer website:

http://earthexplorer.usgs.gov/

The images were aligned with the CIRGIS image by identifying several control points; that is, points that were common to both images. Generally, about 10 points were selected for each image that was geo-referenced. Points were selected to spatially cover an area larger than the MGS site to reduce errors within MGS. Selected locations include the corners of buildings, the corner of the bridge over the Edison Canal, road intersections, corners of the property-line fence, and other equipment/facilities that were common to both images. The control points were then used to transform or warp the image to match the CIRGIS image.

ArcGIS has several options for transforming or warping the image to match the target image (i.e., CIRGIS image). The first-order polynomial (affine) transformation was primarily used. The polynomial transformation uses the control points to construct a polynomial using a least-squares-fit algorithm. The polynomial is optimized to maximize global accuracy at the possible expense of local accuracy (i.e., not all control points may remain exactly aligned). The root-mean-square error was examined, and points with large errors were eliminated. Generally, 10 points were used to control accuracy. Some of the more recently obtained photos were geo-rectified using the spline transformation. The spline transformation uses a piece-wise polynomial that exactly fits the source control points to the target points. It maintains a high degree of local accuracy, but does not guarantee accuracy far from the control points, and requires more points than polynomial transformation. A minimum of 10 points was used for these transformations. Lastly, after the image was geo-rectified, the image was made semi-transparent; placed over the CIRGIS image; and visually inspected. If any significant differences were found between the two images, additional control points were added, and the image geo-rectified again.

The early photographs (pre-1960—before construction of the MGS facility) could not be geo-referenced to the CIRGIS image because of the lack of common control points. These images were geo-referenced to one of the 1967 images that had been referenced to the CIRGIS, because this image still had common features with the pre-MGS images, primarily related to McGrath Lake, vegetation, the dunes, and the beach road.

## DATA REQUEST

**91.** ***Please provide the observed subsidence both generally on the Oxnard plain and particularly near the P3 site.***

## RESPONSE

The following text was provided in the AFC, Section 4.4, Geological Hazards and Resources, subsection 4.4.1.6.5, Subsidence:

> *Historical groundwater withdrawal on the Oxnard Plain since the late 1800s has resulted in approximately 3 feet of land subsidence in the site region. The land subsidence occurred primarily during the drought of the late 1920s, and during the agricultural expansion of the 1950s and 1960s. Artificial recharge of groundwater in the Oxnard Plain, which began in the 1930s, had abated the ground subsidence by the early 1990s (Ninyo & Moore, 2013). Therefore, the potential for subsidence to affect the project site is relatively low.*

The USGS evaluated historical and projected subsidence in the Oxnard Plain (Hanson et al., 2003). The 3 feet of historical subsidence is in the southern portion of the Oxnard Plain, more than 5 miles south of the project site.

Over the more than 60 years that the MGS has been in operation, there has been no subsidence observed at or near the P3 site, which is underlain predominantly by sand.

### References

Hanson, R.T., Peter Martin, and K.M. Koczot, 2003. Simulation of Ground-Water/Surface-Water Flow in the Santa Clara—Calleguas Ground-Water Basin, Ventura County, California. United States Geological Survey – Water Resources Investigations Report 02-4136. Available online at: http://pubs.usgs.gov/wri/wri024136/text.html.

Ninyo & Moore, 2013. Preliminary Geotechnical Evaluation, Mandalay Generating Station Repowering Project, 393 North Harbor Boulevard, Oxnard, California. Prepared for NRG Energy, Inc., November 27.

## DATA REQUESTS

**92.** ***In response to City Data Request No. 49, the applicant states that "it would be unlikely for the tsunami to enter the Channel Island Harbor and then travel up the Edison Canal without considerable loss of energy due to the physical geometry of the harbor." Please provide all analysis, methods and associated results (calculations) that the applicant developed or relied upon to support this statement.***

## RESPONSE

The Channel Island Harbor is protected by an offshore breakwater that extends across the entire mouth of the harbor entrance. Several studies on the effects of breakwaters on tsunami runup height have been conducted (for example, Irtem et al. [2011], Adrichem and Aranguiz [2010], and Ha et al. [2014]). The general conclusion is that breakwaters can reduce the height and extent of tsunami runup. The amount of reduction depends on the exact configuration of the breakwater and local beaches, but a reduction is anticipated.

In addition to the breakwater, parallel jetties restrict the harbor entrance width to about 400 feet. Inside the harbor, the channel is further restricted to less than 300 feet wide by residential developments on both sides of the channel. The harbor contains more than 2,000 boat slips which will tend to reduce the energy of the tsunami. A little more than 2 miles into the harbor, the Edison Canal starts. The channel is furthered narrowed at this point to approximately 100 feet wide. The MGS facility is located another 2 miles from the start of the canal. The narrow canal restricts the inflow of water upstream. Figure 91-1 is from a recent simulation for a tsunami generated by an earthquake on the Ventura-Pitas Point fault, which has an estimated return period of approximately 800 to 2,500 years (Thio et al., 2015). The figure shows the maximum wave amplitude plotted from the entrance to the harbor, through the harbor, and up the canal. The amplitude initially decreases as the waves enter the harbor, but increases toward the end of the harbor where the canal starts due to the restricted flow through the canal, which causes a local buildup of the wave. The restriction of the flow in the canal causes rapid attenuation of the waves as it propagates further north.

### References

Ha, Taemin, Jeseon Yoo, Sejong Han, and Yong-Sik Cho, 2014. Numerical Study on Tsunami Hazard Mitigation using a Submerged Breakwater. The Scientific World Journal. Volume 2014.

Irtem, E., E. Seyfioglu and S. Kabdasli, 2011. Experimental Investigation on the Effects of Submerged Breakwaters on Tsunami Runup Height. Journal of Coastal Research, Special Issue 64, pp. 516-520.

Van Adrichem, Rick and Rafael Aranguiz, 2010. Effect of Tsunami breakwater as a mitigation measure at the Bay of Concepcion. Obras y Proyectos, Volume 8, pp. 19-24.

## DATA REQUEST

**93.** ***Please provide all analysis, methods and associated results (calculations) used to develop the information in Table 59-1 and Table 60-1 in the Applicant's November 6, 2015 responses to City's data requests. Additionally, please update Table 60-1 to account for sea level rise in 2050 and 2100.***

## RESPONSE

Table 59-1 provides maximum wave heights and estimated return periods for tsunamis produced by several possible earthquake sources in the Ventura area, including the Ventura-Pitas Point fault system and Oak Ridge fault. Results from previous studies that analyzed both local and distant earthquake sources of tsunamis that could impact the Ventura County shoreline were also provided. No calculations beyond those reported in the references included with the response were performed for the results shown in the table. Table 59-1 includes the primary reference that addressed tsunamis generated by the source earthquake fault. Those references refer to other references (e.g., Hubbard, 2014) that include additional information on tsunami return periods or recurrence intervals and maximum wave heights. The values shown in the table are based on the Applicant's seismologist's knowledge of the seismology of the areas, and review of the referenced papers.

Table 60-1 lists results for estimated exceedance probabilities for tsunamis, extreme tidal elevations, wave height and runup, and maximum potential erosion. The results shown in Table 60-1 were an update to the results originally provided in Table 47-2. The results in Table 47-2 were in response to the City's data request for the cumulative effect of a tsunami, wave, and storm surge flooding; dune erosion; and riverine inundation. Because tsunamis, storm surge, wave height, and river inundation are independent events, they can be analyzed separately, and the combined or cumulative effect is the product of the probability of each event. As previously described in Applicant's response to Data Request 47, the data on extreme tidal elevations and wave height and period were fit to the generalized extreme value distribution (GEV). The data were fit to the distribution using the method described in Coleman (2002). The form for the GEV that was used is shown in the equation below.

$$P(X \leq x) = \exp\{-\exp(-z)\} \quad \text{for all } z\ (\xi=0)$$
$$\exp\{-(1+\xi z)^{-1/\xi}\} \quad \text{for } 1+\xi z \geq 0\ (\xi \neq 0)$$

where:

$z = (x-\mu)/\sigma$

$\mu, \sigma, \xi$ = the location, scale and shape parameters of the distribution.

X = a random variable

The $\xi = 0$ case gives the Gumbel distribution; for $\xi > 0$ it is the Frechet distribution; and for $\xi < 0$ the Weibull distribution. The method described in Coleman uses the method of probability weighted moments. Details are provided in Coleman (2002).

The results shown in Table 93-1 (Updated Table 60-1) were calculated using the Monte Carlo method. The Monte Carlo method involves generating several trials or simulations of a desired output based on a set of randomly generated inputs. For the analysis shown in Table 93-1 the desired output is the wave runup and maximum potential dune erosion. These outputs are a function of the water level, wave height, wave period, and possibly tsunami height, if that is included. By generating a large number of trials or simulations, a large number of possible outcomes is generated. The advantage of the method is that no prior knowledge of the distribution of the output (e.g., wave runup) is needed. The analysis consisted of the following steps:

1. The probability and height of a tsunami (3rd column in Table 60-1 and Table 93-1) were obtained from Table 59-1.

2. An extreme tidal elevation was calculated using the probability distribution provided on Figure 47-1.

3. An extreme wave height was calculated using the probability distribution shown on Figure 47-2.

4. A wave period was calculated using the distribution shown on Figure 93-1. The probability distribution was calculated as described in response to Data Request 47.

5. The deep-water wave length was calculated as shown in the equation below

   $L_O = 9.81 * T^2 / 2\pi$

   Where:
   Lo = deep water wave length (m)
   T = wave period (s)

6. Wave runup was calculated using the relationship described in Ruggiero et al. (2001) and shown below:

   $R_{2\%} = 0.27(SH_oL_o)^{1/2}$

   Where:
   R = 2 percent exceedance elevation of runup maxima (meters)
   S = beach slope (from profiles described in Data Request 87)
   $H_o$ = deep-water significant wave height (meters) (from step 3)
   Lo = deep-water wave length (meters) (from step 5)

   For comparison, the runup was also calculated using the relationship developed by Stockdon (2006). The Stockdon relationship resulted in runup values about 8 to 9 percent higher than the Ruggiero method (for 99 percent of the comparisons, the difference was less than 1 foot). However, the Ruggiero (2001) and Komar et al. (1999) papers share authors and data, and therefore were determined to be more appropriate.

7. The total water level was calculated as the sum of the extreme tidal elevation (step 2) plus the 2 percent runup values (step 6).

8. The probability of exceedance of the total water level was then calculated as the product of the probability of the tide level, wave height, and wave period. The return period is the inverse of the probability.

9. The maximum potential erosion was calculated using the Komar et al. (1999) method described in the response to Data Request 54. The maximum potential erosion value was calculated for each of the slopes and dune toe elevations determined from the six profiles provided in the response to Data Request 87. The average values for the six profiles are provided in Table 60-1 and Table 93-1. The slope used in the calculations is shown the figures provided in the response to Data Request 87. The slope was selected to represent the slope the wave would need to run up to reach the main dune system. This slope is shallower than the slope of the beach above mean higher high water (see figures in the response to Data Request 87), and so provides a conservative estimate of the maximum potential erosion.

10. The above calculations were conducted for just over 11,000 trials (i.e., combinations of wave height, period, and water level). The exceedance probabilities and return periods provided in Table 60-1 and Table 93-1 were calculated from the 11,000 trials.

11. For sea-level rise (SLR), 2.08 feet were added to the tidal water level for the 2050 SLR; and 4.84 feet were added for the 2100 SLR. All other calculations were the same.

    Note that SLR does not affect wave runup, but increases the total water level by the amount of SLR (e.g., 2.08 feet of SLR by 2050 will increase the elevation of the total water level by 2.08 feet).

The results shown in Tables 93-1 (updated Table 60-1), 93-2, and 93-3 are the average results for the six profiles provided in the response to Data Request 87. The Komar et al. (1999) method for dune erosion is very sensitive to the elevation assumed for the toe of the dune. For example, Profile 5 showed essentially no dune erosion (only 2 percent of the more than 11,000 simulations), and Profiles 1 and 4 estimated erosion only about 40 percent of the time. Profiles 2, 3, and 6 indicated erosion almost every year. In reality, in the more than 60 years of MGS' existence, no significant dune erosion has been observed. It is possible there has been some minor erosion that was not observed, and has since recovered; but the likelihood of extensive erosion would appear to be remote. Also, a review of the profiles provided in Figures 87-2 to 87-7 shows that before the waves can erode the dunes fronting the MGS facility, they have to erode the incipient or foredunes between the beach and the dunes fronting the MGS facility. Therefore, the results presented in Tables 93-1, 93-2, and 93-3 should be considered extremely conservative.

Table 93-1 is an updated version of Table 60-1 and does not include SLR. Tables 93-2 and 93-3 present information similar to Table 93-1, but with the estimated 2050 SLR of 2.08 feet and 2100 SLR of 4.84 feet, respectively.

**References**

Cal-EMA (California Emergency Management Agency), 2009. Tsunami Inundation Map for Emergency Planning, Oxnard Quadrangle: Scale 1:24,000. February 15. Available online at: http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/Inundation_Maps/Ventura/Documents/Tsunami_Inundation_Oxnard_Quad_Ventura.pdf.

Coleman, Rodney, 2002. Modeling Extremes. 2002 Statistical Research Center for Complex Systems, International Statistical Workshop, June 19 and 20, Seoul National University. Available online at: http://wwwf.imperial.ac.uk/~rcoleman/#_papers.

Hubbard, J., J.H. Shaw, J. Dolan, T.L. Pratt, L. McAuliffe, and T.K. Rockwell, 2014. Structure and Seismic Hazard of the Ventura Avenue Anticline and Ventura Fault, California: Prospect for Large, Multisegment Ruptures in the Western Transverse Ranges, Bull. Seismol. Soc. Am., 104, 1070–1087, doi:10.1785/0120130125.

Komar, P.D., W. McDougal, J.J. Marra, and P. Ruggiero, 1999. The Rational Analysis of Setback Distances: Applications to the Oregon Coast. Shore & Beach Vol. 67, No. 1, pp. 41 49. January. Available online (for purchase) at: http://www.researchgate.net/publication/257921997_The_Rational_Analysis_of_Setback_Distances_Applications_to_the_Oregon_Coast.

Ruggiero, P., P.D. Komar, W.G. McDougal, and R.A. Beach, 1996. Extreme Water Levels, Wave Runup and Coastal Erosion. Coastal Engineering Proceedings. Proceedings of 25th Conference on Coastal Engineering, Orlando, Florida, 1996. Available online at: https://journals.tdl.org/icce/index.php/icce.

Ruggiero, Peter, R.A. Holman, and R.A. Beach, 2001. Wave runup on a high-energy dissipative beach. Journal of Geophysical Research, Vol. 109, C06025, doi:10.1029/2003JC002160, 2004. Available online at: http://geo.oregonstate.edu/files/geo/Ruggiero_etal_jgr_2004.pdf.

Ryan, K.J., E.L. Geist, M. Barall, and D.D. Oglesby, 2015. Dynamic models of an earthquake and tsunami offshore Ventura, California, Geophysical Research Letters, 42, 6599–6606, doi:10.1002/2015GL064507. Available online at: http://onlinelibrary.wiley.com/doi/10.1002/2015GL064507/full.

Thio, H.K., K. Ryan, R. Wilson, A. Plesch, D. Oglesby, and J. Shaw, 2015. Tsunami hazard from earthquakes on the Ventura-Pitas Point fault and adjacent structures, 2015, annual meeting of the Southern California Earthquake Center, Palm Springs. Available online at: http://scecinfo.usc.edu/core/cis/2015am/view_abstract.php.

**Table 93-1 (Updated Table 60-1)**
**Updated Cumulative Inundation Sources**
**at the P3 Site and Corresponding Annual Probabilities**

| | | Input Values | | | | Calculated Values | |
|---|---|---|---|---|---|---|---|
| **Return Period (years)[9]** | **Annual Probability of Exceedance** | **Tsunami Water Surface Elevation[1] (feet, NAVD88)** | **Extreme Tidal Elevation (feet)** | **Wave Height (feet)** | **Wave Period (second)** | **Wave Runup[2] (feet)** | **Maximum Potential Erosion [3] (feet)** |
| 2 | 0.5 | NA | 7.15 | 19.4 | 18.2 | 7.6 | 66.4 |
| 5 | 0.20 | NA | 7.25 | 23.1 | 20.2 | 8.7 | 92.7 |
| 10 | 0.10 | NA | 7.29 | 25.6 | 21.3 | 9.3 | 109.5 |
| 25 | 0.04 | NA | 7.31 | 28.7 | 22.3 | 10.0 | 129.2 |
| 50 | 0.02 | NA | 7.32 | 30.8 | 23.0 | 10.5 | 142.9 |
| 75 | 0.013 | NA | 7.32 | 32.4 | 23.4 | 10.8 | 151.5 |
| 100 | 0.01 | NA | 7.32 | 33.3 | 23.5 | 11.0 | 159.0 |
| 200 | 0.005 | NA | 7.32 | 35.5 | 23.9 | 11.5 | 175.1 |
| 500 | 0.002 | 12.0[4] | 7.33 | 38.1 | 24.4 | 12.1 | 199.2 |
| 1,000 | 0.001 | 13.5[5] – 19.3[6] | 7.33 | 40.8 | 24.6 | 12.7 | 216.6 |
| 2,500 | 0.004 | 13.5 – 24.1[7] | 7.33 | 44.0 | 24.9 | 13.3 | 244.5 |
| 10,000 | 0.0001 | 14.5[1] – 15.3[8] | 7.33 | 48.2 | 25.2 | 14.2 | 270.0 |

Notes:

1 Assumes the tsunami occurs at mean high tide. From Cal-EMA (2009), assuming 4.5 feet between mean high water and NAVD88.
2 Excludes tsunami.
3 Maximum potential erosion for annual probabilities shown in table is based on the Komar et al. (1999) method to calculate dune erosion. See response to Data Request 54.
4 SAFRR Tsunami Source, see Table 59-1. Value is for wave amplitude.
5 Ventura-Pitas Point Fault, Thio et al. (2015) , see Table 59-1.
6 Ventura-Pitas Point Fault, Ryan et al. (2015) , see Table 59-1.
7 Low-end value from Ventura-Pitas Point Fault, Thio et al. (2015), high end value from ASCE 7-16 for 10 feet of depth at a ground elevation of 14 feet. See Table 59-1.
8 Oak Ridge Fault, Thio et al. 2015.
9 For the Ve006Etura-Pitas Point tsunami scenarios (both Ryan et al. [2015] and Thio et al. [2015]), the return periods are based on Hubbard et al. (2014). For the Oak Ridge tsunami scenario, return period is from personal communication with Christopher Sorlien of University of California Santa Barbara

**Table 93-2**
**Updated Cumulative Inundation Sources**
**at the P3 Site and Corresponding Annual Probabilities for 2050 SLR**

| | | Input Values | | | | Calculated Values | |
|---|---|---|---|---|---|---|---|
| Return Period (years)[9] | Annual Probability of Exceedance | Tsunami Water Surface Elevation[1] (feet, NAVD88) | Extreme Tidal Elevation (feet) | Wave Height (feet) | Wave Period (second) | Wave Runup[2] (feet) | Maximum Potential Erosion with 2050 SLR [3] (feet) |
| 2 | 0.5 | NA | 9.23 | 19.4 | 18.2 | 7.6 | 101.9 |
| 5 | 0.20 | NA | 9.34 | 23.1 | 20.2 | 8.7 | 124.3 |
| 10 | 0.10 | NA | 9.37 | 25.5 | 21.3 | 9.4 | 140.4 |
| 25 | 0.04 | NA | 9.39 | 28.5 | 22.3 | 10.0 | 162.2 |
| 50 | 0.02 | NA | 9.40 | 30.7 | 22.9 | 10.6 | 179.8 |
| 75 | 0.013 | NA | 9.40 | 32.0 | 23.3 | 10.9 | 189.2 |
| 100 | 0.01 | NA | 9.41 | 32.8 | 23.5 | 11.0 | 197.4 |
| 200 | 0.005 | NA | 9.41 | 34.9 | 23.9 | 11.5 | 212.4 |
| 500 | 0.002 | 12.0[4] | 9.41 | 38.6 | 24.3 | 12.1 | 235.6 |
| 1,000 | 0.001 | 13.5[5] – 19.3[6] | 9.41 | 40.0 | 24.5 | 12.6 | 250.3 |
| 2,500 | 0.004 | 13.5 – 24.1[7] | 9.41 | 42.0 | 24.9 | 12.9 | 257.7 |
| 10,000 | 0.0001 | 14.5[1] – 15.3[8] | 9.41 | 45.7 | 25.1 | 13.3 | 278.8 |

Notes:

1 Assumes the tsunami occurs at mean high tide. From Cal-EMA (2009), assuming 4.5 feet between mean high water and NAVD88.
2 Excludes tsunami.
3 Maximum potential erosion for annual probabilities shown in table is based on the Komar (1999) method to calculate dune erosion. See response to Data Request 54.
4 SAFRR Tsunami Source, see Table 59-1. Value is for wave amplitude.
5 Ventura-Pitas Point Fault, Thio et al. (2015) , see Table 59-1.
6 Ventura-Pitas Point Fault, Ryan al. (2015) , see Table 59-1.
7 Low-end value from Ventura-Pitas Point Fault, Thio et al. (2015), high end value from ASCE 7-16 for 10 feet of depth at a ground elevation of 14 feet. See Table 59-1.
8 Oak Ridge Fault, Thio et al. 2015.
9 For the Ventura-Pitas Point tsunami scenarios (both Ryan et al. [2015] and Thio et al. [2015]), the return periods are based on Hubbard et al. (2014). For the Oak Ridge tsunami scenario, return period is from personal communication with Christopher Sorlien of University of California Santa Barbara.

## Table 93-3
## Updated Cumulative Inundation Sources at the P3 Site and Corresponding Annual Probabilities for 2100 SLR

| | | Input Values | | | | Calculated Values | |
|---|---|---|---|---|---|---|---|
| **Return Period (years)[9]** | **Annual Probability of Exceedance** | **Tsunami Water Surface Elevation[1] (feet, NAVD88)** | **Extreme Tidal Elevation (feet)** | **Wave Height (feet)** | **Wave Period (second)** | **Wave Runup[2] (feet)** | **Maximum Potential Erosion with 2100 SLR [3] (feet)** |
| 2 | 0.5 | NA | 11.99 | 19.5 | 18.2 | 7.6 | 173.4 |
| 5 | 0.20 | NA | 12.10 | 23.2 | 20.2 | 8.7 | 211.4 |
| 10 | 0.10 | NA | 12.13 | 25.6 | 21.2 | 9.3 | 234.1 |
| 25 | 0.04 | NA | 12.15 | 28.5 | 22.3 | 10.1 | 259.1 |
| 50 | 0.02 | NA | 12.16 | 30.8 | 22.9 | 10.6 | 277.2 |
| 75 | 0.013 | NA | 12.16 | 32.2 | 23.2 | 10.8 | 286.1 |
| 100 | 0.01 | NA | 12.16 | 33.0 | 23.4 | 11.0 | 292.3 |
| 200 | 0.005 | NA | 12.17 | 35.4 | 23.9 | 11.5 | 310.6 |
| 500 | 0.002 | 12.0[4] | 12.17 | 38.5 | 24.3 | 12.0 | 326.2 |
| 1,000 | 0.001 | 13.5[5] – 19.3[6] | 12.17 | 39.4 | 24.6 | 12.4 | 338.3 |
| 2,500 | 0.004 | 13.5 – 24.1[7] | 12.17 | 41.0 | 24.8 | 12.9 | 357.6 |
| 10,000 | 0.0001 | 14.5[1] – 15.3[8] | 12.17 | 44.4 | 25.0 | 13.1 | 361.9 |

Notes:

1 Assumes the tsunami occurs at mean high tide. From Cal-EMA (2009), assuming 4.5 feet between mean high water and NAVD88.
2 Excludes tsunami.
3 Maximum potential erosion for annual probabilities shown in table is based on the Komar et al. (1999) method to calculate dune erosion. See response to Data Request 54.
4 SAFRR Tsunami Source, see Table 59-1. Value is for wave amplitude.
5 Ventura-Pitas Point Fault, Thio et al. (2015) , see Table 59-1.
6 Ventura-Pitas Point Fault, Ryan et al. (2015) , see Table 59-1.
7 Low-end value from Ventura-Pitas Point Fault, Thio et al. (2015), high end value from ASCE 7-16 for 10 feet of depth at a ground elevation of 14 feet. See Table 59-1.
8 Oak Ridge Fault, Thio et al. 2015.
9 For the Ventura-Pitas Point tsunami scenarios (both Ryan et al. [2015] and Thio et al. [2015]), the return periods are based on Hubbard et al. (2014). For the Oak Ridge tsunami scenario, return period is from personal communication with Christopher Sorlien of University of California Santa Barbara.

## DATA REQUEST

**94.** ***In response to City Data Request No. 62, the applicant mentions preliminary calculations to evaluate the potential stability of dunes and dikes. Please provide all analysis, methods and associated results (calculations) used to draw the conclusions presented in the response on page 62-1.***

## RESPONSE

The preliminary calculations on the stability of the dunes fronting the MGS against tsunami impact were based on evaluating basic scour conditions and factor-of-safety against slope instability. The load and resistance inputs are based on a flow depth of 10 feet at the dune, applied to the generalized topographic cross section where the dune toe represents the bottom of the loading, and the dune crest is a few feet above the water level. The dune width serves as the basic feature providing resistance to scour by allowing "waste" erosion during the attack. Similarly for slope stability, the sliding friction across the dune width serves as the primary reaction to resist tsunami wave forces acting in shear loading.

For tsunami scour, Federal Emergency Management Agency (FEMA) P-646 (FEMA, 2012) and Francis 2007 provide basic relationships for beach sands. Maximum scour depth can be estimated to be approximately equal to the flow depth. These guidelines also provide hydrostatic and hydrodynamic force equations. Terzaghi et al. (1996) provide basic geotechnical relationships for soil index properties, in situ stresses, shear strength, and sliding resistance.

The broad dune width is shown to provide ample resistance to both estimated extent of scour and shear loading from the design tsunami wave forces.

The preliminary calculations are provided in Appendix 94-1.

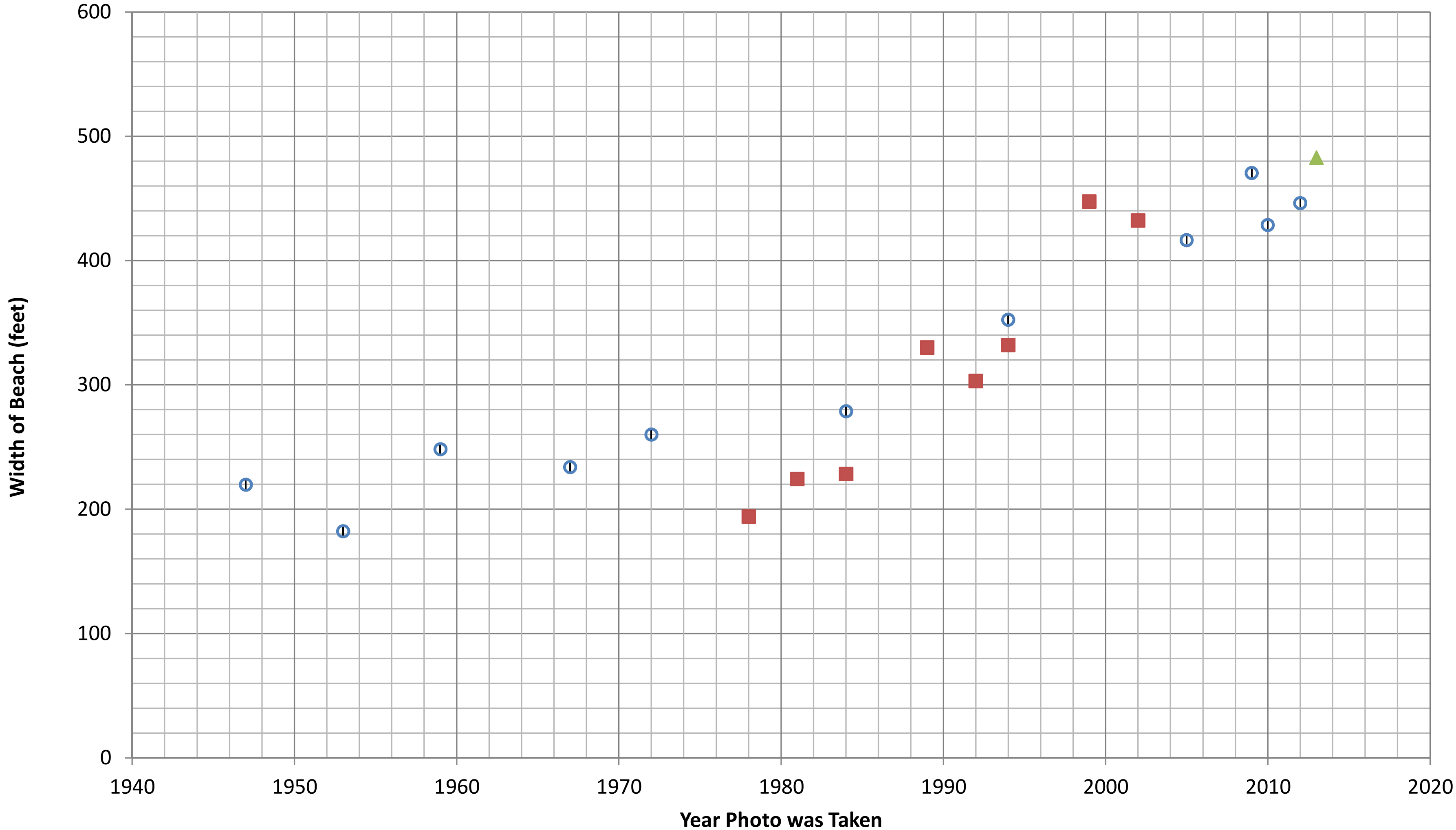
### References

FEMA (Federal Emergency Management Agency), 2012. Guidelines for Design of Structures for Vertical Evacuation from Tsunamis. FEMA P-646. Available online at: http://www.fema.gov/media-library/assets/documents/14708. April 1.

Francis, Mathew J., 2007. Tsunami Inundation Scour of Roadways, Bridges and Foundations Observations and Technical Guidance from the Great Sumatra Andaman Tsunami. Available online at: https://www.eeri.org/wp-content/uploads/MFrancis_EERI_Report_FinalDraft-2-8-08.pdf.

Terzaghi, Karl, Ralph B. Peck, and Gholamreza Mesri, 1996. Soil Mechanics in Engineering Practice. John Wiley and Sons, Inc. Available online at: http://www.scribd.com/doc/129883967/Soil-Mechanics-in-Engineering-Practice-3rd-Edition-Karl-Terzaghi-Ralph-B-Peck-Gholamreza-Mesri-1996#scribd.

# FIGURES




**LEGEND**

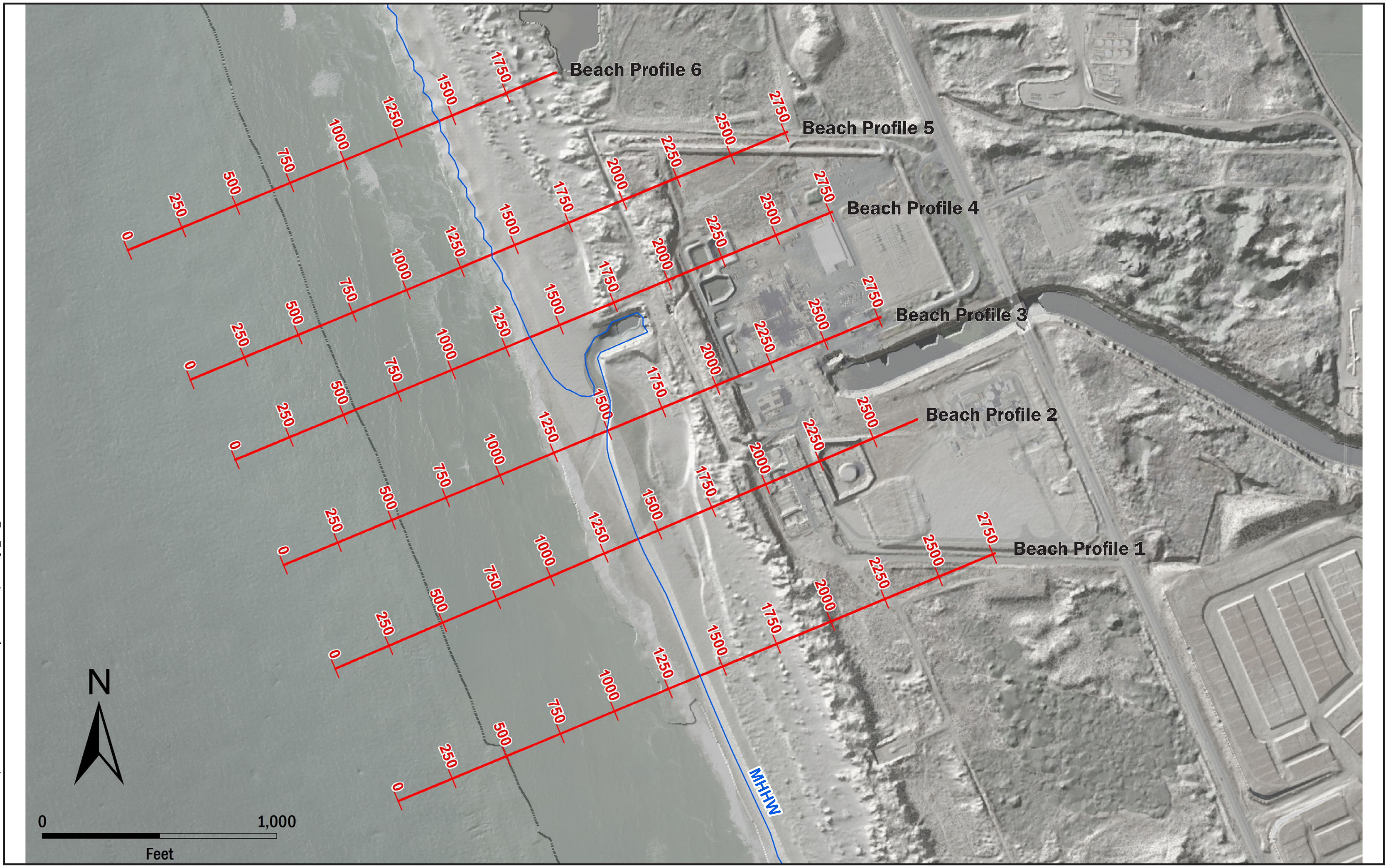
- ○ Based on photos in AFC Appendix N-2 (TN #204220-14)
- ■ Based on photos in Appendix 64-1 (TN #206310)
- ▲ Based on photo in Appendix 90-1 in response to Data Request 90

**WIDTH OF BEACH OVER TIME**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 86-1**

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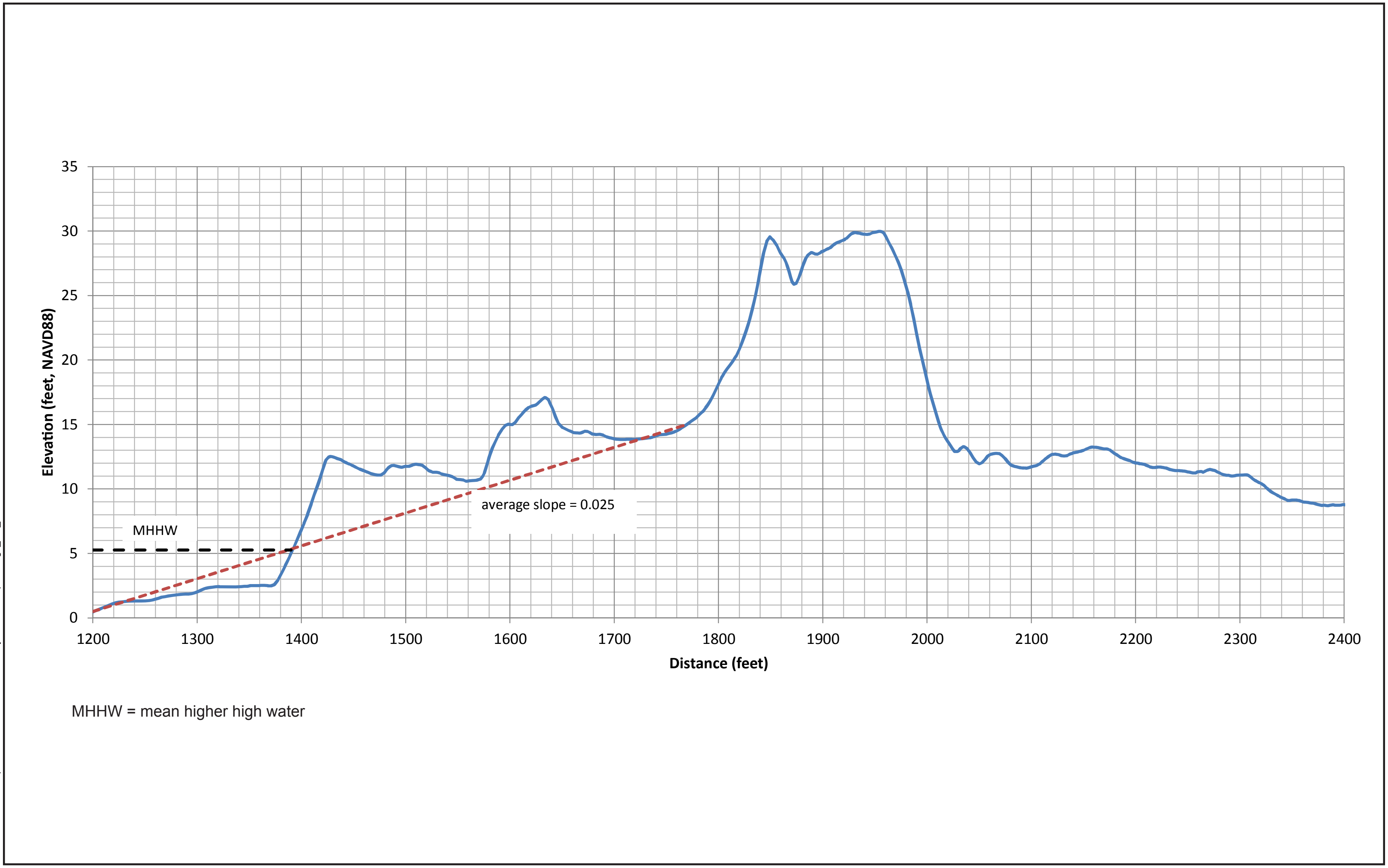
**Note:** See Figures 87-2 through 87-7 for Beach Profiles 1 through 6, respectively.

**BEACH PROFILE LOCATIONS**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 87-1**

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Source: See Response to DR 84.

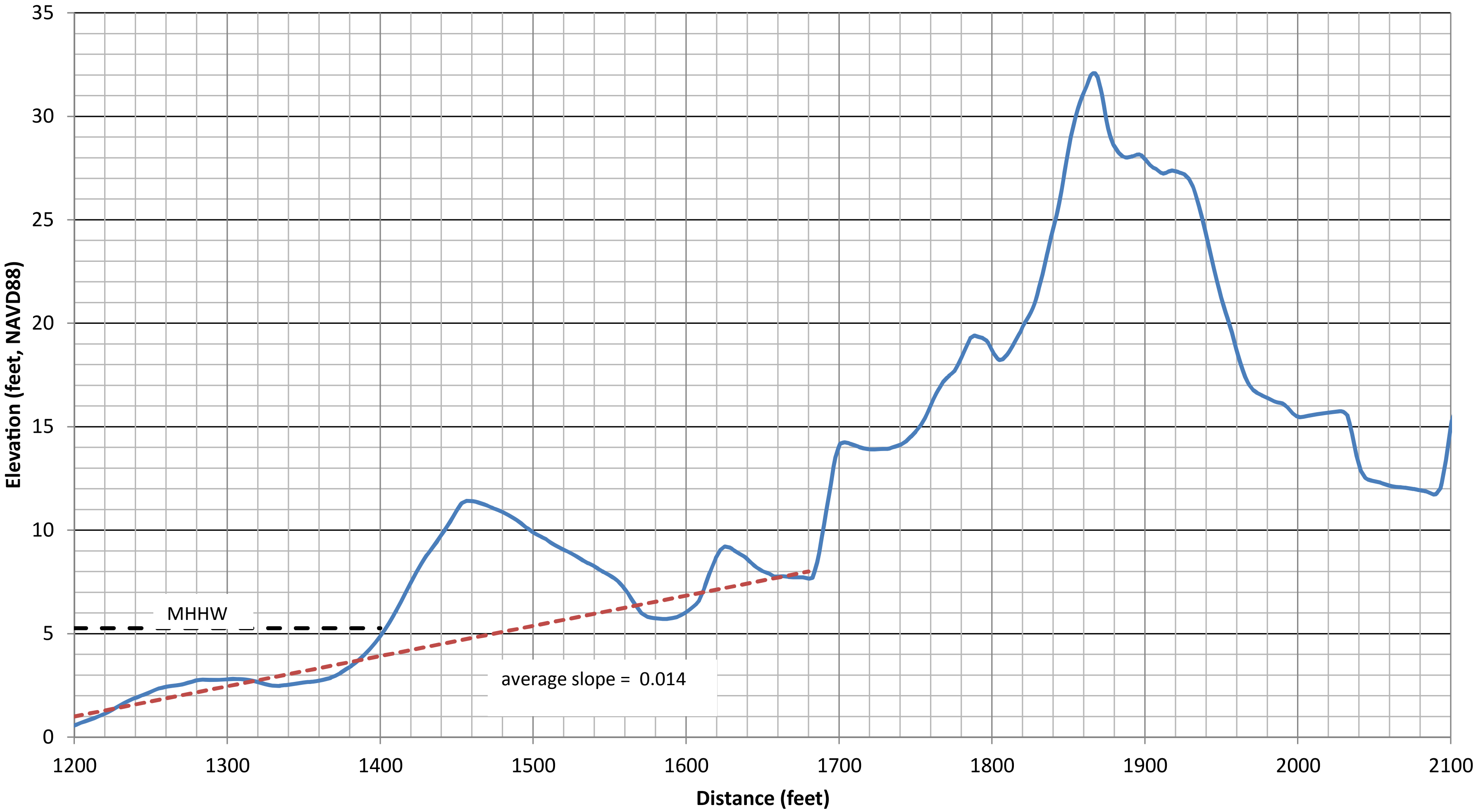
**Note:** See Figure 87-1 for Beach Profile locations.

**BEACH PROFILE 1**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 87-2**




MHHW = mean higher high water

01/04/16 rks U:\Graphics\NRG Puente Power Project\DataRequest\Figs_DR_Jan4.indd

Source: See Response to DR 84.

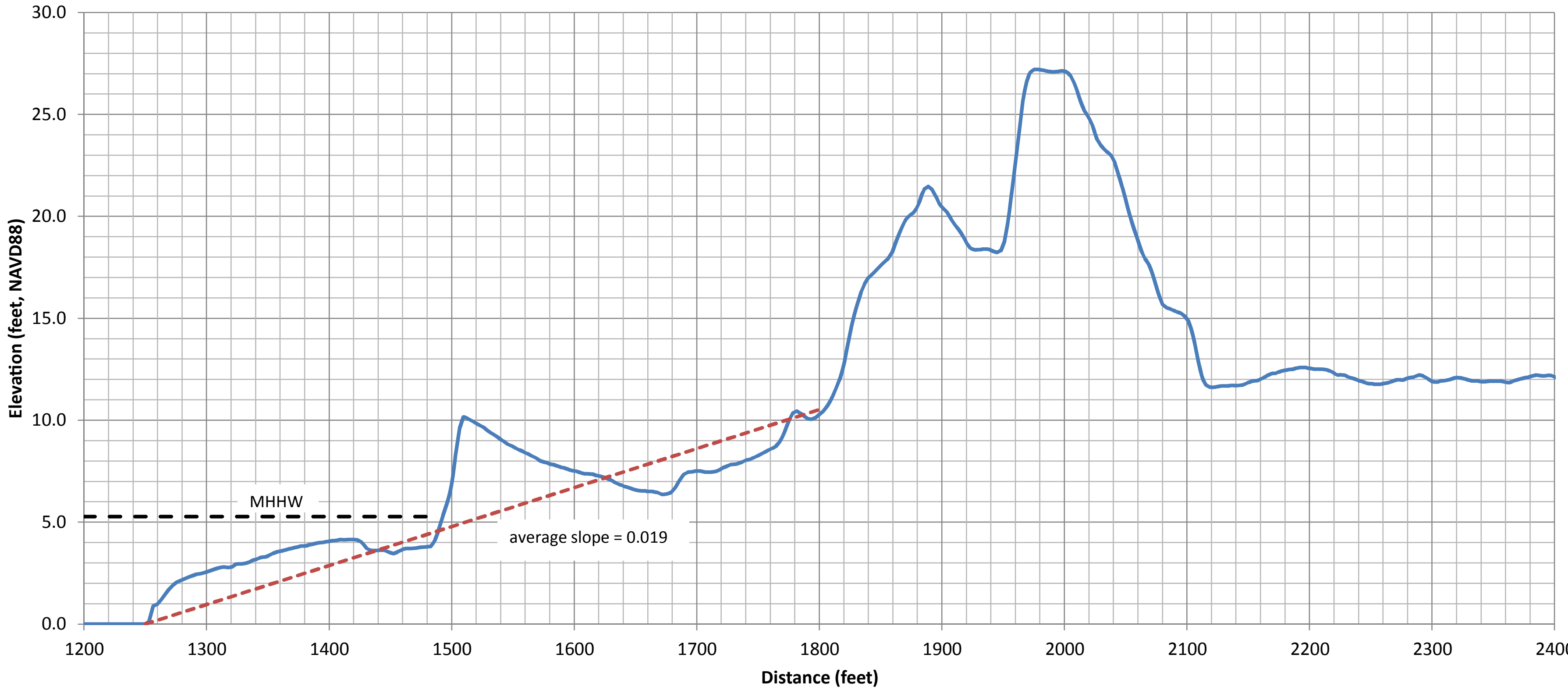
**Note:** See Figure 87-1 for Beach Profile locations.

**BEACH PROFILE 2**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 87-3**




MHHW = mean higher high water



Source: See Response to DR 84.

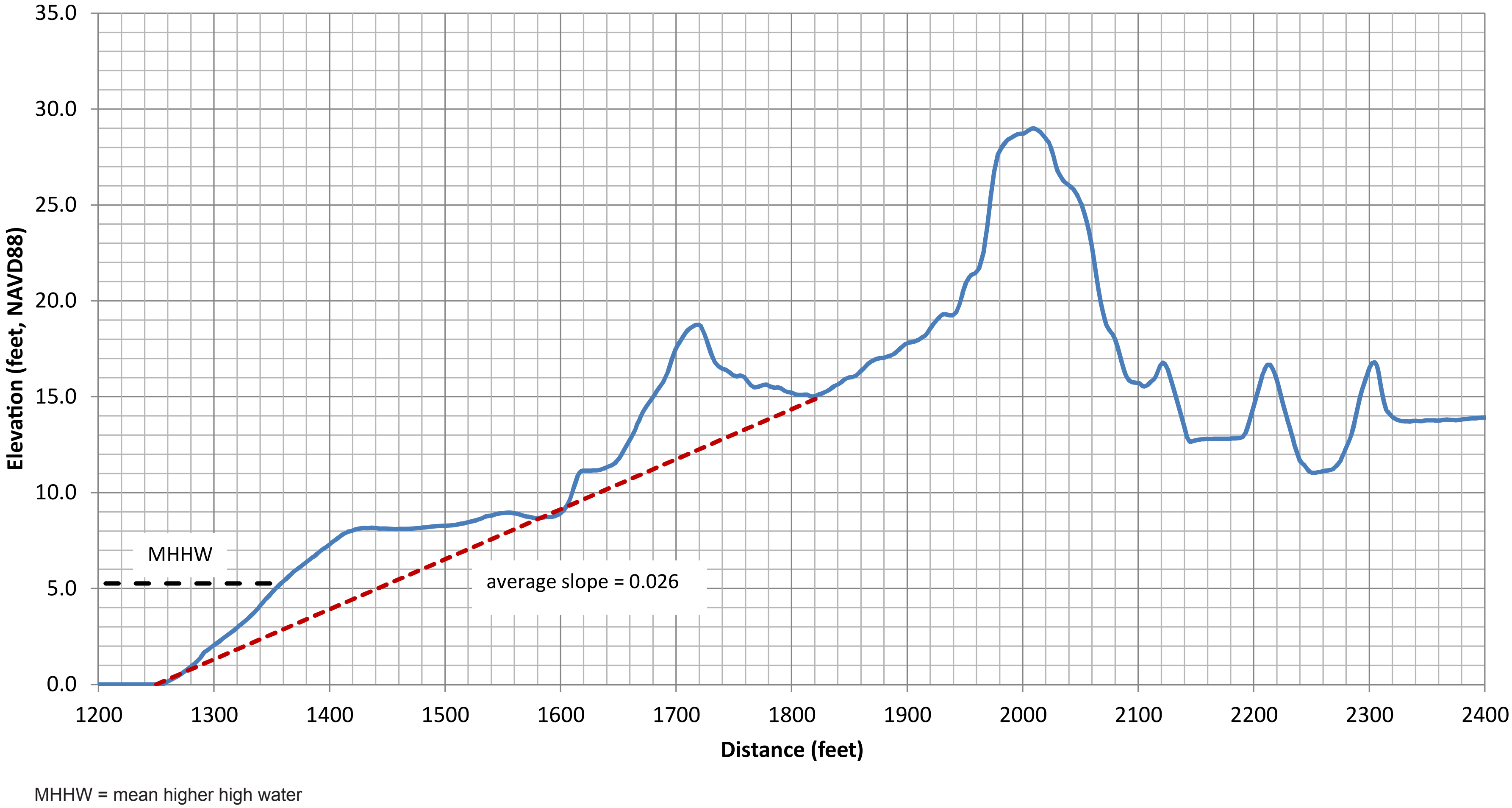
**Note:** See Figure 87-1 for Beach Profile locations.

**BEACH PROFILE 3**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 87-4**

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Source: See Response to DR 84.

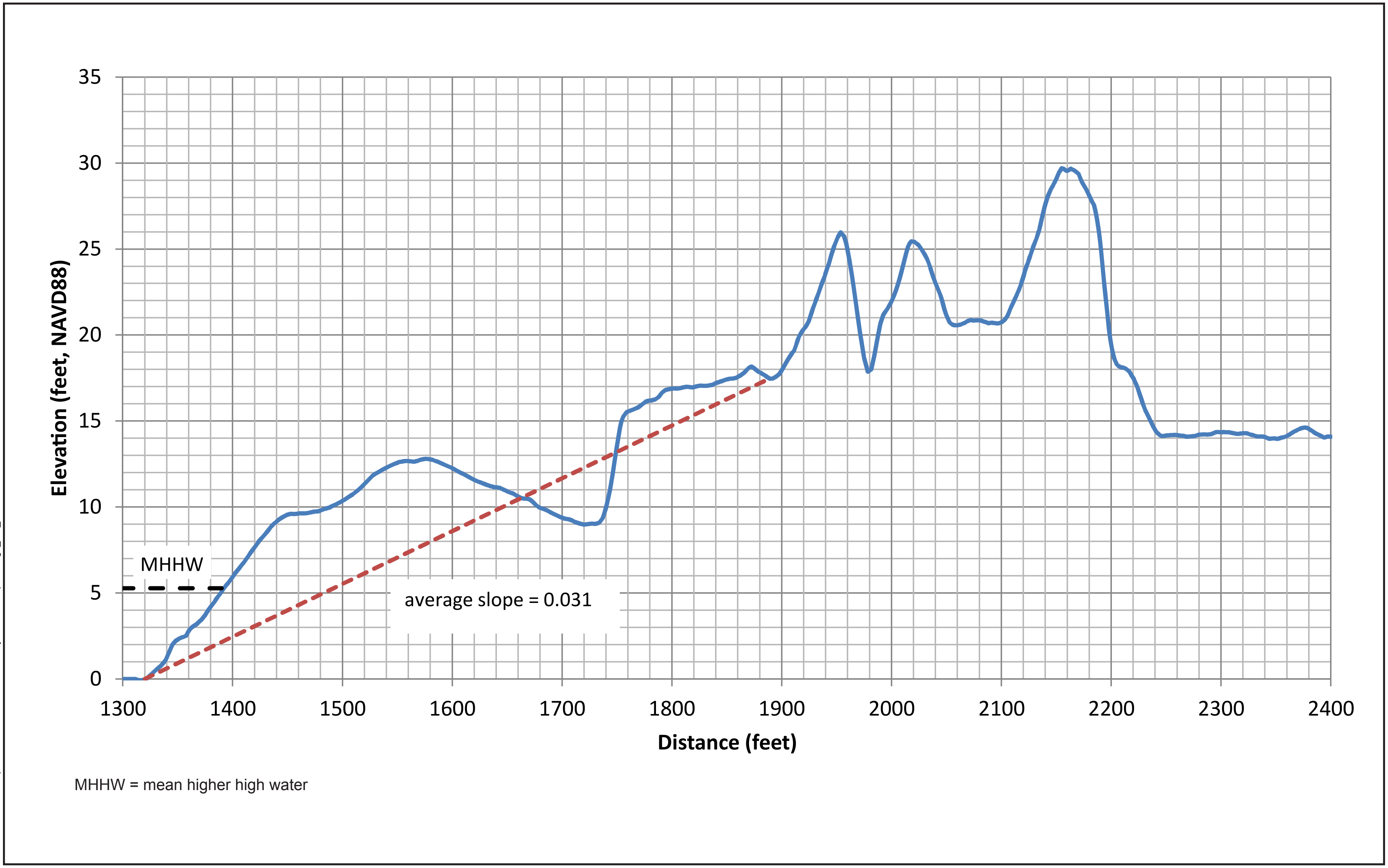
**Note:** See Figure 87-1 for Beach Profile locations.

**BEACH PROFILE 4**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 87-5**






Source: See Response to DR 84.

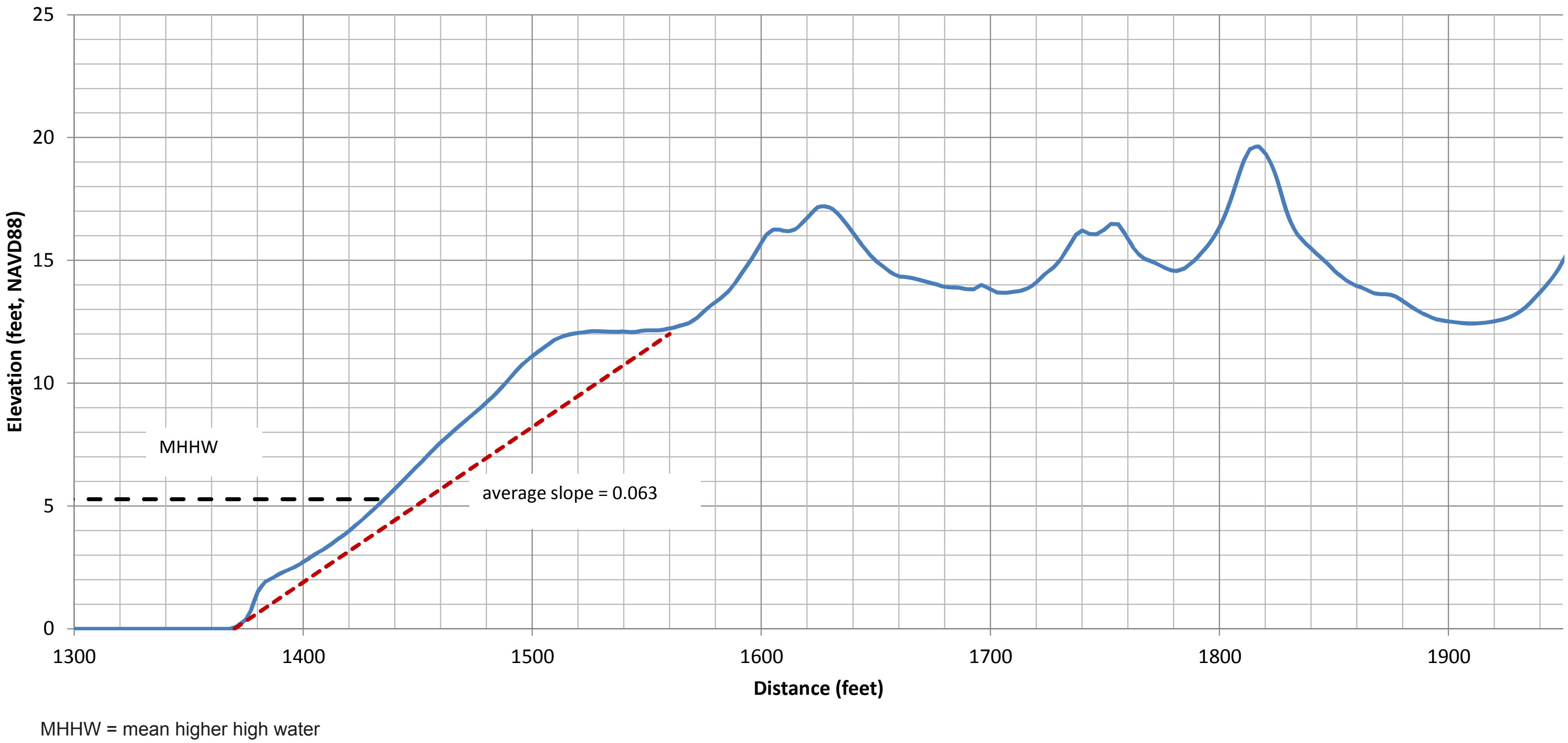
**Note:** See Figure 87-1 for Beach Profile locations.

**BEACH PROFILE 5**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 87-6**

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Source: See Response to DR 84.

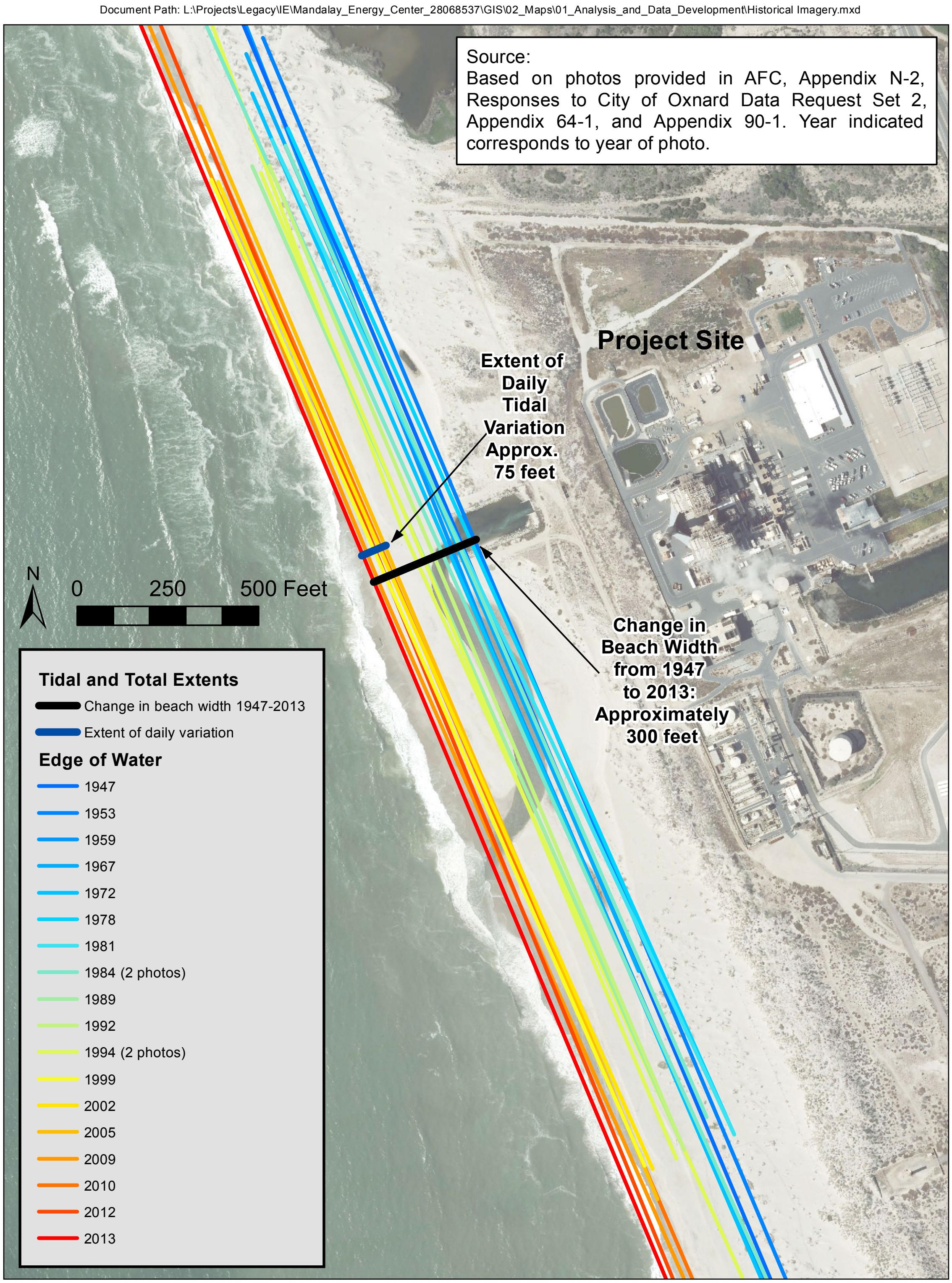
**Note:** See Figure 87-1 for Beach Profile locations.

**BEACH PROFILE 6**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 87-7**




01/04/16 rks U:\Graphics\NRG Puente Power Project\DataRequest\Figs_DR_Jan4.indd

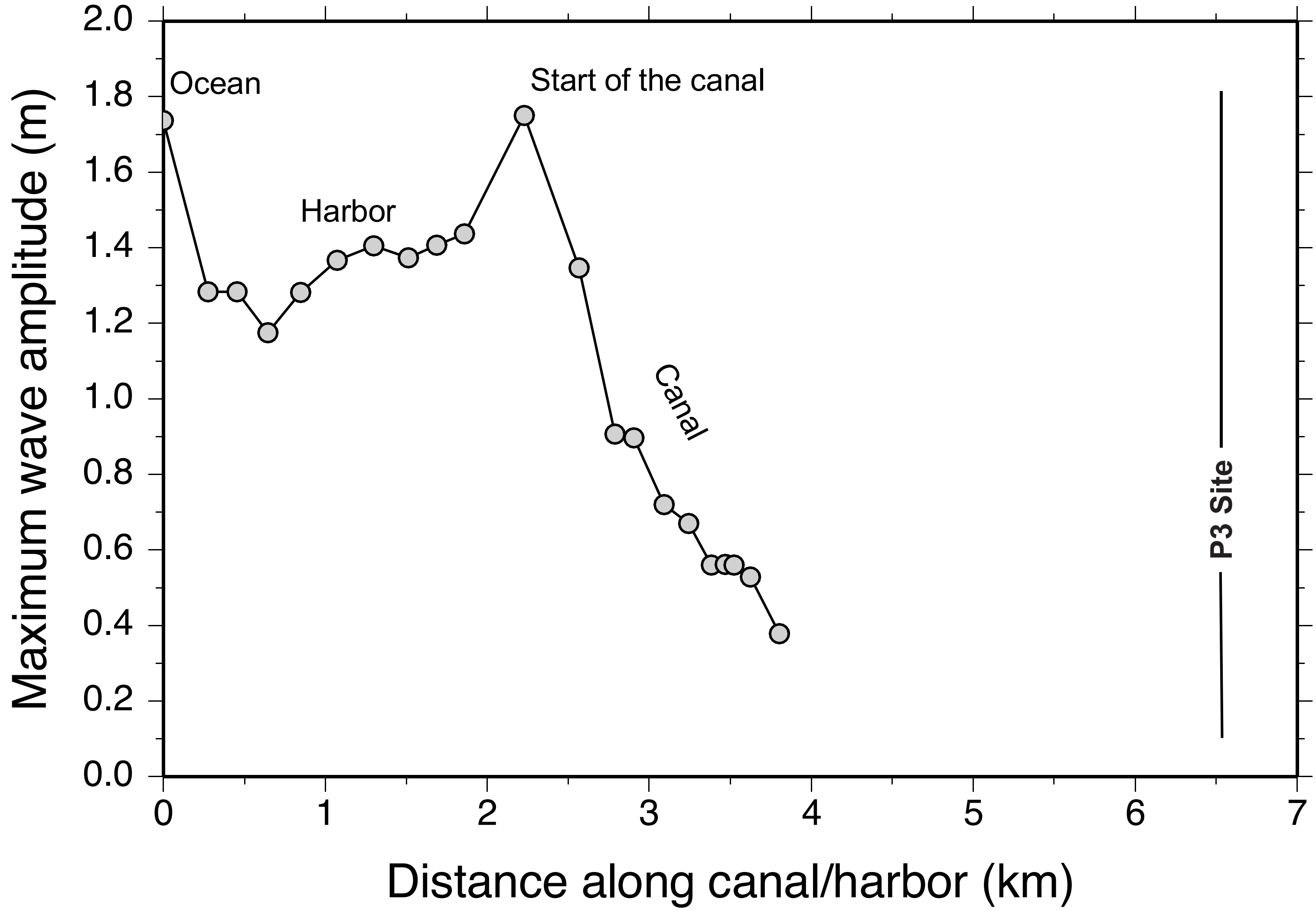
**Note:** Edge of Water as shown on aerial photographs from 1947 - 2013.

**Mandalay Beach 1947 - 2013**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 89-1**





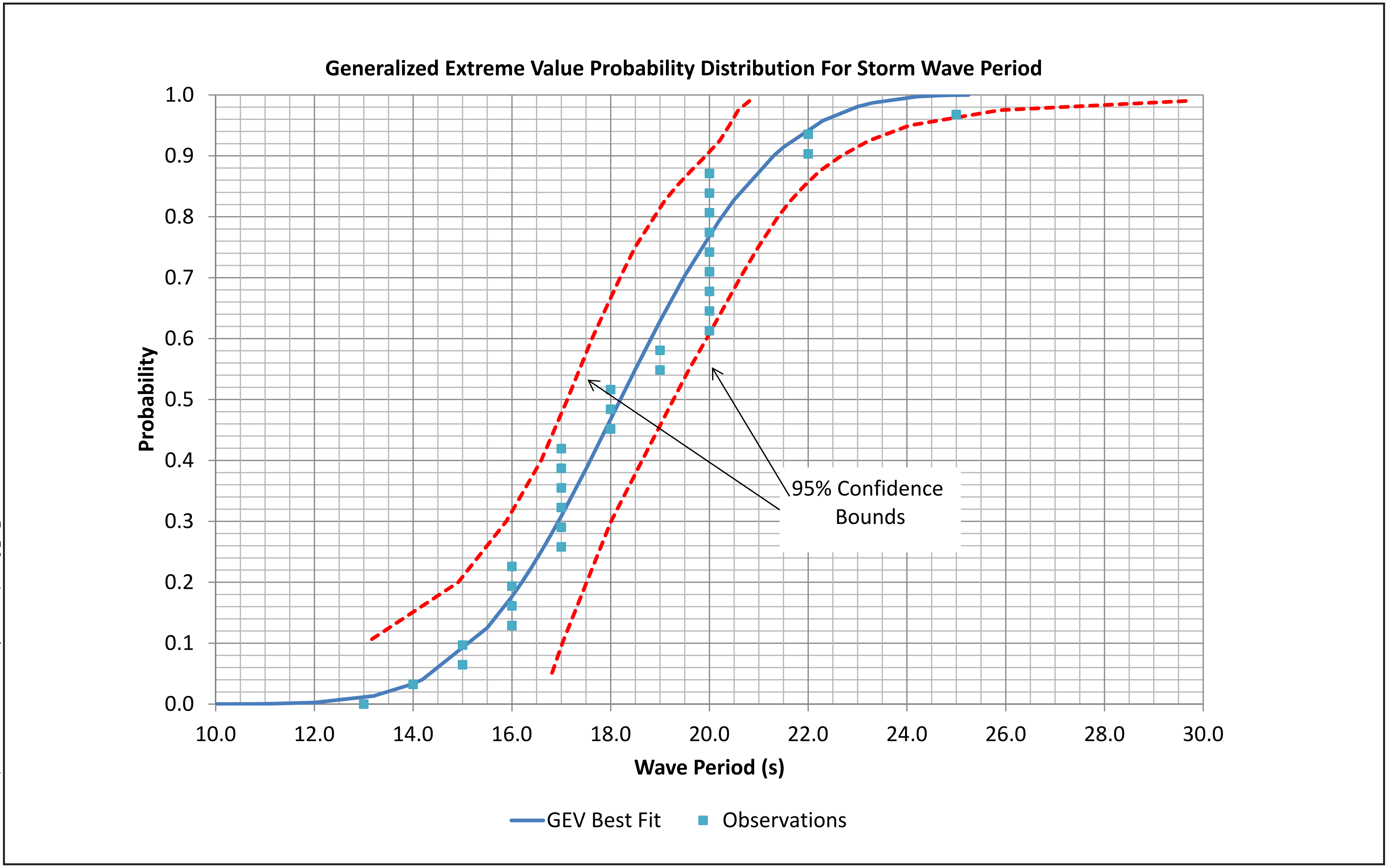

Source: Based on Figure 59-1 (TN# 206533) and Thio et al., 2015.

**Maximum Tsunami Wave Amplitude Dissipation**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 92-1**




Source: Seymour, 1996.



**GENERALIZED EXTREME VALUE PROBABILITY DISTRIBUTION FOR STORM WAVE PERIOD**

NRG
Puente Power Project
Oxnard, California

December 2015

**FIGURE 93-1**

# APPENDICES

# APPENDIX 87-1
# BEACH PROFILE INFORMATION

Profile 1
Source: 2013 LiDAR Data

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 554 | 365.628 | 0.136 | 1199.26 | 0.45 |
| 555 | 366.613 | 0.167 | 1202.49 | 0.55 |
| 556 | 367.597 | 0.198 | 1205.72 | 0.65 |
| 557 | 368.581 | 0.232 | 1208.95 | 0.76 |
| 558 | 369.566 | 0.267 | 1212.18 | 0.88 |
| 559 | 370.550 | 0.297 | 1215.40 | 0.97 |
| 560 | 371.534 | 0.331 | 1218.63 | 1.09 |
| 561 | 372.519 | 0.355 | 1221.86 | 1.16 |
| 562 | 373.503 | 0.371 | 1225.09 | 1.22 |
| 563 | 374.487 | 0.382 | 1228.32 | 1.25 |
| 564 | 375.472 | 0.389 | 1231.55 | 1.28 |
| 565 | 376.411 | 0.395 | 1234.63 | 1.30 |
| 566 | 377.349 | 0.399 | 1237.71 | 1.31 |
| 567 | 378.288 | 0.400 | 1240.79 | 1.31 |
| 568 | 379.227 | 0.401 | 1243.86 | 1.31 |
| 569 | 380.166 | 0.400 | 1246.94 | 1.31 |
| 570 | 381.105 | 0.401 | 1250.02 | 1.31 |
| 571 | 382.044 | 0.406 | 1253.10 | 1.33 |
| 572 | 382.044 | 0.406 | 1253.10 | 1.33 |
| 573 | 383.025 | 0.419 | 1256.32 | 1.37 |
| 574 | 384.007 | 0.439 | 1259.54 | 1.44 |
| 575 | 384.988 | 0.466 | 1262.76 | 1.53 |
| 576 | 385.969 | 0.488 | 1265.98 | 1.60 |
| 577 | 386.951 | 0.504 | 1269.20 | 1.65 |
| 578 | 387.932 | 0.518 | 1272.42 | 1.70 |
| 579 | 388.914 | 0.530 | 1275.64 | 1.74 |
| 580 | 389.895 | 0.542 | 1278.86 | 1.78 |
| 581 | 390.877 | 0.554 | 1282.07 | 1.82 |
| 582 | 391.858 | 0.560 | 1285.29 | 1.84 |
| 583 | 392.839 | 0.561 | 1288.51 | 1.84 |
| 584 | 393.821 | 0.563 | 1291.73 | 1.85 |
| 585 | 394.802 | 0.573 | 1294.95 | 1.88 |
| 586 | 395.784 | 0.596 | 1298.17 | 1.96 |
| 587 | 396.765 | 0.628 | 1301.39 | 2.06 |
| 588 | 397.746 | 0.665 | 1304.61 | 2.18 |
| 589 | 398.728 | 0.695 | 1307.83 | 2.28 |
| 590 | 399.709 | 0.713 | 1311.05 | 2.34 |
| 591 | 400.691 | 0.727 | 1314.27 | 2.38 |
| 592 | 401.672 | 0.736 | 1317.48 | 2.42 |
| 593 | 402.654 | 0.739 | 1320.70 | 2.42 |
| 594 | 402.876 | 0.739 | 1321.43 | 2.42 |
| 595 | 403.619 | 0.735 | 1323.87 | 2.41 |
| 596 | 404.361 | 0.736 | 1326.30 | 2.41 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 597 | 405.104 | 0.737 | 1328.74 | 2.42 |
| 598 | 406.012 | 0.736 | 1331.72 | 2.42 |
| 599 | 406.919 | 0.731 | 1334.70 | 2.40 |
| 600 | 407.827 | 0.730 | 1337.67 | 2.39 |
| 601 | 408.364 | 0.735 | 1339.43 | 2.41 |
| 602 | 408.901 | 0.741 | 1341.20 | 2.43 |
| 603 | 409.263 | 0.744 | 1342.38 | 2.44 |
| 604 | 409.860 | 0.746 | 1344.34 | 2.45 |
| 605 | 410.173 | 0.746 | 1345.37 | 2.45 |
| 606 | 411.043 | 0.747 | 1348.22 | 2.45 |
| 607 | 411.043 | 0.747 | 1348.22 | 2.45 |
| 608 | 411.703 | 0.758 | 1350.39 | 2.49 |
| 609 | 411.913 | 0.762 | 1351.07 | 2.50 |
| 610 | 412.794 | 0.764 | 1353.96 | 2.51 |
| 611 | 412.955 | 0.763 | 1354.49 | 2.50 |
| 612 | 413.894 | 0.762 | 1357.57 | 2.50 |
| 613 | 413.976 | 0.763 | 1357.84 | 2.50 |
| 614 | 413.976 | 0.763 | 1357.84 | 2.50 |
| 615 | 414.477 | 0.765 | 1359.49 | 2.51 |
| 616 | 414.978 | 0.766 | 1361.13 | 2.51 |
| 617 | 414.978 | 0.766 | 1361.13 | 2.51 |
| 618 | 414.993 | 0.767 | 1361.18 | 2.51 |
| 619 | 415.239 | 0.768 | 1361.98 | 2.52 |
| 620 | 415.239 | 0.768 | 1361.98 | 2.52 |
| 621 | 415.985 | 0.769 | 1364.43 | 2.52 |
| 622 | 415.985 | 0.769 | 1364.43 | 2.52 |
| 623 | 416.041 | 0.769 | 1364.62 | 2.52 |
| 624 | 416.041 | 0.769 | 1364.62 | 2.52 |
| 625 | 416.962 | 0.761 | 1367.63 | 2.50 |
| 626 | 417.083 | 0.760 | 1368.03 | 2.49 |
| 627 | 417.924 | 0.757 | 1370.79 | 2.48 |
| 628 | 417.924 | 0.757 | 1370.79 | 2.48 |
| 629 | 418.145 | 0.761 | 1371.52 | 2.50 |
| 630 | 418.145 | 0.761 | 1371.52 | 2.50 |
| 631 | 418.901 | 0.787 | 1374.00 | 2.58 |
| 632 | 419.193 | 0.812 | 1374.95 | 2.66 |
| 633 | 419.854 | 0.881 | 1377.12 | 2.89 |
| 634 | 420.232 | 0.936 | 1378.36 | 3.07 |
| 635 | 420.232 | 0.936 | 1378.36 | 3.07 |
| 636 | 420.834 | 1.023 | 1380.34 | 3.36 |
| 637 | 420.834 | 1.023 | 1380.34 | 3.36 |
| 638 | 421.287 | 1.093 | 1381.82 | 3.59 |
| 639 | 421.802 | 1.178 | 1383.51 | 3.86 |
| 640 | 421.803 | 1.178 | 1383.51 | 3.86 |
| 641 | 422.244 | 1.253 | 1384.96 | 4.11 |
| 642 | 422.942 | 1.371 | 1387.25 | 4.50 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 643 | 423.378 | 1.447 | 1388.68 | 4.75 |
| 644 | 423.378 | 1.447 | 1388.68 | 4.75 |
| 645 | 423.747 | 1.514 | 1389.89 | 4.96 |
| 646 | 423.748 | 1.514 | 1389.89 | 4.96 |
| 647 | 424.426 | 1.634 | 1392.12 | 5.36 |
| 648 | 424.426 | 1.634 | 1392.12 | 5.36 |
| 649 | 424.704 | 1.682 | 1393.03 | 5.52 |
| 650 | 425.473 | 1.822 | 1395.55 | 5.97 |
| 651 | 425.670 | 1.859 | 1396.20 | 6.10 |
| 652 | 425.670 | 1.859 | 1396.20 | 6.10 |
| 653 | 426.522 | 2.023 | 1398.99 | 6.64 |
| 654 | 426.655 | 2.049 | 1399.43 | 6.72 |
| 655 | 427.565 | 2.227 | 1402.41 | 7.30 |
| 656 | 427.602 | 2.234 | 1402.53 | 7.33 |
| 657 | 427.994 | 2.314 | 1403.82 | 7.59 |
| 658 | 427.994 | 2.314 | 1403.82 | 7.59 |
| 659 | 428.605 | 2.443 | 1405.83 | 8.01 |
| 660 | 428.605 | 2.443 | 1405.83 | 8.01 |
| 661 | 428.647 | 2.453 | 1405.96 | 8.05 |
| 662 | 429.635 | 2.688 | 1409.20 | 8.82 |
| 663 | 429.725 | 2.709 | 1409.50 | 8.89 |
| 664 | 429.726 | 2.709 | 1409.50 | 8.89 |
| 665 | 430.515 | 2.898 | 1412.09 | 9.50 |
| 666 | 430.515 | 2.898 | 1412.09 | 9.50 |
| 667 | 431.462 | 3.105 | 1415.20 | 10.19 |
| 668 | 431.672 | 3.151 | 1415.88 | 10.33 |
| 669 | 431.672 | 3.151 | 1415.88 | 10.33 |
| 670 | 431.913 | 3.209 | 1416.67 | 10.52 |
| 671 | 432.698 | 3.409 | 1419.25 | 11.18 |
| 672 | 432.988 | 3.486 | 1420.20 | 11.44 |
| 673 | 433.715 | 3.675 | 1422.59 | 12.05 |
| 674 | 434.079 | 3.737 | 1423.78 | 12.26 |
| 675 | 434.736 | 3.800 | 1425.93 | 12.46 |
| 676 | 435.305 | 3.817 | 1427.80 | 12.52 |
| 677 | 435.777 | 3.812 | 1429.35 | 12.50 |
| 678 | 436.258 | 3.803 | 1430.93 | 12.47 |
| 679 | 436.780 | 3.785 | 1432.64 | 12.41 |
| 680 | 437.324 | 3.767 | 1434.42 | 12.36 |
| 681 | 437.324 | 3.767 | 1434.42 | 12.36 |
| 682 | 437.783 | 3.756 | 1435.93 | 12.32 |
| 683 | 438.387 | 3.737 | 1437.91 | 12.26 |
| 684 | 438.387 | 3.737 | 1437.91 | 12.26 |
| 685 | 438.805 | 3.718 | 1439.28 | 12.19 |
| 686 | 438.805 | 3.718 | 1439.28 | 12.19 |
| 687 | 439.494 | 3.686 | 1441.54 | 12.09 |
| 688 | 439.828 | 3.673 | 1442.63 | 12.05 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 689 | 439.828 | 3.673 | 1442.63 | 12.05 |
| 690 | 440.562 | 3.646 | 1445.04 | 11.96 |
| 691 | 440.834 | 3.637 | 1445.93 | 11.93 |
| 692 | 440.834 | 3.637 | 1445.93 | 11.93 |
| 693 | 441.659 | 3.607 | 1448.64 | 11.83 |
| 694 | 441.877 | 3.597 | 1449.36 | 11.80 |
| 695 | 441.877 | 3.597 | 1449.36 | 11.80 |
| 696 | 442.737 | 3.561 | 1452.18 | 11.68 |
| 697 | 442.878 | 3.556 | 1452.64 | 11.66 |
| 698 | 443.835 | 3.519 | 1455.78 | 11.54 |
| 699 | 443.907 | 3.516 | 1456.01 | 11.53 |
| 700 | 444.820 | 3.487 | 1459.01 | 11.44 |
| 701 | 444.922 | 3.484 | 1459.34 | 11.43 |
| 702 | 444.932 | 3.484 | 1459.38 | 11.43 |
| 703 | 444.932 | 3.484 | 1459.38 | 11.43 |
| 704 | 445.436 | 3.469 | 1461.03 | 11.38 |
| 705 | 445.940 | 3.452 | 1462.68 | 11.32 |
| 706 | 446.014 | 3.449 | 1462.93 | 11.31 |
| 707 | 446.987 | 3.416 | 1466.12 | 11.21 |
| 708 | 447.144 | 3.413 | 1466.63 | 11.20 |
| 709 | 448.000 | 3.395 | 1469.44 | 11.14 |
| 710 | 448.276 | 3.390 | 1470.35 | 11.12 |
| 711 | 449.035 | 3.378 | 1472.84 | 11.08 |
| 712 | 449.400 | 3.378 | 1474.03 | 11.08 |
| 713 | 450.069 | 3.377 | 1476.23 | 11.08 |
| 714 | 450.499 | 3.398 | 1477.64 | 11.15 |
| 715 | 451.077 | 3.431 | 1479.53 | 11.25 |
| 716 | 451.077 | 3.431 | 1479.53 | 11.25 |
| 717 | 451.601 | 3.487 | 1481.25 | 11.44 |
| 718 | 452.100 | 3.539 | 1482.89 | 11.61 |
| 719 | 452.724 | 3.580 | 1484.94 | 11.74 |
| 720 | 452.725 | 3.580 | 1484.94 | 11.74 |
| 721 | 453.143 | 3.598 | 1486.31 | 11.80 |
| 722 | 453.826 | 3.604 | 1488.55 | 11.82 |
| 723 | 454.155 | 3.601 | 1489.63 | 11.81 |
| 724 | 454.937 | 3.584 | 1492.19 | 11.76 |
| 725 | 455.170 | 3.577 | 1492.96 | 11.73 |
| 726 | 455.170 | 3.577 | 1492.96 | 11.73 |
| 727 | 456.047 | 3.562 | 1495.83 | 11.68 |
| 728 | 456.200 | 3.563 | 1496.34 | 11.69 |
| 729 | 457.152 | 3.583 | 1499.46 | 11.75 |
| 730 | 457.153 | 3.583 | 1499.46 | 11.75 |
| 731 | 457.208 | 3.584 | 1499.64 | 11.75 |
| 732 | 457.958 | 3.583 | 1502.10 | 11.75 |
| 733 | 457.958 | 3.583 | 1502.10 | 11.75 |
| 734 | 458.218 | 3.586 | 1502.96 | 11.76 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 735 | 458.233 | 3.586 | 1503.00 | 11.76 |
| 736 | 459.224 | 3.612 | 1506.25 | 11.85 |
| 737 | 459.314 | 3.615 | 1506.55 | 11.86 |
| 738 | 459.314 | 3.615 | 1506.55 | 11.86 |
| 739 | 460.217 | 3.634 | 1509.51 | 11.92 |
| 740 | 460.371 | 3.634 | 1510.02 | 11.92 |
| 741 | 461.225 | 3.622 | 1512.82 | 11.88 |
| 742 | 461.448 | 3.621 | 1513.55 | 11.88 |
| 743 | 462.230 | 3.607 | 1516.12 | 11.83 |
| 744 | 462.230 | 3.607 | 1516.12 | 11.83 |
| 745 | 462.495 | 3.591 | 1516.98 | 11.78 |
| 746 | 463.221 | 3.546 | 1519.36 | 11.63 |
| 747 | 463.565 | 3.519 | 1520.49 | 11.54 |
| 748 | 464.211 | 3.478 | 1522.61 | 11.41 |
| 749 | 464.602 | 3.464 | 1523.89 | 11.36 |
| 750 | 464.602 | 3.464 | 1523.89 | 11.36 |
| 751 | 465.219 | 3.446 | 1525.92 | 11.30 |
| 752 | 465.667 | 3.443 | 1527.39 | 11.29 |
| 753 | 466.221 | 3.445 | 1529.21 | 11.30 |
| 754 | 466.733 | 3.439 | 1530.88 | 11.28 |
| 755 | 467.214 | 3.425 | 1532.46 | 11.23 |
| 756 | 467.791 | 3.407 | 1534.36 | 11.17 |
| 757 | 468.216 | 3.393 | 1535.75 | 11.13 |
| 758 | 468.847 | 3.381 | 1537.82 | 11.09 |
| 759 | 469.201 | 3.379 | 1538.98 | 11.08 |
| 760 | 469.898 | 3.367 | 1541.27 | 11.04 |
| 761 | 470.195 | 3.362 | 1542.24 | 11.03 |
| 762 | 470.195 | 3.362 | 1542.24 | 11.03 |
| 763 | 470.968 | 3.339 | 1544.77 | 10.95 |
| 764 | 470.968 | 3.339 | 1544.77 | 10.95 |
| 765 | 471.216 | 3.326 | 1545.59 | 10.91 |
| 766 | 472.027 | 3.285 | 1548.25 | 10.78 |
| 767 | 472.210 | 3.279 | 1548.85 | 10.75 |
| 768 | 473.087 | 3.271 | 1551.73 | 10.73 |
| 769 | 473.088 | 3.271 | 1551.73 | 10.73 |
| 770 | 473.199 | 3.271 | 1552.09 | 10.73 |
| 771 | 474.149 | 3.262 | 1555.21 | 10.70 |
| 772 | 474.192 | 3.261 | 1555.35 | 10.70 |
| 773 | 474.192 | 3.261 | 1555.35 | 10.70 |
| 774 | 474.921 | 3.235 | 1557.74 | 10.61 |
| 775 | 474.922 | 3.235 | 1557.74 | 10.61 |
| 776 | 475.174 | 3.232 | 1558.57 | 10.60 |
| 777 | 475.194 | 3.232 | 1558.64 | 10.60 |
| 778 | 476.103 | 3.242 | 1561.62 | 10.63 |
| 779 | 476.103 | 3.242 | 1561.62 | 10.63 |
| 780 | 476.214 | 3.242 | 1561.98 | 10.64 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 781 | 477.066 | 3.247 | 1564.78 | 10.65 |
| 782 | 477.242 | 3.247 | 1565.35 | 10.65 |
| 783 | 478.002 | 3.252 | 1567.85 | 10.67 |
| 784 | 478.258 | 3.258 | 1568.69 | 10.68 |
| 785 | 478.914 | 3.279 | 1570.84 | 10.75 |
| 786 | 478.914 | 3.279 | 1570.84 | 10.75 |
| 787 | 479.255 | 3.289 | 1571.96 | 10.79 |
| 788 | 479.256 | 3.289 | 1571.96 | 10.79 |
| 789 | 479.862 | 3.352 | 1573.95 | 11.00 |
| 790 | 480.308 | 3.421 | 1575.41 | 11.22 |
| 791 | 480.308 | 3.421 | 1575.41 | 11.22 |
| 792 | 480.802 | 3.542 | 1577.03 | 11.62 |
| 793 | 481.310 | 3.690 | 1578.70 | 12.10 |
| 794 | 481.708 | 3.798 | 1580.00 | 12.46 |
| 795 | 481.708 | 3.798 | 1580.00 | 12.46 |
| 796 | 482.330 | 3.940 | 1582.04 | 12.92 |
| 797 | 482.658 | 4.011 | 1583.12 | 13.16 |
| 798 | 482.658 | 4.011 | 1583.12 | 13.16 |
| 799 | 483.349 | 4.134 | 1585.39 | 13.56 |
| 800 | 483.618 | 4.178 | 1586.27 | 13.70 |
| 801 | 484.369 | 4.308 | 1588.73 | 14.13 |
| 802 | 484.369 | 4.308 | 1588.73 | 14.13 |
| 803 | 484.527 | 4.333 | 1589.25 | 14.21 |
| 804 | 485.391 | 4.447 | 1592.08 | 14.59 |
| 805 | 485.476 | 4.457 | 1592.36 | 14.62 |
| 806 | 486.297 | 4.538 | 1595.05 | 14.88 |
| 807 | 486.297 | 4.538 | 1595.05 | 14.88 |
| 808 | 486.410 | 4.547 | 1595.42 | 14.91 |
| 809 | 486.417 | 4.548 | 1595.45 | 14.92 |
| 810 | 486.417 | 4.548 | 1595.45 | 14.92 |
| 811 | 487.394 | 4.579 | 1598.65 | 15.02 |
| 812 | 487.472 | 4.577 | 1598.91 | 15.01 |
| 813 | 488.384 | 4.567 | 1601.90 | 14.98 |
| 814 | 488.384 | 4.567 | 1601.90 | 14.98 |
| 815 | 488.528 | 4.572 | 1602.37 | 15.00 |
| 816 | 488.528 | 4.572 | 1602.37 | 15.00 |
| 817 | 489.369 | 4.625 | 1605.13 | 15.17 |
| 818 | 489.370 | 4.625 | 1605.13 | 15.17 |
| 819 | 489.563 | 4.645 | 1605.77 | 15.23 |
| 820 | 490.367 | 4.736 | 1608.40 | 15.53 |
| 821 | 490.614 | 4.759 | 1609.22 | 15.61 |
| 822 | 490.614 | 4.759 | 1609.22 | 15.61 |
| 823 | 491.355 | 4.823 | 1611.64 | 15.82 |
| 824 | 491.671 | 4.853 | 1612.68 | 15.92 |
| 825 | 492.342 | 4.914 | 1614.88 | 16.12 |
| 826 | 492.709 | 4.939 | 1616.09 | 16.20 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 827 | 493.319 | 4.974 | 1618.09 | 16.32 |
| 828 | 493.753 | 4.991 | 1619.51 | 16.37 |
| 829 | 493.753 | 4.991 | 1619.51 | 16.37 |
| 830 | 494.318 | 5.010 | 1621.36 | 16.43 |
| 831 | 494.818 | 5.023 | 1623.00 | 16.48 |
| 832 | 494.818 | 5.023 | 1623.00 | 16.48 |
| 833 | 495.302 | 5.034 | 1624.59 | 16.51 |
| 834 | 495.853 | 5.064 | 1626.40 | 16.61 |
| 835 | 495.854 | 5.064 | 1626.40 | 16.61 |
| 836 | 496.280 | 5.097 | 1627.80 | 16.72 |
| 837 | 496.894 | 5.144 | 1629.81 | 16.87 |
| 838 | 497.264 | 5.172 | 1631.03 | 16.96 |
| 839 | 497.945 | 5.209 | 1633.26 | 17.09 |
| 840 | 498.257 | 5.206 | 1634.28 | 17.08 |
| 841 | 498.986 | 5.168 | 1636.67 | 16.95 |
| 842 | 499.235 | 5.127 | 1637.49 | 16.82 |
| 843 | 499.464 | 5.091 | 1638.24 | 16.70 |
| 844 | 500.263 | 4.946 | 1640.86 | 16.22 |
| 845 | 501.061 | 4.769 | 1643.48 | 15.64 |
| 846 | 501.062 | 4.769 | 1643.48 | 15.64 |
| 847 | 501.195 | 4.745 | 1643.92 | 15.56 |
| 848 | 502.114 | 4.583 | 1646.94 | 15.03 |
| 849 | 502.188 | 4.578 | 1647.18 | 15.02 |
| 850 | 503.145 | 4.505 | 1650.32 | 14.78 |
| 851 | 503.173 | 4.504 | 1650.41 | 14.77 |
| 852 | 503.854 | 4.472 | 1652.64 | 14.67 |
| 853 | 504.536 | 4.447 | 1654.88 | 14.59 |
| 854 | 504.942 | 4.432 | 1656.21 | 14.54 |
| 855 | 505.444 | 4.412 | 1657.86 | 14.47 |
| 856 | 505.945 | 4.396 | 1659.50 | 14.42 |
| 857 | 505.945 | 4.396 | 1659.50 | 14.42 |
| 858 | 506.145 | 4.390 | 1660.16 | 14.40 |
| 859 | 506.391 | 4.382 | 1660.96 | 14.37 |
| 860 | 507.146 | 4.377 | 1663.44 | 14.35 |
| 861 | 507.146 | 4.377 | 1663.44 | 14.35 |
| 862 | 507.508 | 4.372 | 1664.63 | 14.34 |
| 863 | 508.131 | 4.371 | 1666.67 | 14.34 |
| 864 | 508.571 | 4.377 | 1668.11 | 14.36 |
| 865 | 508.571 | 4.377 | 1668.11 | 14.36 |
| 866 | 509.124 | 4.394 | 1669.93 | 14.41 |
| 867 | 509.125 | 4.394 | 1669.93 | 14.41 |
| 868 | 509.673 | 4.412 | 1671.73 | 14.47 |
| 869 | 510.489 | 4.406 | 1674.40 | 14.45 |
| 870 | 511.108 | 4.387 | 1676.44 | 14.39 |
| 871 | 511.108 | 4.387 | 1676.44 | 14.39 |
| 872 | 511.857 | 4.349 | 1678.89 | 14.27 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 873 | 512.103 | 4.347 | 1679.70 | 14.26 |
| 874 | 512.946 | 4.336 | 1682.46 | 14.22 |
| 875 | 512.946 | 4.336 | 1682.46 | 14.22 |
| 876 | 513.081 | 4.338 | 1682.90 | 14.23 |
| 877 | 514.014 | 4.342 | 1685.97 | 14.24 |
| 878 | 514.062 | 4.341 | 1686.12 | 14.24 |
| 879 | 514.062 | 4.341 | 1686.12 | 14.24 |
| 880 | 514.657 | 4.328 | 1688.08 | 14.19 |
| 881 | 514.658 | 4.328 | 1688.08 | 14.19 |
| 882 | 515.069 | 4.317 | 1689.43 | 14.16 |
| 883 | 515.089 | 4.316 | 1689.49 | 14.16 |
| 884 | 516.055 | 4.281 | 1692.66 | 14.04 |
| 885 | 516.055 | 4.281 | 1692.66 | 14.04 |
| 886 | 516.127 | 4.278 | 1692.90 | 14.03 |
| 887 | 516.127 | 4.278 | 1692.90 | 14.03 |
| 888 | 517.026 | 4.259 | 1695.85 | 13.97 |
| 889 | 517.160 | 4.256 | 1696.28 | 13.96 |
| 890 | 518.012 | 4.239 | 1699.08 | 13.90 |
| 891 | 518.196 | 4.235 | 1699.68 | 13.89 |
| 892 | 518.984 | 4.225 | 1702.27 | 13.86 |
| 893 | 519.181 | 4.223 | 1702.91 | 13.85 |
| 894 | 520.051 | 4.221 | 1705.77 | 13.85 |
| 895 | 520.464 | 4.221 | 1707.12 | 13.85 |
| 896 | 520.465 | 4.221 | 1707.12 | 13.85 |
| 897 | 521.035 | 4.220 | 1708.99 | 13.84 |
| 898 | 521.516 | 4.219 | 1710.57 | 13.84 |
| 899 | 521.914 | 4.222 | 1711.88 | 13.85 |
| 900 | 522.320 | 4.224 | 1713.21 | 13.85 |
| 901 | 522.320 | 4.224 | 1713.21 | 13.85 |
| 902 | 522.893 | 4.224 | 1715.09 | 13.85 |
| 903 | 523.341 | 4.222 | 1716.56 | 13.85 |
| 904 | 523.862 | 4.220 | 1718.27 | 13.84 |
| 905 | 523.863 | 4.220 | 1718.27 | 13.84 |
| 906 | 524.388 | 4.223 | 1719.99 | 13.85 |
| 907 | 524.849 | 4.226 | 1721.51 | 13.86 |
| 908 | 525.408 | 4.228 | 1723.34 | 13.87 |
| 909 | 525.408 | 4.228 | 1723.34 | 13.87 |
| 910 | 525.815 | 4.229 | 1724.67 | 13.87 |
| 911 | 526.415 | 4.236 | 1726.64 | 13.89 |
| 912 | 526.769 | 4.240 | 1727.80 | 13.91 |
| 913 | 526.769 | 4.240 | 1727.80 | 13.91 |
| 914 | 527.442 | 4.248 | 1730.01 | 13.93 |
| 915 | 527.747 | 4.251 | 1731.01 | 13.94 |
| 916 | 528.478 | 4.257 | 1733.41 | 13.96 |
| 917 | 528.478 | 4.257 | 1733.41 | 13.96 |
| 918 | 528.730 | 4.260 | 1734.23 | 13.97 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 919 | 529.470 | 4.274 | 1736.66 | 14.02 |
| 920 | 529.673 | 4.279 | 1737.33 | 14.03 |
| 921 | 530.475 | 4.302 | 1739.96 | 14.11 |
| 922 | 530.630 | 4.307 | 1740.47 | 14.13 |
| 923 | 531.457 | 4.329 | 1743.18 | 14.20 |
| 924 | 531.577 | 4.330 | 1743.57 | 14.20 |
| 925 | 531.577 | 4.330 | 1743.57 | 14.20 |
| 926 | 532.432 | 4.333 | 1746.38 | 14.21 |
| 927 | 532.503 | 4.333 | 1746.61 | 14.21 |
| 928 | 533.387 | 4.341 | 1749.51 | 14.24 |
| 929 | 533.387 | 4.341 | 1749.51 | 14.24 |
| 930 | 533.432 | 4.342 | 1749.66 | 14.24 |
| 931 | 533.432 | 4.342 | 1749.66 | 14.24 |
| 932 | 534.351 | 4.362 | 1752.67 | 14.31 |
| 933 | 534.351 | 4.362 | 1752.67 | 14.31 |
| 934 | 534.368 | 4.362 | 1752.73 | 14.31 |
| 935 | 534.368 | 4.362 | 1752.73 | 14.31 |
| 936 | 534.766 | 4.371 | 1754.03 | 14.34 |
| 937 | 534.766 | 4.371 | 1754.03 | 14.34 |
| 938 | 535.280 | 4.382 | 1755.72 | 14.37 |
| 939 | 535.320 | 4.383 | 1755.85 | 14.38 |
| 940 | 536.173 | 4.407 | 1758.65 | 14.46 |
| 941 | 536.174 | 4.407 | 1758.65 | 14.46 |
| 942 | 536.300 | 4.412 | 1759.06 | 14.47 |
| 943 | 536.300 | 4.412 | 1759.06 | 14.47 |
| 944 | 537.067 | 4.442 | 1761.58 | 14.57 |
| 945 | 537.279 | 4.452 | 1762.27 | 14.60 |
| 946 | 537.976 | 4.489 | 1764.56 | 14.72 |
| 947 | 538.265 | 4.505 | 1765.51 | 14.78 |
| 948 | 538.867 | 4.538 | 1767.49 | 14.88 |
| 949 | 539.244 | 4.559 | 1768.72 | 14.95 |
| 950 | 539.245 | 4.559 | 1768.72 | 14.95 |
| 951 | 539.760 | 4.588 | 1770.41 | 15.05 |
| 952 | 540.221 | 4.615 | 1771.92 | 15.14 |

Profile 2
Source: 2013 LiDAR Data

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 513 | 365.367 | 0.160 | 1198.40 | 0.52 |
| 514 | 366.263 | 0.184 | 1201.34 | 0.60 |
| 515 | 367.159 | 0.209 | 1204.28 | 0.68 |
| 516 | 368.056 | 0.232 | 1207.22 | 0.76 |
| 517 | 368.056 | 0.233 | 1207.22 | 0.76 |
| 518 | 368.954 | 0.257 | 1210.17 | 0.84 |
| 519 | 369.852 | 0.282 | 1213.11 | 0.92 |
| 520 | 370.750 | 0.308 | 1216.06 | 1.01 |
| 521 | 370.750 | 0.308 | 1216.06 | 1.01 |
| 522 | 371.422 | 0.329 | 1218.27 | 1.08 |
| 523 | 372.095 | 0.351 | 1220.47 | 1.15 |
| 524 | 372.768 | 0.374 | 1222.68 | 1.23 |
| 525 | 373.484 | 0.404 | 1225.03 | 1.32 |
| 526 | 374.201 | 0.435 | 1227.38 | 1.43 |
| 527 | 374.917 | 0.466 | 1229.73 | 1.53 |
| 528 | 374.918 | 0.466 | 1229.73 | 1.53 |
| 529 | 375.779 | 0.501 | 1232.55 | 1.64 |
| 530 | 376.640 | 0.533 | 1235.38 | 1.75 |
| 531 | 376.640 | 0.533 | 1235.38 | 1.75 |
| 532 | 377.529 | 0.562 | 1238.29 | 1.84 |
| 533 | 378.418 | 0.588 | 1241.21 | 1.93 |
| 534 | 379.306 | 0.613 | 1244.12 | 2.01 |
| 535 | 379.306 | 0.613 | 1244.12 | 2.01 |
| 536 | 379.889 | 0.629 | 1246.04 | 2.06 |
| 537 | 380.220 | 0.639 | 1247.12 | 2.09 |
| 538 | 381.054 | 0.665 | 1249.86 | 2.18 |
| 539 | 381.887 | 0.691 | 1252.59 | 2.27 |
| 540 | 382.721 | 0.715 | 1255.32 | 2.34 |
| 541 | 382.721 | 0.715 | 1255.32 | 2.34 |
| 542 | 383.350 | 0.728 | 1257.39 | 2.39 |
| 543 | 383.980 | 0.738 | 1259.46 | 2.42 |
| 544 | 383.980 | 0.738 | 1259.46 | 2.42 |
| 545 | 384.817 | 0.749 | 1262.20 | 2.46 |
| 546 | 385.654 | 0.757 | 1264.94 | 2.48 |
| 547 | 386.491 | 0.765 | 1267.69 | 2.51 |
| 548 | 387.166 | 0.774 | 1269.90 | 2.54 |
| 549 | 387.841 | 0.786 | 1272.12 | 2.58 |
| 550 | 388.517 | 0.800 | 1274.34 | 2.62 |
| 551 | 389.322 | 0.818 | 1276.98 | 2.68 |
| 552 | 390.128 | 0.834 | 1279.62 | 2.74 |
| 553 | 390.933 | 0.845 | 1282.26 | 2.77 |
| 554 | 391.476 | 0.849 | 1284.04 | 2.78 |
| 555 | 392.018 | 0.847 | 1285.82 | 2.78 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 556 | 392.018 | 0.847 | 1285.82 | 2.78 |
| 557 | 392.722 | 0.845 | 1288.13 | 2.77 |
| 558 | 393.426 | 0.842 | 1290.44 | 2.76 |
| 559 | 394.130 | 0.842 | 1292.75 | 2.76 |
| 560 | 394.991 | 0.844 | 1295.57 | 2.77 |
| 561 | 395.853 | 0.849 | 1298.40 | 2.78 |
| 562 | 396.743 | 0.855 | 1301.32 | 2.80 |
| 563 | 397.524 | 0.857 | 1303.88 | 2.81 |
| 564 | 398.306 | 0.857 | 1306.44 | 2.81 |
| 565 | 399.104 | 0.854 | 1309.06 | 2.80 |
| 566 | 399.901 | 0.849 | 1311.68 | 2.79 |
| 567 | 400.611 | 0.842 | 1314.00 | 2.76 |
| 568 | 401.320 | 0.832 | 1316.33 | 2.73 |
| 569 | 401.649 | 0.826 | 1317.41 | 2.71 |
| 570 | 402.397 | 0.812 | 1319.86 | 2.66 |
| 571 | 403.144 | 0.796 | 1322.31 | 2.61 |
| 572 | 403.892 | 0.782 | 1324.77 | 2.57 |
| 573 | 403.892 | 0.782 | 1324.77 | 2.57 |
| 574 | 404.597 | 0.770 | 1327.08 | 2.53 |
| 575 | 405.302 | 0.759 | 1329.39 | 2.49 |
| 576 | 405.302 | 0.759 | 1329.39 | 2.49 |
| 577 | 405.614 | 0.757 | 1330.41 | 2.48 |
| 578 | 405.614 | 0.757 | 1330.41 | 2.48 |
| 579 | 406.563 | 0.755 | 1333.53 | 2.48 |
| 580 | 406.563 | 0.755 | 1333.53 | 2.48 |
| 581 | 406.738 | 0.756 | 1334.10 | 2.48 |
| 582 | 406.937 | 0.758 | 1334.75 | 2.48 |
| 583 | 407.746 | 0.765 | 1337.41 | 2.51 |
| 584 | 407.747 | 0.765 | 1337.41 | 2.51 |
| 585 | 408.015 | 0.767 | 1338.29 | 2.52 |
| 586 | 408.761 | 0.775 | 1340.74 | 2.54 |
| 587 | 409.113 | 0.779 | 1341.89 | 2.56 |
| 588 | 409.113 | 0.779 | 1341.89 | 2.56 |
| 589 | 409.775 | 0.786 | 1344.06 | 2.58 |
| 590 | 409.775 | 0.786 | 1344.06 | 2.58 |
| 591 | 410.211 | 0.791 | 1345.49 | 2.59 |
| 592 | 410.799 | 0.796 | 1347.42 | 2.61 |
| 593 | 411.302 | 0.802 | 1349.07 | 2.63 |
| 594 | 411.302 | 0.802 | 1349.07 | 2.63 |
| 595 | 411.810 | 0.808 | 1350.74 | 2.65 |
| 596 | 412.402 | 0.813 | 1352.68 | 2.67 |
| 597 | 412.828 | 0.814 | 1354.08 | 2.67 |
| 598 | 413.196 | 0.815 | 1355.28 | 2.67 |
| 599 | 413.861 | 0.821 | 1357.47 | 2.69 |
| 600 | 414.587 | 0.832 | 1359.85 | 2.73 |
| 601 | 414.587 | 0.832 | 1359.85 | 2.73 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 602 | 414.855 | 0.836 | 1360.73 | 2.74 |
| 603 | 415.677 | 0.848 | 1363.42 | 2.78 |
| 604 | 415.677 | 0.848 | 1363.42 | 2.78 |
| 605 | 415.854 | 0.851 | 1364.00 | 2.79 |
| 606 | 416.039 | 0.854 | 1364.61 | 2.80 |
| 607 | 416.888 | 0.872 | 1367.39 | 2.86 |
| 608 | 416.972 | 0.874 | 1367.67 | 2.87 |
| 609 | 417.896 | 0.901 | 1370.70 | 2.96 |
| 610 | 418.859 | 0.941 | 1373.86 | 3.09 |
| 611 | 418.911 | 0.944 | 1374.03 | 3.10 |
| 612 | 418.974 | 0.947 | 1374.23 | 3.11 |
| 613 | 419.914 | 0.995 | 1377.32 | 3.26 |
| 614 | 420.070 | 1.003 | 1377.83 | 3.29 |
| 615 | 420.937 | 1.043 | 1380.67 | 3.42 |
| 616 | 421.180 | 1.056 | 1381.47 | 3.46 |
| 617 | 421.180 | 1.056 | 1381.47 | 3.46 |
| 618 | 421.948 | 1.100 | 1383.99 | 3.61 |
| 619 | 422.291 | 1.121 | 1385.12 | 3.68 |
| 620 | 422.946 | 1.162 | 1387.26 | 3.81 |
| 621 | 422.946 | 1.162 | 1387.26 | 3.81 |
| 622 | 423.394 | 1.193 | 1388.73 | 3.91 |
| 623 | 423.960 | 1.233 | 1390.59 | 4.05 |
| 624 | 424.499 | 1.275 | 1392.36 | 4.18 |
| 625 | 424.500 | 1.275 | 1392.36 | 4.18 |
| 626 | 424.980 | 1.314 | 1393.93 | 4.31 |
| 627 | 425.609 | 1.369 | 1396.00 | 4.49 |
| 628 | 425.979 | 1.402 | 1397.21 | 4.60 |
| 629 | 426.715 | 1.473 | 1399.63 | 4.83 |
| 630 | 426.987 | 1.501 | 1400.52 | 4.92 |
| 631 | 427.797 | 1.589 | 1403.17 | 5.21 |
| 632 | 427.987 | 1.611 | 1403.80 | 5.28 |
| 633 | 427.987 | 1.611 | 1403.80 | 5.28 |
| 634 | 428.884 | 1.716 | 1406.74 | 5.63 |
| 635 | 428.988 | 1.729 | 1407.08 | 5.67 |
| 636 | 429.817 | 1.834 | 1409.80 | 6.01 |
| 637 | 430.008 | 1.859 | 1410.43 | 6.10 |
| 638 | 430.024 | 1.861 | 1410.48 | 6.10 |
| 639 | 430.024 | 1.861 | 1410.48 | 6.10 |
| 640 | 430.997 | 1.996 | 1413.67 | 6.55 |
| 641 | 431.069 | 2.006 | 1413.91 | 6.58 |
| 642 | 431.069 | 2.006 | 1413.91 | 6.58 |
| 643 | 432.015 | 2.145 | 1417.01 | 7.04 |
| 644 | 432.149 | 2.165 | 1417.45 | 7.10 |
| 645 | 432.149 | 2.165 | 1417.45 | 7.10 |
| 646 | 433.045 | 2.294 | 1420.39 | 7.52 |
| 647 | 433.046 | 2.294 | 1420.39 | 7.52 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 648 | 433.251 | 2.322 | 1421.06 | 7.62 |
| 649 | 434.037 | 2.429 | 1423.64 | 7.97 |
| 650 | 434.317 | 2.465 | 1424.56 | 8.09 |
| 651 | 435.051 | 2.556 | 1426.97 | 8.38 |
| 652 | 435.052 | 2.556 | 1426.97 | 8.38 |
| 653 | 435.707 | 2.630 | 1429.12 | 8.63 |
| 654 | 436.078 | 2.671 | 1430.33 | 8.76 |
| 655 | 436.476 | 2.712 | 1431.64 | 8.90 |
| 656 | 436.476 | 2.712 | 1431.64 | 8.90 |
| 657 | 437.084 | 2.774 | 1433.64 | 9.10 |
| 658 | 437.564 | 2.821 | 1435.21 | 9.25 |
| 659 | 438.099 | 2.877 | 1436.97 | 9.44 |
| 660 | 438.641 | 2.936 | 1438.74 | 9.63 |
| 661 | 438.642 | 2.936 | 1438.74 | 9.63 |
| 662 | 439.098 | 2.985 | 1440.24 | 9.79 |
| 663 | 439.731 | 3.052 | 1442.32 | 10.01 |
| 664 | 440.125 | 3.095 | 1443.61 | 10.15 |
| 665 | 440.125 | 3.095 | 1443.61 | 10.15 |
| 666 | 440.796 | 3.173 | 1445.81 | 10.41 |
| 667 | 440.796 | 3.173 | 1445.81 | 10.41 |
| 668 | 441.129 | 3.213 | 1446.90 | 10.54 |
| 669 | 441.885 | 3.313 | 1449.38 | 10.87 |
| 670 | 442.135 | 3.347 | 1450.20 | 10.98 |
| 671 | 442.136 | 3.347 | 1450.20 | 10.98 |
| 672 | 442.944 | 3.433 | 1452.85 | 11.26 |
| 673 | 443.137 | 3.449 | 1453.49 | 11.31 |
| 674 | 444.028 | 3.480 | 1456.41 | 11.41 |
| 675 | 444.151 | 3.481 | 1456.82 | 11.42 |
| 676 | 445.130 | 3.476 | 1460.03 | 11.40 |
| 677 | 445.180 | 3.476 | 1460.19 | 11.40 |
| 678 | 445.180 | 3.476 | 1460.19 | 11.40 |
| 679 | 445.820 | 3.468 | 1462.29 | 11.37 |
| 680 | 446.182 | 3.461 | 1463.48 | 11.35 |
| 681 | 446.223 | 3.460 | 1463.61 | 11.35 |
| 682 | 447.165 | 3.439 | 1466.70 | 11.28 |
| 683 | 447.322 | 3.435 | 1467.22 | 11.27 |
| 684 | 447.322 | 3.435 | 1467.22 | 11.27 |
| 685 | 448.163 | 3.411 | 1469.98 | 11.19 |
| 686 | 448.412 | 3.403 | 1470.79 | 11.16 |
| 687 | 449.166 | 3.379 | 1473.27 | 11.08 |
| 688 | 449.489 | 3.369 | 1474.32 | 11.05 |
| 689 | 449.489 | 3.369 | 1474.32 | 11.05 |
| 690 | 450.149 | 3.349 | 1476.49 | 10.99 |
| 691 | 450.592 | 3.336 | 1477.94 | 10.94 |
| 692 | 451.137 | 3.320 | 1479.73 | 10.89 |
| 693 | 451.137 | 3.320 | 1479.73 | 10.89 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 694 | 451.688 | 3.300 | 1481.54 | 10.82 |
| 695 | 451.688 | 3.300 | 1481.54 | 10.82 |
| 696 | 452.127 | 3.283 | 1482.98 | 10.77 |
| 697 | 452.127 | 3.283 | 1482.98 | 10.77 |
| 698 | 452.783 | 3.254 | 1485.13 | 10.67 |
| 699 | 453.110 | 3.240 | 1486.20 | 10.63 |
| 700 | 453.110 | 3.240 | 1486.20 | 10.63 |
| 701 | 453.874 | 3.205 | 1488.71 | 10.51 |
| 702 | 453.874 | 3.205 | 1488.71 | 10.51 |
| 703 | 454.111 | 3.194 | 1489.48 | 10.48 |
| 704 | 454.969 | 3.146 | 1492.30 | 10.32 |
| 705 | 454.970 | 3.146 | 1492.30 | 10.32 |
| 706 | 455.095 | 3.139 | 1492.71 | 10.30 |
| 707 | 456.066 | 3.083 | 1495.90 | 10.11 |
| 708 | 456.079 | 3.082 | 1495.94 | 10.11 |
| 709 | 456.190 | 3.075 | 1496.30 | 10.09 |
| 710 | 456.190 | 3.075 | 1496.30 | 10.09 |
| 711 | 457.026 | 3.031 | 1499.05 | 9.94 |
| 712 | 457.088 | 3.028 | 1499.25 | 9.93 |
| 713 | 457.971 | 2.987 | 1502.14 | 9.80 |
| 714 | 458.103 | 2.982 | 1502.58 | 9.78 |
| 715 | 458.916 | 2.952 | 1505.24 | 9.68 |
| 716 | 459.111 | 2.946 | 1505.89 | 9.66 |
| 717 | 459.885 | 2.916 | 1508.42 | 9.56 |
| 718 | 460.138 | 2.904 | 1509.25 | 9.52 |
| 719 | 460.138 | 2.904 | 1509.25 | 9.52 |
| 720 | 460.826 | 2.869 | 1511.51 | 9.41 |
| 721 | 461.147 | 2.853 | 1512.56 | 9.36 |
| 722 | 461.147 | 2.853 | 1512.56 | 9.36 |
| 723 | 461.771 | 2.824 | 1514.61 | 9.26 |
| 724 | 461.771 | 2.824 | 1514.61 | 9.26 |
| 725 | 462.163 | 2.808 | 1515.89 | 9.21 |
| 726 | 462.717 | 2.786 | 1517.71 | 9.14 |
| 727 | 463.170 | 2.769 | 1519.20 | 9.08 |
| 728 | 463.666 | 2.751 | 1520.83 | 9.02 |
| 729 | 463.666 | 2.751 | 1520.83 | 9.02 |
| 730 | 464.187 | 2.734 | 1522.53 | 8.97 |
| 731 | 464.616 | 2.718 | 1523.94 | 8.92 |
| 732 | 464.616 | 2.718 | 1523.94 | 8.92 |
| 733 | 465.195 | 2.697 | 1525.84 | 8.84 |
| 734 | 465.568 | 2.681 | 1527.06 | 8.79 |
| 735 | 465.568 | 2.681 | 1527.06 | 8.79 |
| 736 | 466.206 | 2.653 | 1529.16 | 8.70 |
| 737 | 466.514 | 2.639 | 1530.17 | 8.65 |
| 738 | 466.514 | 2.639 | 1530.17 | 8.65 |
| 739 | 467.220 | 2.605 | 1532.48 | 8.54 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 740 | 467.220 | 2.605 | 1532.48 | 8.54 |
| 741 | 467.457 | 2.594 | 1533.26 | 8.51 |
| 742 | 468.215 | 2.566 | 1535.75 | 8.42 |
| 743 | 468.396 | 2.560 | 1536.34 | 8.40 |
| 744 | 469.231 | 2.528 | 1539.08 | 8.29 |
| 745 | 469.232 | 2.528 | 1539.08 | 8.29 |
| 746 | 469.338 | 2.524 | 1539.43 | 8.28 |
| 747 | 470.251 | 2.483 | 1542.42 | 8.14 |
| 748 | 470.252 | 2.483 | 1542.43 | 8.14 |
| 749 | 470.308 | 2.480 | 1542.61 | 8.14 |
| 750 | 471.088 | 2.444 | 1545.17 | 8.02 |
| 751 | 471.264 | 2.436 | 1545.75 | 7.99 |
| 752 | 471.285 | 2.435 | 1545.81 | 7.99 |
| 753 | 472.233 | 2.398 | 1548.93 | 7.86 |
| 754 | 472.357 | 2.393 | 1549.33 | 7.85 |
| 755 | 473.211 | 2.356 | 1552.13 | 7.73 |
| 756 | 473.437 | 2.345 | 1552.87 | 7.69 |
| 757 | 474.205 | 2.300 | 1555.39 | 7.54 |
| 758 | 474.574 | 2.272 | 1556.60 | 7.45 |
| 759 | 475.185 | 2.222 | 1558.61 | 7.29 |
| 760 | 475.662 | 2.177 | 1560.17 | 7.14 |
| 761 | 476.171 | 2.125 | 1561.84 | 6.97 |
| 762 | 476.769 | 2.052 | 1563.80 | 6.73 |
| 763 | 477.167 | 2.006 | 1565.11 | 6.58 |
| 764 | 477.167 | 2.006 | 1565.11 | 6.58 |
| 765 | 477.864 | 1.934 | 1567.39 | 6.34 |
| 766 | 477.864 | 1.934 | 1567.39 | 6.34 |
| 767 | 478.144 | 1.904 | 1568.31 | 6.25 |
| 768 | 478.144 | 1.904 | 1568.31 | 6.25 |
| 769 | 478.945 | 1.828 | 1570.94 | 6.00 |
| 770 | 478.945 | 1.828 | 1570.94 | 6.00 |
| 771 | 479.115 | 1.814 | 1571.50 | 5.95 |
| 772 | 479.115 | 1.814 | 1571.50 | 5.95 |
| 773 | 480.033 | 1.775 | 1574.51 | 5.82 |
| 774 | 480.117 | 1.772 | 1574.78 | 5.81 |
| 775 | 480.117 | 1.772 | 1574.78 | 5.81 |
| 776 | 480.816 | 1.760 | 1577.08 | 5.77 |
| 777 | 480.816 | 1.760 | 1577.08 | 5.77 |
| 778 | 481.079 | 1.757 | 1577.94 | 5.76 |
| 779 | 481.098 | 1.757 | 1578.00 | 5.76 |
| 780 | 482.048 | 1.749 | 1581.12 | 5.74 |
| 781 | 482.130 | 1.748 | 1581.39 | 5.73 |
| 782 | 483.039 | 1.742 | 1584.37 | 5.71 |
| 783 | 483.193 | 1.741 | 1584.87 | 5.71 |
| 784 | 483.995 | 1.740 | 1587.50 | 5.71 |
| 785 | 484.216 | 1.743 | 1588.23 | 5.72 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 786 | 484.963 | 1.753 | 1590.68 | 5.75 |
| 787 | 485.249 | 1.757 | 1591.62 | 5.76 |
| 788 | 485.953 | 1.767 | 1593.93 | 5.80 |
| 789 | 485.953 | 1.767 | 1593.93 | 5.80 |
| 790 | 486.304 | 1.780 | 1595.08 | 5.84 |
| 791 | 486.922 | 1.802 | 1597.10 | 5.91 |
| 792 | 487.335 | 1.819 | 1598.46 | 5.97 |
| 793 | 487.886 | 1.843 | 1600.27 | 6.05 |
| 794 | 488.349 | 1.868 | 1601.78 | 6.13 |
| 795 | 488.848 | 1.898 | 1603.42 | 6.23 |
| 796 | 489.383 | 1.932 | 1605.18 | 6.34 |
| 797 | 489.819 | 1.959 | 1606.61 | 6.42 |
| 798 | 489.819 | 1.959 | 1606.61 | 6.42 |
| 799 | 490.396 | 2.011 | 1608.50 | 6.60 |
| 800 | 490.769 | 2.069 | 1609.72 | 6.79 |
| 801 | 490.769 | 2.069 | 1609.72 | 6.79 |
| 802 | 491.401 | 2.182 | 1611.80 | 7.16 |
| 803 | 491.725 | 2.253 | 1612.86 | 7.39 |
| 804 | 492.424 | 2.404 | 1615.15 | 7.89 |
| 805 | 492.424 | 2.404 | 1615.15 | 7.89 |
| 806 | 492.690 | 2.453 | 1616.02 | 8.05 |
| 807 | 493.415 | 2.585 | 1618.40 | 8.48 |
| 808 | 493.628 | 2.620 | 1619.10 | 8.59 |
| 809 | 493.824 | 2.649 | 1619.74 | 8.69 |
| 810 | 493.824 | 2.649 | 1619.74 | 8.69 |
| 811 | 494.643 | 2.758 | 1622.43 | 9.04 |
| 812 | 495.461 | 2.805 | 1625.11 | 9.20 |
| 813 | 495.461 | 2.805 | 1625.11 | 9.20 |
| 814 | 495.555 | 2.809 | 1625.42 | 9.21 |
| 815 | 495.555 | 2.809 | 1625.42 | 9.21 |
| 816 | 496.495 | 2.793 | 1628.50 | 9.16 |
| 817 | 496.495 | 2.793 | 1628.50 | 9.16 |
| 818 | 496.516 | 2.792 | 1628.57 | 9.16 |
| 819 | 496.891 | 2.778 | 1629.80 | 9.11 |
| 820 | 497.441 | 2.749 | 1631.61 | 9.02 |
| 821 | 497.441 | 2.749 | 1631.61 | 9.02 |
| 822 | 497.489 | 2.746 | 1631.76 | 9.01 |
| 823 | 497.489 | 2.746 | 1631.76 | 9.01 |
| 824 | 497.547 | 2.743 | 1631.95 | 9.00 |
| 825 | 498.490 | 2.702 | 1635.05 | 8.86 |
| 826 | 499.237 | 2.669 | 1637.50 | 8.76 |
| 827 | 499.237 | 2.669 | 1637.50 | 8.76 |
| 828 | 499.439 | 2.658 | 1638.16 | 8.72 |
| 829 | 499.739 | 2.641 | 1639.14 | 8.66 |
| 830 | 499.739 | 2.641 | 1639.14 | 8.66 |
| 831 | 500.444 | 2.593 | 1641.46 | 8.50 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 832 | 500.830 | 2.563 | 1642.72 | 8.41 |
| 833 | 500.831 | 2.563 | 1642.72 | 8.41 |
| 834 | 501.436 | 2.526 | 1644.71 | 8.29 |
| 835 | 501.436 | 2.526 | 1644.71 | 8.29 |
| 836 | 501.925 | 2.500 | 1646.32 | 8.20 |
| 837 | 501.925 | 2.500 | 1646.32 | 8.20 |
| 838 | 502.411 | 2.475 | 1647.91 | 8.12 |
| 839 | 502.994 | 2.450 | 1649.82 | 8.03 |
| 840 | 502.994 | 2.450 | 1649.82 | 8.03 |
| 841 | 503.381 | 2.435 | 1651.09 | 7.99 |
| 842 | 504.090 | 2.416 | 1653.41 | 7.92 |
| 843 | 504.370 | 2.408 | 1654.33 | 7.90 |
| 844 | 504.370 | 2.408 | 1654.33 | 7.90 |
| 845 | 505.180 | 2.374 | 1656.99 | 7.79 |
| 846 | 505.355 | 2.367 | 1657.56 | 7.77 |
| 847 | 506.231 | 2.366 | 1660.44 | 7.76 |
| 848 | 506.299 | 2.367 | 1660.66 | 7.76 |
| 849 | 506.982 | 2.370 | 1662.90 | 7.77 |
| 850 | 506.982 | 2.370 | 1662.90 | 7.77 |
| 851 | 507.279 | 2.370 | 1663.87 | 7.77 |
| 852 | 507.279 | 2.370 | 1663.88 | 7.77 |
| 853 | 507.291 | 2.370 | 1663.91 | 7.77 |
| 854 | 508.241 | 2.362 | 1667.03 | 7.75 |
| 855 | 508.320 | 2.360 | 1667.29 | 7.74 |
| 856 | 509.185 | 2.353 | 1670.13 | 7.72 |
| 857 | 509.333 | 2.353 | 1670.61 | 7.72 |
| 858 | 510.094 | 2.354 | 1673.11 | 7.72 |
| 859 | 510.871 | 2.356 | 1675.66 | 7.73 |
| 860 | 510.871 | 2.356 | 1675.66 | 7.73 |
| 861 | 511.105 | 2.353 | 1676.42 | 7.72 |
| 862 | 511.373 | 2.349 | 1677.30 | 7.71 |
| 863 | 512.059 | 2.337 | 1679.55 | 7.67 |
| 864 | 512.059 | 2.337 | 1679.55 | 7.67 |
| 865 | 512.387 | 2.336 | 1680.63 | 7.66 |

Profile 3
Source: 2013 LiDAR Data

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 570 | 381.105 | 0.000 | 1250.03 | 0.00 |
| 571 | 382.044 | 0.036 | 1253.10 | 0.12 |
| 572 | 382.044 | 0.036 | 1253.10 | 0.12 |
| 573 | 383.026 | 0.268 | 1256.32 | 0.88 |
| 574 | 384.007 | 0.295 | 1259.54 | 0.97 |
| 575 | 384.988 | 0.361 | 1262.76 | 1.18 |
| 576 | 385.970 | 0.440 | 1265.98 | 1.44 |
| 577 | 386.951 | 0.515 | 1269.20 | 1.69 |
| 578 | 387.933 | 0.577 | 1272.42 | 1.89 |
| 579 | 388.914 | 0.623 | 1275.64 | 2.04 |
| 580 | 389.896 | 0.651 | 1278.86 | 2.13 |
| 581 | 390.877 | 0.673 | 1282.08 | 2.21 |
| 582 | 391.858 | 0.698 | 1285.30 | 2.29 |
| 583 | 392.840 | 0.725 | 1288.51 | 2.38 |
| 584 | 393.821 | 0.744 | 1291.73 | 2.44 |
| 585 | 394.803 | 0.755 | 1294.95 | 2.48 |
| 586 | 395.784 | 0.769 | 1298.17 | 2.52 |
| 587 | 396.766 | 0.788 | 1301.39 | 2.58 |
| 588 | 397.747 | 0.808 | 1304.61 | 2.65 |
| 589 | 398.728 | 0.830 | 1307.83 | 2.72 |
| 590 | 399.710 | 0.847 | 1311.05 | 2.78 |
| 591 | 400.691 | 0.853 | 1314.27 | 2.80 |
| 592 | 401.673 | 0.846 | 1317.49 | 2.77 |
| 593 | 402.654 | 0.853 | 1320.71 | 2.80 |
| 594 | 402.877 | 0.862 | 1321.44 | 2.83 |
| 595 | 403.619 | 0.897 | 1323.87 | 2.94 |
| 596 | 404.362 | 0.898 | 1326.31 | 2.95 |
| 597 | 405.104 | 0.901 | 1328.74 | 2.96 |
| 598 | 406.012 | 0.909 | 1331.72 | 2.98 |
| 599 | 406.920 | 0.927 | 1334.70 | 3.04 |
| 600 | 407.828 | 0.955 | 1337.67 | 3.13 |
| 601 | 408.365 | 0.963 | 1339.44 | 3.16 |
| 602 | 408.902 | 0.973 | 1341.20 | 3.19 |
| 603 | 409.264 | 0.983 | 1342.39 | 3.23 |
| 604 | 409.861 | 0.997 | 1344.34 | 3.27 |
| 605 | 410.173 | 1.002 | 1345.37 | 3.28 |
| 606 | 411.043 | 1.005 | 1348.22 | 3.30 |
| 607 | 411.043 | 1.005 | 1348.22 | 3.30 |
| 608 | 411.703 | 1.019 | 1350.39 | 3.34 |
| 609 | 411.914 | 1.028 | 1351.08 | 3.37 |
| 610 | 412.795 | 1.055 | 1353.97 | 3.46 |
| 611 | 412.955 | 1.060 | 1354.49 | 3.48 |
| 612 | 413.894 | 1.079 | 1357.57 | 3.54 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 613 | 413.977 | 1.080 | 1357.84 | 3.54 |
| 614 | 413.977 | 1.080 | 1357.84 | 3.54 |
| 615 | 414.478 | 1.087 | 1359.49 | 3.57 |
| 616 | 414.979 | 1.094 | 1361.13 | 3.59 |
| 617 | 414.979 | 1.094 | 1361.13 | 3.59 |
| 618 | 414.994 | 1.094 | 1361.18 | 3.59 |
| 619 | 415.239 | 1.097 | 1361.98 | 3.60 |
| 620 | 415.240 | 1.097 | 1361.99 | 3.60 |
| 621 | 415.985 | 1.107 | 1364.43 | 3.63 |
| 622 | 415.985 | 1.107 | 1364.43 | 3.63 |
| 623 | 416.042 | 1.108 | 1364.62 | 3.63 |
| 624 | 416.042 | 1.108 | 1364.62 | 3.63 |
| 625 | 416.962 | 1.125 | 1367.64 | 3.69 |
| 626 | 417.084 | 1.128 | 1368.03 | 3.70 |
| 627 | 417.925 | 1.139 | 1370.79 | 3.73 |
| 628 | 417.925 | 1.139 | 1370.79 | 3.73 |
| 629 | 418.146 | 1.141 | 1371.52 | 3.74 |
| 630 | 418.146 | 1.141 | 1371.52 | 3.74 |
| 631 | 418.902 | 1.151 | 1374.00 | 3.77 |
| 632 | 419.194 | 1.156 | 1374.95 | 3.79 |
| 633 | 419.854 | 1.167 | 1377.12 | 3.83 |
| 634 | 420.232 | 1.166 | 1378.36 | 3.82 |
| 635 | 420.232 | 1.166 | 1378.36 | 3.82 |
| 636 | 420.835 | 1.167 | 1380.34 | 3.83 |
| 637 | 420.835 | 1.167 | 1380.34 | 3.83 |
| 638 | 421.287 | 1.174 | 1381.82 | 3.85 |
| 639 | 421.803 | 1.183 | 1383.51 | 3.88 |
| 640 | 421.803 | 1.183 | 1383.51 | 3.88 |
| 641 | 422.244 | 1.190 | 1384.96 | 3.90 |
| 642 | 422.943 | 1.199 | 1387.25 | 3.93 |
| 643 | 423.379 | 1.204 | 1388.68 | 3.95 |
| 644 | 423.379 | 1.204 | 1388.68 | 3.95 |
| 645 | 423.748 | 1.210 | 1389.89 | 3.97 |
| 646 | 423.748 | 1.210 | 1389.89 | 3.97 |
| 647 | 424.426 | 1.218 | 1392.12 | 3.99 |
| 648 | 424.426 | 1.218 | 1392.12 | 3.99 |
| 649 | 424.705 | 1.219 | 1393.03 | 4.00 |
| 650 | 425.474 | 1.222 | 1395.55 | 4.01 |
| 651 | 425.670 | 1.224 | 1396.20 | 4.02 |
| 652 | 425.670 | 1.224 | 1396.20 | 4.02 |
| 653 | 426.523 | 1.234 | 1398.99 | 4.05 |
| 654 | 426.656 | 1.236 | 1399.43 | 4.05 |
| 655 | 427.566 | 1.246 | 1402.42 | 4.09 |
| 656 | 427.602 | 1.246 | 1402.54 | 4.09 |
| 657 | 427.994 | 1.247 | 1403.82 | 4.09 |
| 658 | 427.995 | 1.247 | 1403.82 | 4.09 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 659 | 428.606 | 1.250 | 1405.83 | 4.10 |
| 660 | 428.606 | 1.250 | 1405.83 | 4.10 |
| 661 | 428.648 | 1.251 | 1405.96 | 4.10 |
| 662 | 429.636 | 1.263 | 1409.21 | 4.14 |
| 663 | 429.726 | 1.263 | 1409.50 | 4.14 |
| 664 | 429.726 | 1.263 | 1409.50 | 4.14 |
| 665 | 430.515 | 1.258 | 1412.09 | 4.13 |
| 666 | 430.516 | 1.258 | 1412.09 | 4.13 |
| 667 | 431.463 | 1.263 | 1415.20 | 4.14 |
| 668 | 431.672 | 1.264 | 1415.89 | 4.15 |
| 669 | 431.672 | 1.264 | 1415.89 | 4.15 |
| 670 | 431.913 | 1.264 | 1416.68 | 4.15 |
| 671 | 432.699 | 1.265 | 1419.25 | 4.15 |
| 672 | 432.989 | 1.264 | 1420.20 | 4.15 |
| 673 | 433.716 | 1.261 | 1422.59 | 4.14 |
| 674 | 434.079 | 1.251 | 1423.78 | 4.10 |
| 675 | 434.737 | 1.231 | 1425.94 | 4.04 |
| 676 | 435.305 | 1.197 | 1427.80 | 3.93 |
| 677 | 435.778 | 1.158 | 1429.35 | 3.80 |
| 678 | 436.259 | 1.132 | 1430.93 | 3.71 |
| 679 | 436.780 | 1.113 | 1432.64 | 3.65 |
| 680 | 437.324 | 1.100 | 1434.42 | 3.61 |
| 681 | 437.324 | 1.100 | 1434.42 | 3.61 |
| 682 | 437.784 | 1.102 | 1435.93 | 3.61 |
| 683 | 438.388 | 1.102 | 1437.91 | 3.61 |
| 684 | 438.388 | 1.102 | 1437.91 | 3.61 |
| 685 | 438.806 | 1.102 | 1439.28 | 3.61 |
| 686 | 438.806 | 1.102 | 1439.28 | 3.61 |
| 687 | 439.495 | 1.104 | 1441.54 | 3.62 |
| 688 | 439.828 | 1.106 | 1442.64 | 3.63 |
| 689 | 439.828 | 1.106 | 1442.64 | 3.63 |
| 690 | 440.562 | 1.103 | 1445.04 | 3.62 |
| 691 | 440.834 | 1.097 | 1445.94 | 3.60 |
| 692 | 440.834 | 1.097 | 1445.94 | 3.60 |
| 693 | 441.660 | 1.076 | 1448.64 | 3.53 |
| 694 | 441.877 | 1.070 | 1449.36 | 3.51 |
| 695 | 441.877 | 1.070 | 1449.36 | 3.51 |
| 696 | 442.738 | 1.055 | 1452.18 | 3.46 |
| 697 | 442.879 | 1.056 | 1452.64 | 3.46 |
| 698 | 443.836 | 1.075 | 1455.78 | 3.53 |
| 699 | 443.908 | 1.078 | 1456.02 | 3.54 |
| 700 | 444.821 | 1.106 | 1459.01 | 3.63 |
| 701 | 444.922 | 1.109 | 1459.35 | 3.64 |
| 702 | 444.932 | 1.109 | 1459.38 | 3.64 |
| 703 | 444.933 | 1.109 | 1459.38 | 3.64 |
| 704 | 445.436 | 1.121 | 1461.03 | 3.68 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 705 | 445.940 | 1.128 | 1462.68 | 3.70 |
| 706 | 446.015 | 1.128 | 1462.93 | 3.70 |
| 707 | 446.988 | 1.131 | 1466.12 | 3.71 |
| 708 | 447.145 | 1.132 | 1466.63 | 3.71 |
| 709 | 448.001 | 1.133 | 1469.44 | 3.72 |
| 710 | 448.277 | 1.135 | 1470.35 | 3.72 |
| 711 | 449.036 | 1.143 | 1472.84 | 3.75 |
| 712 | 449.400 | 1.145 | 1474.03 | 3.75 |
| 713 | 450.070 | 1.150 | 1476.23 | 3.77 |
| 714 | 450.499 | 1.153 | 1477.64 | 3.78 |
| 715 | 451.078 | 1.155 | 1479.54 | 3.79 |
| 716 | 451.078 | 1.155 | 1479.54 | 3.79 |
| 717 | 451.602 | 1.159 | 1481.25 | 3.80 |
| 718 | 452.101 | 1.161 | 1482.89 | 3.81 |
| 719 | 452.725 | 1.211 | 1484.94 | 3.97 |
| 720 | 452.725 | 1.211 | 1484.94 | 3.97 |
| 721 | 453.144 | 1.250 | 1486.31 | 4.10 |
| 722 | 453.827 | 1.362 | 1488.55 | 4.47 |
| 723 | 454.156 | 1.430 | 1489.63 | 4.69 |
| 724 | 454.937 | 1.578 | 1492.19 | 5.18 |
| 725 | 455.171 | 1.622 | 1492.96 | 5.32 |
| 726 | 455.171 | 1.622 | 1492.96 | 5.32 |
| 727 | 456.047 | 1.785 | 1495.84 | 5.86 |
| 728 | 456.201 | 1.813 | 1496.34 | 5.95 |
| 729 | 457.153 | 2.052 | 1499.46 | 6.73 |
| 730 | 457.153 | 2.052 | 1499.46 | 6.73 |
| 731 | 457.209 | 2.068 | 1499.65 | 6.78 |
| 732 | 457.958 | 2.354 | 1502.10 | 7.72 |
| 733 | 457.959 | 2.354 | 1502.10 | 7.72 |
| 734 | 458.219 | 2.492 | 1502.96 | 8.17 |
| 735 | 458.234 | 2.500 | 1503.01 | 8.20 |
| 736 | 459.225 | 2.908 | 1506.26 | 9.54 |
| 737 | 459.314 | 2.934 | 1506.55 | 9.62 |
| 738 | 459.315 | 2.934 | 1506.55 | 9.62 |
| 739 | 460.218 | 3.096 | 1509.51 | 10.15 |
| 740 | 460.371 | 3.095 | 1510.02 | 10.15 |
| 741 | 461.226 | 3.078 | 1512.82 | 10.09 |
| 742 | 461.448 | 3.069 | 1513.55 | 10.07 |
| 743 | 462.231 | 3.041 | 1516.12 | 9.97 |
| 744 | 462.231 | 3.041 | 1516.12 | 9.97 |
| 745 | 462.495 | 3.033 | 1516.99 | 9.95 |
| 746 | 463.222 | 3.008 | 1519.37 | 9.87 |
| 747 | 463.565 | 2.996 | 1520.49 | 9.83 |
| 748 | 464.212 | 2.975 | 1522.61 | 9.76 |
| 749 | 464.603 | 2.963 | 1523.90 | 9.72 |
| 750 | 464.603 | 2.963 | 1523.90 | 9.72 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 751 | 465.220 | 2.941 | 1525.92 | 9.65 |
| 752 | 465.667 | 2.920 | 1527.39 | 9.58 |
| 753 | 466.222 | 2.895 | 1529.21 | 9.49 |
| 754 | 466.733 | 2.874 | 1530.88 | 9.43 |
| 755 | 467.215 | 2.856 | 1532.46 | 9.37 |
| 756 | 467.792 | 2.832 | 1534.36 | 9.29 |
| 757 | 468.216 | 2.816 | 1535.75 | 9.24 |
| 758 | 468.848 | 2.791 | 1537.82 | 9.15 |
| 759 | 469.202 | 2.776 | 1538.98 | 9.10 |
| 760 | 469.899 | 2.747 | 1541.27 | 9.01 |
| 761 | 470.196 | 2.736 | 1542.24 | 8.97 |
| 762 | 470.196 | 2.736 | 1542.24 | 8.97 |
| 763 | 470.968 | 2.702 | 1544.78 | 8.86 |
| 764 | 470.968 | 2.702 | 1544.78 | 8.86 |
| 765 | 471.217 | 2.693 | 1545.59 | 8.83 |
| 766 | 472.028 | 2.670 | 1548.25 | 8.76 |
| 767 | 472.210 | 2.666 | 1548.85 | 8.75 |
| 768 | 473.088 | 2.638 | 1551.73 | 8.65 |
| 769 | 473.088 | 2.638 | 1551.73 | 8.65 |
| 770 | 473.199 | 2.634 | 1552.09 | 8.64 |
| 771 | 474.150 | 2.603 | 1555.21 | 8.54 |
| 772 | 474.192 | 2.602 | 1555.35 | 8.53 |
| 773 | 474.192 | 2.602 | 1555.35 | 8.53 |
| 774 | 474.922 | 2.585 | 1557.74 | 8.48 |
| 775 | 474.922 | 2.585 | 1557.75 | 8.48 |
| 776 | 475.174 | 2.577 | 1558.57 | 8.45 |
| 777 | 475.195 | 2.576 | 1558.64 | 8.45 |
| 778 | 476.104 | 2.550 | 1561.62 | 8.37 |
| 779 | 476.104 | 2.550 | 1561.62 | 8.37 |
| 780 | 476.215 | 2.548 | 1561.99 | 8.36 |
| 781 | 477.067 | 2.522 | 1564.78 | 8.27 |
| 782 | 477.242 | 2.516 | 1565.35 | 8.25 |
| 783 | 478.003 | 2.496 | 1567.85 | 8.19 |
| 784 | 478.259 | 2.488 | 1568.69 | 8.16 |
| 785 | 478.915 | 2.460 | 1570.84 | 8.07 |
| 786 | 478.915 | 2.460 | 1570.84 | 8.07 |
| 787 | 479.256 | 2.446 | 1571.96 | 8.02 |
| 788 | 479.256 | 2.446 | 1571.96 | 8.02 |
| 789 | 479.862 | 2.433 | 1573.95 | 7.98 |
| 790 | 480.308 | 2.425 | 1575.41 | 7.95 |
| 791 | 480.309 | 2.425 | 1575.41 | 7.95 |
| 792 | 480.802 | 2.414 | 1577.03 | 7.92 |
| 793 | 481.310 | 2.401 | 1578.70 | 7.88 |
| 794 | 481.709 | 2.393 | 1580.00 | 7.85 |
| 795 | 481.709 | 2.393 | 1580.00 | 7.85 |
| 796 | 482.331 | 2.388 | 1582.04 | 7.83 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 797 | 482.659 | 2.385 | 1583.12 | 7.82 |
| 798 | 482.659 | 2.385 | 1583.12 | 7.82 |
| 799 | 483.350 | 2.371 | 1585.39 | 7.78 |
| 800 | 483.619 | 2.364 | 1586.27 | 7.75 |
| 801 | 484.370 | 2.347 | 1588.73 | 7.70 |
| 802 | 484.370 | 2.347 | 1588.73 | 7.70 |
| 803 | 484.528 | 2.343 | 1589.25 | 7.68 |
| 804 | 485.392 | 2.333 | 1592.08 | 7.65 |
| 805 | 485.476 | 2.332 | 1592.36 | 7.65 |
| 806 | 486.297 | 2.313 | 1595.05 | 7.59 |
| 807 | 486.297 | 2.313 | 1595.06 | 7.59 |
| 808 | 486.411 | 2.311 | 1595.43 | 7.58 |
| 809 | 486.417 | 2.310 | 1595.45 | 7.58 |
| 810 | 486.417 | 2.310 | 1595.45 | 7.58 |
| 811 | 487.394 | 2.295 | 1598.65 | 7.53 |
| 812 | 487.473 | 2.295 | 1598.91 | 7.53 |
| 813 | 488.384 | 2.284 | 1601.90 | 7.49 |
| 814 | 488.384 | 2.284 | 1601.90 | 7.49 |
| 815 | 488.528 | 2.281 | 1602.37 | 7.48 |
| 816 | 488.529 | 2.281 | 1602.37 | 7.48 |
| 817 | 489.370 | 2.263 | 1605.13 | 7.42 |
| 818 | 489.370 | 2.263 | 1605.13 | 7.42 |
| 819 | 489.563 | 2.258 | 1605.77 | 7.41 |
| 820 | 490.368 | 2.246 | 1608.41 | 7.37 |
| 821 | 490.615 | 2.247 | 1609.22 | 7.37 |
| 822 | 490.615 | 2.247 | 1609.22 | 7.37 |
| 823 | 491.355 | 2.246 | 1611.65 | 7.37 |
| 824 | 491.671 | 2.244 | 1612.68 | 7.36 |
| 825 | 492.342 | 2.241 | 1614.88 | 7.35 |
| 826 | 492.710 | 2.235 | 1616.09 | 7.33 |
| 827 | 493.319 | 2.223 | 1618.09 | 7.29 |
| 828 | 493.754 | 2.216 | 1619.51 | 7.27 |
| 829 | 493.754 | 2.216 | 1619.51 | 7.27 |
| 830 | 494.319 | 2.211 | 1621.37 | 7.25 |
| 831 | 494.819 | 2.203 | 1623.01 | 7.23 |
| 832 | 494.819 | 2.203 | 1623.01 | 7.23 |
| 833 | 495.303 | 2.193 | 1624.59 | 7.19 |
| 834 | 495.854 | 2.180 | 1626.40 | 7.15 |
| 835 | 495.854 | 2.180 | 1626.40 | 7.15 |
| 836 | 496.280 | 2.170 | 1627.80 | 7.12 |
| 837 | 496.894 | 2.153 | 1629.81 | 7.06 |
| 838 | 497.265 | 2.141 | 1631.03 | 7.02 |
| 839 | 497.946 | 2.119 | 1633.26 | 6.95 |
| 840 | 498.258 | 2.110 | 1634.29 | 6.92 |
| 841 | 498.986 | 2.090 | 1636.68 | 6.85 |
| 842 | 499.236 | 2.084 | 1637.49 | 6.84 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 843 | 499.465 | 2.079 | 1638.24 | 6.82 |
| 844 | 500.263 | 2.059 | 1640.86 | 6.75 |
| 845 | 501.062 | 2.046 | 1643.48 | 6.71 |
| 846 | 501.062 | 2.046 | 1643.48 | 6.71 |
| 847 | 501.196 | 2.043 | 1643.92 | 6.70 |
| 848 | 502.115 | 2.025 | 1646.94 | 6.64 |
| 849 | 502.188 | 2.023 | 1647.18 | 6.64 |
| 850 | 503.146 | 2.006 | 1650.32 | 6.58 |
| 851 | 503.173 | 2.006 | 1650.41 | 6.58 |
| 852 | 503.855 | 1.997 | 1652.64 | 6.55 |
| 853 | 504.537 | 1.993 | 1654.88 | 6.54 |
| 854 | 504.943 | 1.993 | 1656.21 | 6.54 |
| 855 | 505.445 | 1.992 | 1657.86 | 6.54 |
| 856 | 505.946 | 1.985 | 1659.50 | 6.51 |
| 857 | 505.946 | 1.985 | 1659.50 | 6.51 |
| 858 | 506.146 | 1.983 | 1660.16 | 6.51 |
| 859 | 506.392 | 1.982 | 1660.97 | 6.50 |
| 860 | 507.147 | 1.982 | 1663.44 | 6.50 |
| 861 | 507.147 | 1.982 | 1663.44 | 6.50 |
| 862 | 507.508 | 1.979 | 1664.63 | 6.49 |
| 863 | 508.132 | 1.973 | 1666.67 | 6.47 |
| 864 | 508.572 | 1.967 | 1668.12 | 6.45 |
| 865 | 508.572 | 1.967 | 1668.12 | 6.45 |
| 866 | 509.125 | 1.952 | 1669.93 | 6.40 |
| 867 | 509.125 | 1.952 | 1669.93 | 6.40 |
| 868 | 509.674 | 1.937 | 1671.73 | 6.35 |
| 869 | 510.490 | 1.940 | 1674.41 | 6.36 |
| 870 | 511.109 | 1.949 | 1676.44 | 6.39 |
| 871 | 511.109 | 1.949 | 1676.44 | 6.39 |
| 872 | 511.858 | 1.965 | 1678.89 | 6.45 |
| 873 | 512.104 | 1.980 | 1679.70 | 6.49 |
| 874 | 512.947 | 2.037 | 1682.47 | 6.68 |
| 875 | 512.947 | 2.037 | 1682.47 | 6.68 |
| 876 | 513.081 | 2.050 | 1682.91 | 6.72 |
| 877 | 514.015 | 2.151 | 1685.97 | 7.05 |
| 878 | 514.063 | 2.155 | 1686.13 | 7.07 |
| 879 | 514.063 | 2.155 | 1686.13 | 7.07 |
| 880 | 514.658 | 2.207 | 1688.08 | 7.24 |
| 881 | 514.658 | 2.207 | 1688.08 | 7.24 |
| 882 | 515.070 | 2.239 | 1689.43 | 7.34 |
| 883 | 515.089 | 2.239 | 1689.49 | 7.35 |
| 884 | 516.056 | 2.270 | 1692.66 | 7.45 |
| 885 | 516.056 | 2.270 | 1692.66 | 7.45 |
| 886 | 516.127 | 2.272 | 1692.90 | 7.45 |
| 887 | 516.128 | 2.272 | 1692.90 | 7.45 |
| 888 | 517.027 | 2.275 | 1695.85 | 7.46 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 889 | 517.161 | 2.275 | 1696.29 | 7.46 |
| 890 | 518.013 | 2.287 | 1699.08 | 7.50 |
| 891 | 518.197 | 2.290 | 1699.69 | 7.51 |
| 892 | 518.985 | 2.289 | 1702.27 | 7.51 |
| 893 | 519.182 | 2.288 | 1702.92 | 7.51 |
| 894 | 520.052 | 2.277 | 1705.77 | 7.47 |
| 895 | 520.465 | 2.271 | 1707.13 | 7.45 |
| 896 | 520.465 | 2.271 | 1707.13 | 7.45 |
| 897 | 521.035 | 2.271 | 1709.00 | 7.45 |
| 898 | 521.516 | 2.272 | 1710.57 | 7.45 |
| 899 | 521.915 | 2.273 | 1711.88 | 7.46 |
| 900 | 522.321 | 2.275 | 1713.21 | 7.46 |
| 901 | 522.321 | 2.275 | 1713.21 | 7.46 |
| 902 | 522.894 | 2.280 | 1715.09 | 7.48 |
| 903 | 523.342 | 2.289 | 1716.56 | 7.51 |
| 904 | 523.863 | 2.302 | 1718.27 | 7.55 |
| 905 | 523.863 | 2.302 | 1718.27 | 7.55 |
| 906 | 524.388 | 2.322 | 1719.99 | 7.62 |
| 907 | 524.850 | 2.338 | 1721.51 | 7.67 |
| 908 | 525.409 | 2.352 | 1723.34 | 7.72 |
| 909 | 525.409 | 2.352 | 1723.34 | 7.72 |
| 910 | 525.816 | 2.363 | 1724.68 | 7.75 |
| 911 | 526.416 | 2.376 | 1726.64 | 7.79 |
| 912 | 526.769 | 2.384 | 1727.80 | 7.82 |
| 913 | 526.769 | 2.384 | 1727.80 | 7.82 |
| 914 | 527.443 | 2.390 | 1730.01 | 7.84 |
| 915 | 527.748 | 2.391 | 1731.01 | 7.84 |
| 916 | 528.479 | 2.400 | 1733.41 | 7.87 |
| 917 | 528.479 | 2.400 | 1733.41 | 7.87 |
| 918 | 528.731 | 2.405 | 1734.24 | 7.89 |
| 919 | 529.471 | 2.421 | 1736.66 | 7.94 |
| 920 | 529.673 | 2.426 | 1737.33 | 7.96 |
| 921 | 530.476 | 2.448 | 1739.96 | 8.03 |
| 922 | 530.630 | 2.450 | 1740.47 | 8.04 |
| 923 | 531.458 | 2.463 | 1743.18 | 8.08 |
| 924 | 531.578 | 2.466 | 1743.58 | 8.09 |
| 925 | 531.578 | 2.466 | 1743.58 | 8.09 |
| 926 | 532.433 | 2.488 | 1746.38 | 8.16 |
| 927 | 532.504 | 2.490 | 1746.61 | 8.17 |
| 928 | 533.388 | 2.516 | 1749.51 | 8.25 |
| 929 | 533.388 | 2.516 | 1749.51 | 8.25 |
| 930 | 533.433 | 2.517 | 1749.66 | 8.26 |
| 931 | 533.433 | 2.517 | 1749.66 | 8.26 |
| 932 | 534.351 | 2.543 | 1752.67 | 8.34 |
| 933 | 534.352 | 2.543 | 1752.67 | 8.34 |
| 934 | 534.368 | 2.543 | 1752.73 | 8.34 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 935 | 534.369 | 2.543 | 1752.73 | 8.34 |
| 936 | 534.767 | 2.555 | 1754.04 | 8.38 |
| 937 | 534.767 | 2.555 | 1754.04 | 8.38 |
| 938 | 535.281 | 2.574 | 1755.72 | 8.44 |
| 939 | 535.321 | 2.576 | 1755.85 | 8.45 |
| 940 | 536.174 | 2.605 | 1758.65 | 8.54 |
| 941 | 536.174 | 2.605 | 1758.65 | 8.54 |
| 942 | 536.300 | 2.609 | 1759.06 | 8.56 |
| 943 | 536.300 | 2.609 | 1759.07 | 8.56 |
| 944 | 537.067 | 2.627 | 1761.58 | 8.62 |
| 945 | 537.280 | 2.633 | 1762.28 | 8.64 |
| 946 | 537.977 | 2.658 | 1764.56 | 8.72 |
| 947 | 538.266 | 2.677 | 1765.51 | 8.78 |
| 948 | 538.868 | 2.720 | 1767.49 | 8.92 |
| 949 | 539.245 | 2.759 | 1768.72 | 9.05 |
| 950 | 539.245 | 2.759 | 1768.72 | 9.05 |
| 951 | 539.760 | 2.819 | 1770.41 | 9.25 |
| 952 | 540.221 | 2.885 | 1771.93 | 9.46 |
| 953 | 540.221 | 2.885 | 1771.93 | 9.46 |
| 954 | 540.662 | 2.954 | 1773.37 | 9.69 |
| 955 | 540.662 | 2.954 | 1773.37 | 9.69 |
| 956 | 541.178 | 3.031 | 1775.06 | 9.94 |
| 957 | 541.178 | 3.031 | 1775.06 | 9.94 |
| 958 | 541.535 | 3.077 | 1776.24 | 10.09 |
| 959 | 541.535 | 3.077 | 1776.24 | 10.09 |
| 960 | 542.153 | 3.150 | 1778.26 | 10.33 |
| 961 | 542.425 | 3.163 | 1779.15 | 10.37 |
| 962 | 543.137 | 3.183 | 1781.49 | 10.44 |
| 963 | 543.325 | 3.180 | 1782.11 | 10.43 |
| 964 | 544.118 | 3.149 | 1784.71 | 10.33 |
| 965 | 544.218 | 3.145 | 1785.04 | 10.32 |
| 966 | 544.218 | 3.145 | 1785.04 | 10.32 |
| 967 | 545.077 | 3.107 | 1787.85 | 10.19 |
| 968 | 545.098 | 3.106 | 1787.92 | 10.19 |
| 969 | 545.381 | 3.095 | 1788.85 | 10.15 |
| 970 | 546.018 | 3.069 | 1790.94 | 10.07 |
| 971 | 546.018 | 3.069 | 1790.94 | 10.07 |
| 972 | 546.047 | 3.068 | 1791.03 | 10.06 |
| 973 | 546.958 | 3.061 | 1794.02 | 10.04 |
| 974 | 547.772 | 3.086 | 1796.69 | 10.12 |
| 975 | 548.058 | 3.098 | 1797.63 | 10.16 |
| 976 | 548.058 | 3.098 | 1797.63 | 10.16 |
| 977 | 548.817 | 3.133 | 1800.12 | 10.28 |

Profile 4
Source: 2013 LiDAR Data

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 570 | 381.106 | 0.000 | 1250.03 | 0.00 |
| 571 | 382.044 | -0.001 | 1253.11 | 0.00 |
| 572 | 382.045 | -0.001 | 1253.11 | 0.00 |
| 573 | 383.026 | 0.004 | 1256.33 | 0.01 |
| 574 | 384.007 | 0.045 | 1259.54 | 0.15 |
| 575 | 384.989 | 0.076 | 1262.76 | 0.25 |
| 576 | 385.970 | 0.103 | 1265.98 | 0.34 |
| 577 | 386.952 | 0.136 | 1269.20 | 0.44 |
| 578 | 387.933 | 0.177 | 1272.42 | 0.58 |
| 579 | 388.915 | 0.220 | 1275.64 | 0.72 |
| 580 | 389.896 | 0.266 | 1278.86 | 0.87 |
| 581 | 390.877 | 0.313 | 1282.08 | 1.03 |
| 582 | 391.859 | 0.366 | 1285.30 | 1.20 |
| 583 | 392.840 | 0.433 | 1288.52 | 1.42 |
| 584 | 393.822 | 0.513 | 1291.74 | 1.68 |
| 585 | 394.803 | 0.551 | 1294.95 | 1.81 |
| 586 | 395.785 | 0.602 | 1298.17 | 1.98 |
| 587 | 396.766 | 0.643 | 1301.39 | 2.11 |
| 588 | 397.747 | 0.679 | 1304.61 | 2.23 |
| 589 | 398.729 | 0.731 | 1307.83 | 2.40 |
| 590 | 399.710 | 0.775 | 1311.05 | 2.54 |
| 591 | 400.692 | 0.817 | 1314.27 | 2.68 |
| 592 | 401.673 | 0.861 | 1317.49 | 2.83 |
| 593 | 402.655 | 0.914 | 1320.71 | 3.00 |
| 594 | 402.877 | 0.924 | 1321.44 | 3.03 |
| 595 | 403.620 | 0.959 | 1323.87 | 3.15 |
| 596 | 404.362 | 0.999 | 1326.31 | 3.28 |
| 597 | 405.105 | 1.037 | 1328.74 | 3.40 |
| 598 | 406.012 | 1.087 | 1331.72 | 3.57 |
| 599 | 406.920 | 1.142 | 1334.70 | 3.74 |
| 600 | 407.828 | 1.201 | 1337.68 | 3.94 |
| 601 | 408.365 | 1.241 | 1339.44 | 4.07 |
| 602 | 408.902 | 1.279 | 1341.20 | 4.20 |
| 603 | 409.264 | 1.306 | 1342.39 | 4.28 |
| 604 | 409.861 | 1.349 | 1344.34 | 4.42 |
| 605 | 410.173 | 1.369 | 1345.37 | 4.49 |
| 606 | 411.044 | 1.422 | 1348.22 | 4.66 |
| 607 | 411.044 | 1.422 | 1348.22 | 4.66 |
| 608 | 411.704 | 1.467 | 1350.39 | 4.81 |
| 609 | 411.914 | 1.483 | 1351.08 | 4.86 |
| 610 | 412.795 | 1.537 | 1353.97 | 5.04 |
| 611 | 412.956 | 1.547 | 1354.49 | 5.07 |
| 612 | 413.895 | 1.600 | 1357.57 | 5.25 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 613 | 413.977 | 1.604 | 1357.84 | 5.26 |
| 614 | 413.977 | 1.604 | 1357.85 | 5.26 |
| 615 | 414.478 | 1.631 | 1359.49 | 5.35 |
| 616 | 414.979 | 1.657 | 1361.13 | 5.43 |
| 617 | 414.979 | 1.657 | 1361.13 | 5.43 |
| 618 | 414.994 | 1.658 | 1361.18 | 5.44 |
| 619 | 415.240 | 1.671 | 1361.99 | 5.48 |
| 620 | 415.240 | 1.671 | 1361.99 | 5.48 |
| 621 | 415.986 | 1.715 | 1364.43 | 5.62 |
| 622 | 415.986 | 1.715 | 1364.43 | 5.62 |
| 623 | 416.042 | 1.718 | 1364.62 | 5.64 |
| 624 | 416.042 | 1.718 | 1364.62 | 5.64 |
| 625 | 416.963 | 1.770 | 1367.64 | 5.81 |
| 626 | 417.084 | 1.777 | 1368.04 | 5.83 |
| 627 | 417.925 | 1.817 | 1370.79 | 5.96 |
| 628 | 417.925 | 1.817 | 1370.79 | 5.96 |
| 629 | 418.146 | 1.826 | 1371.52 | 5.99 |
| 630 | 418.146 | 1.826 | 1371.52 | 5.99 |
| 631 | 418.902 | 1.860 | 1374.00 | 6.10 |
| 632 | 419.194 | 1.874 | 1374.96 | 6.15 |
| 633 | 419.855 | 1.905 | 1377.12 | 6.25 |
| 634 | 420.233 | 1.922 | 1378.36 | 6.31 |
| 635 | 420.233 | 1.922 | 1378.36 | 6.31 |
| 636 | 420.835 | 1.950 | 1380.34 | 6.40 |
| 637 | 420.835 | 1.950 | 1380.34 | 6.40 |
| 638 | 421.287 | 1.973 | 1381.82 | 6.47 |
| 639 | 421.803 | 1.997 | 1383.52 | 6.55 |
| 640 | 421.804 | 1.997 | 1383.52 | 6.55 |
| 641 | 422.245 | 2.016 | 1384.96 | 6.61 |
| 642 | 422.943 | 2.045 | 1387.25 | 6.71 |
| 643 | 423.379 | 2.068 | 1388.68 | 6.78 |
| 644 | 423.379 | 2.068 | 1388.68 | 6.78 |
| 645 | 423.748 | 2.088 | 1389.89 | 6.85 |
| 646 | 423.749 | 2.088 | 1389.90 | 6.85 |
| 647 | 424.427 | 2.122 | 1392.12 | 6.96 |
| 648 | 424.427 | 2.122 | 1392.12 | 6.96 |
| 649 | 424.705 | 2.134 | 1393.03 | 7.00 |
| 650 | 425.474 | 2.165 | 1395.56 | 7.10 |
| 651 | 425.670 | 2.173 | 1396.20 | 7.13 |
| 652 | 425.671 | 2.173 | 1396.20 | 7.13 |
| 653 | 426.523 | 2.211 | 1399.00 | 7.25 |
| 654 | 426.656 | 2.217 | 1399.43 | 7.27 |
| 655 | 427.566 | 2.262 | 1402.42 | 7.42 |
| 656 | 427.603 | 2.263 | 1402.54 | 7.42 |
| 657 | 427.995 | 2.280 | 1403.82 | 7.48 |
| 658 | 427.995 | 2.280 | 1403.82 | 7.48 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 659 | 428.606 | 2.307 | 1405.83 | 7.57 |
| 660 | 428.606 | 2.307 | 1405.83 | 7.57 |
| 661 | 428.648 | 2.309 | 1405.97 | 7.57 |
| 662 | 429.636 | 2.356 | 1409.21 | 7.73 |
| 663 | 429.726 | 2.359 | 1409.50 | 7.74 |
| 664 | 429.727 | 2.359 | 1409.50 | 7.74 |
| 665 | 430.516 | 2.393 | 1412.09 | 7.85 |
| 666 | 430.516 | 2.393 | 1412.09 | 7.85 |
| 667 | 431.463 | 2.419 | 1415.20 | 7.94 |
| 668 | 431.673 | 2.425 | 1415.89 | 7.95 |
| 669 | 431.673 | 2.425 | 1415.89 | 7.95 |
| 670 | 431.914 | 2.430 | 1416.68 | 7.97 |
| 671 | 432.699 | 2.442 | 1419.25 | 8.01 |
| 672 | 432.989 | 2.449 | 1420.20 | 8.03 |
| 673 | 433.716 | 2.466 | 1422.59 | 8.09 |
| 674 | 434.080 | 2.470 | 1423.78 | 8.10 |
| 675 | 434.737 | 2.477 | 1425.94 | 8.12 |
| 676 | 435.306 | 2.482 | 1427.80 | 8.14 |
| 677 | 435.778 | 2.487 | 1429.35 | 8.16 |
| 678 | 436.259 | 2.486 | 1430.93 | 8.15 |
| 679 | 436.781 | 2.484 | 1432.64 | 8.15 |
| 680 | 437.324 | 2.486 | 1434.42 | 8.15 |
| 681 | 437.325 | 2.486 | 1434.42 | 8.15 |
| 682 | 437.784 | 2.490 | 1435.93 | 8.17 |
| 683 | 438.388 | 2.491 | 1437.91 | 8.17 |
| 684 | 438.388 | 2.491 | 1437.91 | 8.17 |
| 685 | 438.806 | 2.489 | 1439.28 | 8.16 |
| 686 | 438.806 | 2.489 | 1439.28 | 8.16 |
| 687 | 439.495 | 2.482 | 1441.54 | 8.14 |
| 688 | 439.828 | 2.478 | 1442.64 | 8.13 |
| 689 | 439.829 | 2.478 | 1442.64 | 8.13 |
| 690 | 440.563 | 2.476 | 1445.05 | 8.12 |
| 691 | 440.835 | 2.478 | 1445.94 | 8.13 |
| 692 | 440.835 | 2.478 | 1445.94 | 8.13 |
| 693 | 441.660 | 2.478 | 1448.65 | 8.13 |
| 694 | 441.877 | 2.477 | 1449.36 | 8.13 |
| 695 | 441.878 | 2.477 | 1449.36 | 8.13 |
| 696 | 442.738 | 2.476 | 1452.18 | 8.12 |
| 697 | 442.879 | 2.476 | 1452.64 | 8.12 |
| 698 | 443.836 | 2.471 | 1455.78 | 8.10 |
| 699 | 443.908 | 2.471 | 1456.02 | 8.10 |
| 700 | 444.822 | 2.469 | 1459.01 | 8.10 |
| 701 | 444.923 | 2.470 | 1459.35 | 8.10 |
| 702 | 444.933 | 2.470 | 1459.38 | 8.10 |
| 703 | 444.933 | 2.470 | 1459.38 | 8.10 |
| 704 | 445.437 | 2.473 | 1461.03 | 8.11 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 705 | 445.941 | 2.475 | 1462.69 | 8.12 |
| 706 | 446.015 | 2.474 | 1462.93 | 8.12 |
| 707 | 446.988 | 2.473 | 1466.12 | 8.11 |
| 708 | 447.145 | 2.474 | 1466.64 | 8.11 |
| 709 | 448.001 | 2.476 | 1469.44 | 8.12 |
| 710 | 448.277 | 2.476 | 1470.35 | 8.12 |
| 711 | 449.036 | 2.479 | 1472.84 | 8.13 |
| 712 | 449.401 | 2.483 | 1474.03 | 8.14 |
| 713 | 450.070 | 2.488 | 1476.23 | 8.16 |
| 714 | 450.500 | 2.489 | 1477.64 | 8.16 |
| 715 | 451.078 | 2.491 | 1479.54 | 8.17 |
| 716 | 451.078 | 2.491 | 1479.54 | 8.17 |
| 717 | 451.602 | 2.494 | 1481.26 | 8.18 |
| 718 | 452.102 | 2.495 | 1482.89 | 8.18 |
| 719 | 452.726 | 2.500 | 1484.94 | 8.20 |
| 720 | 452.726 | 2.500 | 1484.94 | 8.20 |
| 721 | 453.145 | 2.504 | 1486.31 | 8.21 |
| 722 | 453.827 | 2.511 | 1488.55 | 8.23 |
| 723 | 454.156 | 2.515 | 1489.63 | 8.25 |
| 724 | 454.938 | 2.517 | 1492.20 | 8.26 |
| 725 | 455.171 | 2.517 | 1492.96 | 8.26 |
| 726 | 455.171 | 2.517 | 1492.96 | 8.26 |
| 727 | 456.048 | 2.521 | 1495.84 | 8.27 |
| 728 | 456.201 | 2.521 | 1496.34 | 8.27 |
| 729 | 457.153 | 2.520 | 1499.46 | 8.27 |
| 730 | 457.154 | 2.520 | 1499.46 | 8.27 |
| 731 | 457.210 | 2.520 | 1499.65 | 8.27 |
| 732 | 457.959 | 2.524 | 1502.10 | 8.28 |
| 733 | 457.959 | 2.524 | 1502.11 | 8.28 |
| 734 | 458.219 | 2.526 | 1502.96 | 8.28 |
| 735 | 458.234 | 2.526 | 1503.01 | 8.28 |
| 736 | 459.225 | 2.530 | 1506.26 | 8.30 |
| 737 | 459.315 | 2.530 | 1506.55 | 8.30 |
| 738 | 459.315 | 2.530 | 1506.55 | 8.30 |
| 739 | 460.218 | 2.537 | 1509.52 | 8.32 |
| 740 | 460.372 | 2.539 | 1510.02 | 8.33 |
| 741 | 461.226 | 2.551 | 1512.82 | 8.37 |
| 742 | 461.449 | 2.554 | 1513.55 | 8.38 |
| 743 | 462.231 | 2.561 | 1516.12 | 8.40 |
| 744 | 462.231 | 2.561 | 1516.12 | 8.40 |
| 745 | 462.496 | 2.563 | 1516.99 | 8.41 |
| 746 | 463.222 | 2.575 | 1519.37 | 8.45 |
| 747 | 463.566 | 2.582 | 1520.50 | 8.47 |
| 748 | 464.212 | 2.590 | 1522.62 | 8.50 |
| 749 | 464.603 | 2.594 | 1523.90 | 8.51 |
| 750 | 464.603 | 2.594 | 1523.90 | 8.51 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 751 | 465.220 | 2.602 | 1525.92 | 8.53 |
| 752 | 465.668 | 2.611 | 1527.39 | 8.56 |
| 753 | 466.222 | 2.624 | 1529.21 | 8.61 |
| 754 | 466.734 | 2.634 | 1530.89 | 8.64 |
| 755 | 467.215 | 2.645 | 1532.47 | 8.68 |
| 756 | 467.792 | 2.661 | 1534.36 | 8.73 |
| 757 | 468.217 | 2.672 | 1535.75 | 8.77 |
| 758 | 468.848 | 2.679 | 1537.82 | 8.79 |
| 759 | 469.202 | 2.680 | 1538.98 | 8.79 |
| 760 | 469.899 | 2.691 | 1541.27 | 8.83 |
| 761 | 470.196 | 2.697 | 1542.24 | 8.85 |
| 762 | 470.196 | 2.697 | 1542.24 | 8.85 |
| 763 | 470.969 | 2.709 | 1544.78 | 8.88 |
| 764 | 470.969 | 2.709 | 1544.78 | 8.88 |
| 765 | 471.217 | 2.712 | 1545.59 | 8.90 |
| 766 | 472.029 | 2.723 | 1548.25 | 8.93 |
| 767 | 472.211 | 2.725 | 1548.85 | 8.94 |
| 768 | 473.088 | 2.729 | 1551.73 | 8.95 |
| 769 | 473.089 | 2.729 | 1551.73 | 8.95 |
| 770 | 473.200 | 2.729 | 1552.10 | 8.95 |
| 771 | 474.150 | 2.731 | 1555.21 | 8.96 |
| 772 | 474.193 | 2.731 | 1555.35 | 8.96 |
| 773 | 474.193 | 2.731 | 1555.35 | 8.96 |
| 774 | 474.922 | 2.729 | 1557.75 | 8.95 |
| 775 | 474.923 | 2.729 | 1557.75 | 8.95 |
| 776 | 475.175 | 2.726 | 1558.57 | 8.94 |
| 777 | 475.195 | 2.726 | 1558.64 | 8.94 |
| 778 | 476.104 | 2.715 | 1561.62 | 8.91 |
| 779 | 476.104 | 2.715 | 1561.62 | 8.91 |
| 780 | 476.215 | 2.714 | 1561.99 | 8.90 |
| 781 | 477.067 | 2.701 | 1564.78 | 8.86 |
| 782 | 477.243 | 2.697 | 1565.36 | 8.85 |
| 783 | 478.003 | 2.680 | 1567.85 | 8.79 |
| 784 | 478.259 | 2.676 | 1568.69 | 8.78 |
| 785 | 478.915 | 2.670 | 1570.84 | 8.76 |
| 786 | 478.915 | 2.670 | 1570.84 | 8.76 |
| 787 | 479.256 | 2.666 | 1571.96 | 8.74 |
| 788 | 479.257 | 2.666 | 1571.96 | 8.74 |
| 789 | 479.863 | 2.658 | 1573.95 | 8.72 |
| 790 | 480.309 | 2.654 | 1575.41 | 8.70 |
| 791 | 480.309 | 2.654 | 1575.41 | 8.70 |
| 792 | 480.803 | 2.648 | 1577.03 | 8.69 |
| 793 | 481.311 | 2.644 | 1578.70 | 8.67 |
| 794 | 481.709 | 2.644 | 1580.01 | 8.67 |
| 795 | 481.709 | 2.644 | 1580.01 | 8.67 |
| 796 | 482.331 | 2.647 | 1582.05 | 8.68 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 797 | 482.659 | 2.649 | 1583.12 | 8.69 |
| 798 | 482.659 | 2.649 | 1583.12 | 8.69 |
| 799 | 483.351 | 2.656 | 1585.39 | 8.71 |
| 800 | 483.619 | 2.658 | 1586.27 | 8.72 |
| 801 | 484.370 | 2.659 | 1588.73 | 8.72 |
| 802 | 484.370 | 2.659 | 1588.73 | 8.72 |
| 803 | 484.528 | 2.660 | 1589.25 | 8.72 |
| 804 | 485.392 | 2.664 | 1592.09 | 8.74 |
| 805 | 485.477 | 2.665 | 1592.36 | 8.74 |
| 806 | 486.298 | 2.677 | 1595.06 | 8.78 |
| 807 | 486.298 | 2.677 | 1595.06 | 8.78 |
| 808 | 486.411 | 2.678 | 1595.43 | 8.78 |
| 809 | 486.418 | 2.678 | 1595.45 | 8.78 |
| 810 | 486.418 | 2.678 | 1595.45 | 8.78 |
| 811 | 487.395 | 2.703 | 1598.66 | 8.86 |
| 812 | 487.473 | 2.705 | 1598.91 | 8.87 |
| 813 | 488.385 | 2.753 | 1601.90 | 9.03 |
| 814 | 488.385 | 2.754 | 1601.90 | 9.03 |
| 815 | 488.529 | 2.763 | 1602.37 | 9.06 |
| 816 | 488.529 | 2.763 | 1602.38 | 9.06 |
| 817 | 489.371 | 2.831 | 1605.14 | 9.29 |
| 818 | 489.371 | 2.831 | 1605.14 | 9.29 |
| 819 | 489.564 | 2.851 | 1605.77 | 9.35 |
| 820 | 490.368 | 2.957 | 1608.41 | 9.70 |
| 821 | 490.615 | 3.000 | 1609.22 | 9.84 |
| 822 | 490.616 | 3.000 | 1609.22 | 9.84 |
| 823 | 491.356 | 3.140 | 1611.65 | 10.30 |
| 824 | 491.672 | 3.203 | 1612.68 | 10.51 |
| 825 | 492.343 | 3.316 | 1614.88 | 10.88 |
| 826 | 492.711 | 3.354 | 1616.09 | 11.00 |
| 827 | 493.320 | 3.396 | 1618.09 | 11.14 |
| 828 | 493.754 | 3.398 | 1619.51 | 11.14 |
| 829 | 493.754 | 3.398 | 1619.51 | 11.14 |
| 830 | 494.320 | 3.398 | 1621.37 | 11.15 |
| 831 | 494.819 | 3.397 | 1623.01 | 11.14 |
| 832 | 494.819 | 3.397 | 1623.01 | 11.14 |
| 833 | 495.303 | 3.397 | 1624.59 | 11.14 |
| 834 | 495.855 | 3.400 | 1626.40 | 11.15 |
| 835 | 495.855 | 3.400 | 1626.40 | 11.15 |
| 836 | 496.281 | 3.402 | 1627.80 | 11.16 |
| 837 | 496.895 | 3.404 | 1629.81 | 11.16 |
| 838 | 497.265 | 3.405 | 1631.03 | 11.17 |
| 839 | 497.946 | 3.409 | 1633.26 | 11.18 |
| 840 | 498.258 | 3.414 | 1634.29 | 11.20 |
| 841 | 498.987 | 3.427 | 1636.68 | 11.24 |
| 842 | 499.236 | 3.433 | 1637.49 | 11.26 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 843 | 499.465 | 3.439 | 1638.25 | 11.28 |
| 844 | 500.264 | 3.457 | 1640.87 | 11.34 |
| 845 | 501.063 | 3.477 | 1643.49 | 11.41 |
| 846 | 501.063 | 3.477 | 1643.49 | 11.41 |
| 847 | 501.196 | 3.481 | 1643.92 | 11.42 |
| 848 | 502.116 | 3.517 | 1646.94 | 11.54 |
| 849 | 502.189 | 3.521 | 1647.18 | 11.55 |
| 850 | 503.146 | 3.582 | 1650.32 | 11.75 |
| 851 | 503.174 | 3.585 | 1650.41 | 11.76 |
| 852 | 503.855 | 3.649 | 1652.65 | 11.97 |
| 853 | 504.537 | 3.724 | 1654.88 | 12.21 |
| 854 | 504.944 | 3.770 | 1656.22 | 12.37 |
| 855 | 505.445 | 3.825 | 1657.86 | 12.55 |
| 856 | 505.946 | 3.876 | 1659.50 | 12.71 |
| 857 | 505.947 | 3.876 | 1659.50 | 12.71 |
| 858 | 506.146 | 3.897 | 1660.16 | 12.78 |
| 859 | 506.393 | 3.924 | 1660.97 | 12.87 |
| 860 | 507.148 | 4.007 | 1663.44 | 13.14 |
| 861 | 507.148 | 4.007 | 1663.44 | 13.14 |
| 862 | 507.509 | 4.052 | 1664.63 | 13.29 |
| 863 | 508.132 | 4.145 | 1666.67 | 13.60 |
| 864 | 508.572 | 4.205 | 1668.12 | 13.79 |
| 865 | 508.572 | 4.205 | 1668.12 | 13.79 |
| 866 | 509.126 | 4.278 | 1669.93 | 14.03 |
| 867 | 509.126 | 4.278 | 1669.93 | 14.03 |
| 868 | 509.674 | 4.344 | 1671.73 | 14.25 |
| 869 | 510.490 | 4.424 | 1674.41 | 14.51 |
| 870 | 511.109 | 4.474 | 1676.44 | 14.68 |
| 871 | 511.110 | 4.474 | 1676.44 | 14.68 |
| 872 | 511.858 | 4.536 | 1678.90 | 14.88 |
| 873 | 512.105 | 4.560 | 1679.70 | 14.96 |
| 874 | 512.947 | 4.643 | 1682.47 | 15.23 |
| 875 | 512.947 | 4.643 | 1682.47 | 15.23 |
| 876 | 513.082 | 4.654 | 1682.91 | 15.26 |
| 877 | 514.016 | 4.734 | 1685.97 | 15.53 |
| 878 | 514.063 | 4.738 | 1686.13 | 15.54 |
| 879 | 514.063 | 4.738 | 1686.13 | 15.54 |
| 880 | 514.658 | 4.790 | 1688.08 | 15.71 |
| 881 | 514.659 | 4.790 | 1688.08 | 15.71 |
| 882 | 515.070 | 4.831 | 1689.43 | 15.85 |
| 883 | 515.090 | 4.833 | 1689.49 | 15.85 |
| 884 | 516.056 | 4.954 | 1692.66 | 16.25 |
| 885 | 516.056 | 4.954 | 1692.66 | 16.25 |
| 886 | 516.128 | 4.965 | 1692.90 | 16.29 |
| 887 | 516.128 | 4.965 | 1692.90 | 16.29 |
| 888 | 517.028 | 5.139 | 1695.85 | 16.86 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 889 | 517.161 | 5.165 | 1696.29 | 16.94 |
| 890 | 518.013 | 5.303 | 1699.08 | 17.39 |
| 891 | 518.198 | 5.331 | 1699.69 | 17.48 |
| 892 | 518.985 | 5.419 | 1702.27 | 17.77 |
| 893 | 519.182 | 5.435 | 1702.92 | 17.83 |
| 894 | 520.052 | 5.520 | 1705.77 | 18.11 |
| 895 | 520.466 | 5.557 | 1707.13 | 18.23 |
| 896 | 520.466 | 5.557 | 1707.13 | 18.23 |
| 897 | 521.036 | 5.608 | 1709.00 | 18.40 |
| 898 | 521.517 | 5.640 | 1710.58 | 18.50 |
| 899 | 521.915 | 5.660 | 1711.88 | 18.57 |
| 900 | 522.321 | 5.675 | 1713.21 | 18.61 |
| 901 | 522.321 | 5.675 | 1713.21 | 18.61 |
| 902 | 522.894 | 5.696 | 1715.09 | 18.68 |
| 903 | 523.342 | 5.713 | 1716.56 | 18.74 |
| 904 | 523.864 | 5.718 | 1718.27 | 18.75 |
| 905 | 523.864 | 5.718 | 1718.27 | 18.76 |
| 906 | 524.389 | 5.714 | 1720.00 | 18.74 |
| 907 | 524.850 | 5.692 | 1721.51 | 18.67 |
| 908 | 525.409 | 5.624 | 1723.34 | 18.45 |
| 909 | 525.410 | 5.623 | 1723.34 | 18.44 |
| 910 | 525.817 | 5.567 | 1724.68 | 18.26 |
| 911 | 526.416 | 5.450 | 1726.65 | 17.88 |
| 912 | 526.770 | 5.392 | 1727.80 | 17.69 |
| 913 | 526.770 | 5.392 | 1727.81 | 17.69 |
| 914 | 527.443 | 5.278 | 1730.01 | 17.31 |
| 915 | 527.748 | 5.228 | 1731.01 | 17.15 |
| 916 | 528.479 | 5.134 | 1733.41 | 16.84 |
| 917 | 528.479 | 5.134 | 1733.41 | 16.84 |
| 918 | 528.731 | 5.107 | 1734.24 | 16.75 |
| 919 | 529.471 | 5.058 | 1736.67 | 16.59 |
| 920 | 529.674 | 5.050 | 1737.33 | 16.56 |
| 921 | 530.476 | 5.022 | 1739.96 | 16.47 |
| 922 | 530.631 | 5.017 | 1740.47 | 16.46 |
| 923 | 531.459 | 4.997 | 1743.18 | 16.39 |
| 924 | 531.578 | 4.994 | 1743.58 | 16.38 |
| 925 | 531.578 | 4.994 | 1743.58 | 16.38 |
| 926 | 532.433 | 4.960 | 1746.38 | 16.27 |
| 927 | 532.504 | 4.956 | 1746.61 | 16.26 |
| 928 | 533.389 | 4.913 | 1749.51 | 16.12 |
| 929 | 533.389 | 4.913 | 1749.51 | 16.12 |
| 930 | 533.433 | 4.912 | 1749.66 | 16.11 |
| 931 | 533.433 | 4.912 | 1749.66 | 16.11 |
| 932 | 534.352 | 4.895 | 1752.67 | 16.06 |
| 933 | 534.352 | 4.895 | 1752.67 | 16.06 |
| 934 | 534.369 | 4.895 | 1752.73 | 16.05 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 935 | 534.369 | 4.895 | 1752.73 | 16.05 |
| 936 | 534.767 | 4.903 | 1754.04 | 16.08 |
| 937 | 534.767 | 4.903 | 1754.04 | 16.08 |
| 938 | 535.281 | 4.912 | 1755.72 | 16.11 |
| 939 | 535.322 | 4.913 | 1755.85 | 16.11 |
| 940 | 536.175 | 4.892 | 1758.65 | 16.05 |
| 941 | 536.175 | 4.892 | 1758.65 | 16.05 |
| 942 | 536.301 | 4.887 | 1759.07 | 16.03 |
| 943 | 536.301 | 4.887 | 1759.07 | 16.03 |
| 944 | 537.068 | 4.828 | 1761.58 | 15.83 |
| 945 | 537.280 | 4.808 | 1762.28 | 15.77 |
| 946 | 537.977 | 4.757 | 1764.56 | 15.60 |
| 947 | 538.267 | 4.743 | 1765.51 | 15.56 |
| 948 | 538.869 | 4.723 | 1767.49 | 15.49 |
| 949 | 539.246 | 4.725 | 1768.73 | 15.50 |
| 950 | 539.246 | 4.725 | 1768.73 | 15.50 |
| 951 | 539.761 | 4.729 | 1770.42 | 15.51 |
| 952 | 540.222 | 4.738 | 1771.93 | 15.54 |
| 953 | 540.222 | 4.738 | 1771.93 | 15.54 |
| 954 | 540.662 | 4.747 | 1773.37 | 15.57 |
| 955 | 540.662 | 4.747 | 1773.37 | 15.57 |
| 956 | 541.179 | 4.758 | 1775.07 | 15.61 |
| 957 | 541.179 | 4.758 | 1775.07 | 15.61 |
| 958 | 541.536 | 4.764 | 1776.24 | 15.63 |
| 959 | 541.536 | 4.764 | 1776.24 | 15.63 |
| 960 | 542.154 | 4.765 | 1778.26 | 15.63 |
| 961 | 542.426 | 4.759 | 1779.16 | 15.61 |
| 962 | 543.137 | 4.735 | 1781.49 | 15.53 |
| 963 | 543.326 | 4.733 | 1782.11 | 15.52 |
| 964 | 544.119 | 4.718 | 1784.71 | 15.48 |
| 965 | 544.219 | 4.717 | 1785.04 | 15.47 |
| 966 | 544.219 | 4.717 | 1785.04 | 15.47 |
| 967 | 545.077 | 4.721 | 1787.85 | 15.49 |
| 968 | 545.099 | 4.721 | 1787.92 | 15.49 |
| 969 | 545.381 | 4.720 | 1788.85 | 15.48 |
| 970 | 546.018 | 4.705 | 1790.94 | 15.43 |
| 971 | 546.018 | 4.705 | 1790.94 | 15.43 |
| 972 | 546.047 | 4.704 | 1791.03 | 15.43 |
| 973 | 546.959 | 4.667 | 1794.02 | 15.31 |
| 974 | 547.772 | 4.645 | 1796.69 | 15.24 |
| 975 | 548.058 | 4.644 | 1797.63 | 15.23 |
| 976 | 548.058 | 4.644 | 1797.63 | 15.23 |
| 977 | 548.818 | 4.636 | 1800.12 | 15.21 |
| 978 | 549.577 | 4.620 | 1802.61 | 15.15 |
| 979 | 549.789 | 4.614 | 1803.31 | 15.13 |
| 980 | 550.018 | 4.608 | 1804.06 | 15.11 |

| Index | X-meters | Y-meters | X-feet | Y-feet |
|---|---|---|---|---|
| 981 | 550.741 | 4.602 | 1806.43 | 15.10 |
| 982 | 551.380 | 4.603 | 1808.53 | 15.10 |
| 983 | 551.380 | 4.603 | 1808.53 | 15.10 |
| 984 | 551.815 | 4.603 | 1809.95 | 15.10 |
| 985 | 552.111 | 4.606 | 1810.92 | 15.11 |
| 986 | 552.111 | 4.606 | 1810.92 | 15.11 |
| 987 | 552.860 | 4.606 | 1813.38 | 15.11 |
| 988 | 552.994 | 4.602 | 1813.82 | 15.10 |
| 989 | 552.994 | 4.602 | 1813.82 | 15.10 |
| 990 | 553.550 | 4.586 | 1815.64 | 15.04 |
| 991 | 553.550 | 4.586 | 1815.64 | 15.04 |
| 992 | 554.001 | 4.575 | 1817.12 | 15.01 |
| 993 | 554.001 | 4.575 | 1817.12 | 15.01 |
| 994 | 554.508 | 4.575 | 1818.79 | 15.01 |
| 995 | 554.998 | 4.580 | 1820.39 | 15.02 |
| 996 | 555.441 | 4.595 | 1821.85 | 15.07 |
| 997 | 555.983 | 4.610 | 1823.62 | 15.12 |
| 998 | 556.380 | 4.617 | 1824.93 | 15.15 |
| 999 | 556.971 | 4.630 | 1826.87 | 15.19 |

Profile 5
Source: 2013 LiDAR Data

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 590 | 399.710 | -0.001 | 1311.05 | 0.00 |
| 591 | 400.692 | -0.023 | 1314.27 | -0.08 |
| 592 | 401.673 | -0.023 | 1317.49 | -0.08 |
| 593 | 402.655 | -0.005 | 1320.71 | -0.02 |
| 594 | 402.877 | 0.000 | 1321.44 | 0.00 |
| 595 | 403.620 | 0.043 | 1323.87 | 0.14 |
| 596 | 404.362 | 0.088 | 1326.31 | 0.29 |
| 597 | 405.105 | 0.131 | 1328.74 | 0.43 |
| 598 | 406.013 | 0.183 | 1331.72 | 0.60 |
| 599 | 406.920 | 0.233 | 1334.70 | 0.76 |
| 600 | 407.828 | 0.300 | 1337.68 | 0.98 |
| 601 | 408.365 | 0.346 | 1339.44 | 1.13 |
| 602 | 408.903 | 0.425 | 1341.20 | 1.39 |
| 603 | 409.265 | 0.483 | 1342.39 | 1.59 |
| 604 | 409.861 | 0.572 | 1344.34 | 1.88 |
| 605 | 410.174 | 0.611 | 1345.37 | 2.00 |
| 606 | 411.044 | 0.674 | 1348.22 | 2.21 |
| 607 | 411.044 | 0.674 | 1348.22 | 2.21 |
| 608 | 411.704 | 0.702 | 1350.39 | 2.30 |
| 609 | 411.914 | 0.709 | 1351.08 | 2.33 |
| 610 | 412.795 | 0.737 | 1353.97 | 2.42 |
| 611 | 412.956 | 0.739 | 1354.49 | 2.42 |
| 612 | 413.895 | 0.762 | 1357.58 | 2.50 |
| 613 | 413.977 | 0.772 | 1357.85 | 2.53 |
| 614 | 413.977 | 0.772 | 1357.85 | 2.53 |
| 615 | 414.478 | 0.833 | 1359.49 | 2.73 |
| 616 | 414.979 | 0.881 | 1361.13 | 2.89 |
| 617 | 414.979 | 0.881 | 1361.13 | 2.89 |
| 618 | 414.994 | 0.882 | 1361.18 | 2.89 |
| 619 | 415.240 | 0.897 | 1361.99 | 2.94 |
| 620 | 415.240 | 0.897 | 1361.99 | 2.94 |
| 621 | 415.986 | 0.938 | 1364.43 | 3.08 |
| 622 | 415.986 | 0.938 | 1364.43 | 3.08 |
| 623 | 416.042 | 0.939 | 1364.62 | 3.08 |
| 624 | 416.043 | 0.939 | 1364.62 | 3.08 |
| 625 | 416.963 | 0.977 | 1367.64 | 3.20 |
| 626 | 417.084 | 0.985 | 1368.04 | 3.23 |
| 627 | 417.925 | 1.034 | 1370.79 | 3.39 |
| 628 | 417.925 | 1.034 | 1370.79 | 3.39 |
| 629 | 418.146 | 1.048 | 1371.52 | 3.44 |
| 630 | 418.146 | 1.048 | 1371.52 | 3.44 |
| 631 | 418.902 | 1.107 | 1374.00 | 3.63 |
| 632 | 419.194 | 1.131 | 1374.96 | 3.71 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 633 | 419.855 | 1.197 | 1377.12 | 3.93 |
| 634 | 420.233 | 1.235 | 1378.36 | 4.05 |
| 635 | 420.233 | 1.235 | 1378.36 | 4.05 |
| 636 | 420.835 | 1.288 | 1380.34 | 4.22 |
| 637 | 420.835 | 1.288 | 1380.34 | 4.22 |
| 638 | 421.288 | 1.324 | 1381.82 | 4.34 |
| 639 | 421.804 | 1.371 | 1383.52 | 4.50 |
| 640 | 421.804 | 1.371 | 1383.52 | 4.50 |
| 641 | 422.245 | 1.412 | 1384.96 | 4.63 |
| 642 | 422.943 | 1.472 | 1387.25 | 4.83 |
| 643 | 423.379 | 1.510 | 1388.68 | 4.95 |
| 644 | 423.380 | 1.510 | 1388.69 | 4.95 |
| 645 | 423.749 | 1.542 | 1389.90 | 5.06 |
| 646 | 423.749 | 1.542 | 1389.90 | 5.06 |
| 647 | 424.427 | 1.606 | 1392.12 | 5.27 |
| 648 | 424.427 | 1.606 | 1392.12 | 5.27 |
| 649 | 424.705 | 1.632 | 1393.03 | 5.35 |
| 650 | 425.474 | 1.692 | 1395.56 | 5.55 |
| 651 | 425.671 | 1.707 | 1396.20 | 5.60 |
| 652 | 425.671 | 1.707 | 1396.20 | 5.60 |
| 653 | 426.523 | 1.781 | 1399.00 | 5.84 |
| 654 | 426.656 | 1.793 | 1399.43 | 5.88 |
| 655 | 427.567 | 1.875 | 1402.42 | 6.15 |
| 656 | 427.603 | 1.878 | 1402.54 | 6.16 |
| 657 | 427.995 | 1.910 | 1403.82 | 6.26 |
| 658 | 427.995 | 1.910 | 1403.82 | 6.26 |
| 659 | 428.606 | 1.957 | 1405.83 | 6.42 |
| 660 | 428.607 | 1.957 | 1405.83 | 6.42 |
| 661 | 428.648 | 1.960 | 1405.97 | 6.43 |
| 662 | 429.637 | 2.040 | 1409.21 | 6.69 |
| 663 | 429.727 | 2.048 | 1409.50 | 6.72 |
| 664 | 429.727 | 2.048 | 1409.50 | 6.72 |
| 665 | 430.516 | 2.116 | 1412.09 | 6.94 |
| 666 | 430.516 | 2.116 | 1412.09 | 6.94 |
| 667 | 431.463 | 2.201 | 1415.20 | 7.22 |
| 668 | 431.673 | 2.221 | 1415.89 | 7.28 |
| 669 | 431.673 | 2.221 | 1415.89 | 7.28 |
| 670 | 431.914 | 2.244 | 1416.68 | 7.36 |
| 671 | 432.699 | 2.314 | 1419.25 | 7.59 |
| 672 | 432.989 | 2.340 | 1420.20 | 7.67 |
| 673 | 433.716 | 2.402 | 1422.59 | 7.88 |
| 674 | 434.080 | 2.433 | 1423.78 | 7.98 |
| 675 | 434.737 | 2.484 | 1425.94 | 8.15 |
| 676 | 435.306 | 2.524 | 1427.80 | 8.28 |
| 677 | 435.779 | 2.559 | 1429.35 | 8.39 |
| 678 | 436.259 | 2.598 | 1430.93 | 8.52 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 679 | 436.781 | 2.641 | 1432.64 | 8.66 |
| 680 | 437.325 | 2.685 | 1434.42 | 8.81 |
| 681 | 437.325 | 2.685 | 1434.43 | 8.81 |
| 682 | 437.784 | 2.719 | 1435.93 | 8.92 |
| 683 | 438.388 | 2.755 | 1437.91 | 9.04 |
| 684 | 438.388 | 2.755 | 1437.91 | 9.04 |
| 685 | 438.806 | 2.778 | 1439.28 | 9.11 |
| 686 | 438.806 | 2.778 | 1439.28 | 9.11 |
| 687 | 439.495 | 2.815 | 1441.54 | 9.23 |
| 688 | 439.829 | 2.832 | 1442.64 | 9.29 |
| 689 | 439.829 | 2.832 | 1442.64 | 9.29 |
| 690 | 440.563 | 2.862 | 1445.05 | 9.39 |
| 691 | 440.835 | 2.873 | 1445.94 | 9.42 |
| 692 | 440.835 | 2.873 | 1445.94 | 9.42 |
| 693 | 441.660 | 2.900 | 1448.65 | 9.51 |
| 694 | 441.878 | 2.908 | 1449.36 | 9.54 |
| 695 | 441.878 | 2.908 | 1449.36 | 9.54 |
| 696 | 442.738 | 2.925 | 1452.18 | 9.59 |
| 697 | 442.879 | 2.928 | 1452.64 | 9.60 |
| 698 | 443.837 | 2.923 | 1455.78 | 9.59 |
| 699 | 443.908 | 2.922 | 1456.02 | 9.59 |
| 700 | 444.822 | 2.929 | 1459.02 | 9.61 |
| 701 | 444.923 | 2.931 | 1459.35 | 9.61 |
| 702 | 444.933 | 2.931 | 1459.38 | 9.61 |
| 703 | 444.933 | 2.931 | 1459.38 | 9.61 |
| 704 | 445.437 | 2.935 | 1461.03 | 9.63 |
| 705 | 445.941 | 2.937 | 1462.69 | 9.63 |
| 706 | 446.015 | 2.938 | 1462.93 | 9.64 |
| 707 | 446.989 | 2.938 | 1466.12 | 9.64 |
| 708 | 447.145 | 2.938 | 1466.64 | 9.64 |
| 709 | 448.001 | 2.946 | 1469.44 | 9.66 |
| 710 | 448.278 | 2.949 | 1470.35 | 9.67 |
| 711 | 449.036 | 2.960 | 1472.84 | 9.71 |
| 712 | 449.401 | 2.966 | 1474.04 | 9.73 |
| 713 | 450.070 | 2.969 | 1476.23 | 9.74 |
| 714 | 450.500 | 2.970 | 1477.64 | 9.74 |
| 715 | 451.078 | 2.980 | 1479.54 | 9.78 |
| 716 | 451.079 | 2.980 | 1479.54 | 9.78 |
| 717 | 451.603 | 2.993 | 1481.26 | 9.82 |
| 718 | 452.102 | 3.006 | 1482.89 | 9.86 |
| 719 | 452.726 | 3.019 | 1484.94 | 9.90 |
| 720 | 452.726 | 3.019 | 1484.94 | 9.90 |
| 721 | 453.145 | 3.028 | 1486.31 | 9.93 |
| 722 | 453.827 | 3.041 | 1488.55 | 9.98 |
| 723 | 454.157 | 3.051 | 1489.63 | 10.01 |
| 724 | 454.938 | 3.076 | 1492.20 | 10.09 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 725 | 455.171 | 3.084 | 1492.96 | 10.11 |
| 726 | 455.172 | 3.084 | 1492.96 | 10.11 |
| 727 | 456.048 | 3.111 | 1495.84 | 10.20 |
| 728 | 456.201 | 3.116 | 1496.34 | 10.22 |
| 729 | 457.154 | 3.150 | 1499.46 | 10.33 |
| 730 | 457.154 | 3.150 | 1499.46 | 10.33 |
| 731 | 457.210 | 3.152 | 1499.65 | 10.34 |
| 732 | 457.959 | 3.180 | 1502.11 | 10.43 |
| 733 | 457.959 | 3.180 | 1502.11 | 10.43 |
| 734 | 458.220 | 3.191 | 1502.96 | 10.47 |
| 735 | 458.234 | 3.191 | 1503.01 | 10.47 |
| 736 | 459.225 | 3.231 | 1506.26 | 10.60 |
| 737 | 459.315 | 3.235 | 1506.55 | 10.61 |
| 738 | 459.315 | 3.235 | 1506.55 | 10.61 |
| 739 | 460.218 | 3.274 | 1509.52 | 10.74 |
| 740 | 460.372 | 3.282 | 1510.02 | 10.76 |
| 741 | 461.226 | 3.325 | 1512.82 | 10.91 |
| 742 | 461.449 | 3.337 | 1513.55 | 10.95 |
| 743 | 462.231 | 3.381 | 1516.12 | 11.09 |
| 744 | 462.232 | 3.381 | 1516.12 | 11.09 |
| 745 | 462.496 | 3.396 | 1516.99 | 11.14 |
| 746 | 463.222 | 3.442 | 1519.37 | 11.29 |
| 747 | 463.566 | 3.463 | 1520.50 | 11.36 |
| 748 | 464.212 | 3.507 | 1522.62 | 11.50 |
| 749 | 464.603 | 3.532 | 1523.90 | 11.59 |
| 750 | 464.603 | 3.532 | 1523.90 | 11.59 |
| 751 | 465.220 | 3.572 | 1525.92 | 11.71 |
| 752 | 465.668 | 3.599 | 1527.39 | 11.80 |
| 753 | 466.222 | 3.625 | 1529.21 | 11.89 |
| 754 | 466.734 | 3.647 | 1530.89 | 11.96 |
| 755 | 467.215 | 3.664 | 1532.47 | 12.02 |
| 756 | 467.793 | 3.684 | 1534.36 | 12.08 |
| 757 | 468.217 | 3.699 | 1535.75 | 12.13 |
| 758 | 468.849 | 3.721 | 1537.82 | 12.21 |
| 759 | 469.202 | 3.733 | 1538.98 | 12.25 |
| 760 | 469.900 | 3.758 | 1541.27 | 12.33 |
| 761 | 470.196 | 3.767 | 1542.24 | 12.36 |
| 762 | 470.196 | 3.767 | 1542.24 | 12.36 |
| 763 | 470.969 | 3.789 | 1544.78 | 12.43 |
| 764 | 470.969 | 3.789 | 1544.78 | 12.43 |
| 765 | 471.217 | 3.797 | 1545.59 | 12.45 |
| 766 | 472.029 | 3.819 | 1548.25 | 12.53 |
| 767 | 472.211 | 3.824 | 1548.85 | 12.54 |
| 768 | 473.089 | 3.847 | 1551.73 | 12.62 |
| 769 | 473.089 | 3.847 | 1551.73 | 12.62 |
| 770 | 473.200 | 3.849 | 1552.10 | 12.62 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 771 | 474.150 | 3.857 | 1555.21 | 12.65 |
| 772 | 474.193 | 3.858 | 1555.35 | 12.65 |
| 773 | 474.193 | 3.858 | 1555.35 | 12.65 |
| 774 | 474.923 | 3.862 | 1557.75 | 12.67 |
| 775 | 474.923 | 3.862 | 1557.75 | 12.67 |
| 776 | 475.175 | 3.864 | 1558.57 | 12.67 |
| 777 | 475.195 | 3.864 | 1558.64 | 12.67 |
| 778 | 476.104 | 3.859 | 1561.62 | 12.66 |
| 779 | 476.104 | 3.859 | 1561.62 | 12.66 |
| 780 | 476.216 | 3.858 | 1561.99 | 12.65 |
| 781 | 477.068 | 3.853 | 1564.78 | 12.64 |
| 782 | 477.243 | 3.853 | 1565.36 | 12.64 |
| 783 | 478.003 | 3.863 | 1567.85 | 12.67 |
| 784 | 478.259 | 3.869 | 1568.69 | 12.69 |
| 785 | 478.916 | 3.884 | 1570.84 | 12.74 |
| 786 | 478.916 | 3.884 | 1570.84 | 12.74 |
| 787 | 479.257 | 3.890 | 1571.96 | 12.76 |
| 788 | 479.257 | 3.890 | 1571.96 | 12.76 |
| 789 | 479.863 | 3.899 | 1573.95 | 12.79 |
| 790 | 480.309 | 3.900 | 1575.41 | 12.79 |
| 791 | 480.309 | 3.900 | 1575.41 | 12.79 |
| 792 | 480.803 | 3.900 | 1577.03 | 12.79 |
| 793 | 481.311 | 3.897 | 1578.70 | 12.78 |
| 794 | 481.709 | 3.894 | 1580.01 | 12.77 |
| 795 | 481.709 | 3.894 | 1580.01 | 12.77 |
| 796 | 482.331 | 3.884 | 1582.05 | 12.74 |
| 797 | 482.659 | 3.877 | 1583.12 | 12.72 |
| 798 | 482.659 | 3.877 | 1583.12 | 12.72 |
| 799 | 483.351 | 3.861 | 1585.39 | 12.66 |
| 800 | 483.620 | 3.854 | 1586.27 | 12.64 |
| 801 | 484.370 | 3.834 | 1588.73 | 12.58 |
| 802 | 484.370 | 3.834 | 1588.74 | 12.58 |
| 803 | 484.529 | 3.830 | 1589.25 | 12.56 |
| 804 | 485.392 | 3.804 | 1592.09 | 12.48 |
| 805 | 485.477 | 3.802 | 1592.36 | 12.47 |
| 806 | 486.298 | 3.781 | 1595.06 | 12.40 |
| 807 | 486.298 | 3.781 | 1595.06 | 12.40 |
| 808 | 486.411 | 3.778 | 1595.43 | 12.39 |
| 809 | 486.418 | 3.778 | 1595.45 | 12.39 |
| 810 | 486.418 | 3.778 | 1595.45 | 12.39 |
| 811 | 487.395 | 3.751 | 1598.66 | 12.30 |
| 812 | 487.474 | 3.749 | 1598.91 | 12.30 |
| 813 | 488.385 | 3.715 | 1601.90 | 12.19 |
| 814 | 488.385 | 3.715 | 1601.90 | 12.19 |
| 815 | 488.529 | 3.710 | 1602.38 | 12.17 |
| 816 | 488.529 | 3.710 | 1602.38 | 12.17 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 817 | 489.371 | 3.680 | 1605.14 | 12.07 |
| 818 | 489.371 | 3.680 | 1605.14 | 12.07 |
| 819 | 489.564 | 3.674 | 1605.77 | 12.05 |
| 820 | 490.368 | 3.648 | 1608.41 | 11.97 |
| 821 | 490.616 | 3.641 | 1609.22 | 11.94 |
| 822 | 490.616 | 3.641 | 1609.22 | 11.94 |
| 823 | 491.356 | 3.616 | 1611.65 | 11.86 |
| 824 | 491.672 | 3.606 | 1612.68 | 11.83 |
| 825 | 492.343 | 3.582 | 1614.88 | 11.75 |
| 826 | 492.711 | 3.568 | 1616.09 | 11.70 |
| 827 | 493.320 | 3.547 | 1618.09 | 11.64 |
| 828 | 493.755 | 3.533 | 1619.51 | 11.59 |
| 829 | 493.755 | 3.533 | 1619.52 | 11.59 |
| 830 | 494.320 | 3.517 | 1621.37 | 11.53 |
| 831 | 494.820 | 3.503 | 1623.01 | 11.49 |
| 832 | 494.820 | 3.503 | 1623.01 | 11.49 |
| 833 | 495.303 | 3.490 | 1624.59 | 11.45 |
| 834 | 495.855 | 3.477 | 1626.40 | 11.41 |
| 835 | 495.855 | 3.477 | 1626.40 | 11.41 |
| 836 | 496.281 | 3.468 | 1627.80 | 11.37 |
| 837 | 496.895 | 3.453 | 1629.82 | 11.33 |
| 838 | 497.266 | 3.443 | 1631.03 | 11.29 |
| 839 | 497.947 | 3.427 | 1633.27 | 11.24 |
| 840 | 498.258 | 3.420 | 1634.29 | 11.22 |
| 841 | 498.987 | 3.408 | 1636.68 | 11.18 |
| 842 | 499.236 | 3.403 | 1637.50 | 11.16 |
| 843 | 499.465 | 3.400 | 1638.25 | 11.15 |
| 844 | 500.264 | 3.395 | 1640.87 | 11.14 |
| 845 | 501.063 | 3.385 | 1643.49 | 11.10 |
| 846 | 501.063 | 3.385 | 1643.49 | 11.10 |
| 847 | 501.196 | 3.383 | 1643.92 | 11.10 |
| 848 | 502.116 | 3.355 | 1646.94 | 11.00 |
| 849 | 502.189 | 3.352 | 1647.18 | 11.00 |
| 850 | 503.147 | 3.323 | 1650.32 | 10.90 |
| 851 | 503.174 | 3.322 | 1650.41 | 10.90 |
| 852 | 503.856 | 3.306 | 1652.65 | 10.84 |
| 853 | 504.537 | 3.290 | 1654.88 | 10.79 |
| 854 | 504.944 | 3.278 | 1656.22 | 10.75 |
| 855 | 505.445 | 3.260 | 1657.86 | 10.69 |
| 856 | 505.947 | 3.240 | 1659.51 | 10.63 |
| 857 | 505.947 | 3.240 | 1659.51 | 10.63 |
| 858 | 506.147 | 3.233 | 1660.16 | 10.60 |
| 859 | 506.393 | 3.225 | 1660.97 | 10.58 |
| 860 | 507.148 | 3.204 | 1663.44 | 10.51 |
| 861 | 507.148 | 3.204 | 1663.44 | 10.51 |
| 862 | 507.509 | 3.199 | 1664.63 | 10.49 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 863 | 508.133 | 3.196 | 1666.67 | 10.48 |
| 864 | 508.572 | 3.196 | 1668.12 | 10.48 |
| 865 | 508.572 | 3.196 | 1668.12 | 10.48 |
| 866 | 509.126 | 3.188 | 1669.93 | 10.46 |
| 867 | 509.126 | 3.188 | 1669.93 | 10.46 |
| 868 | 509.674 | 3.164 | 1671.73 | 10.38 |
| 869 | 510.490 | 3.118 | 1674.41 | 10.23 |
| 870 | 511.110 | 3.077 | 1676.44 | 10.09 |
| 871 | 511.110 | 3.077 | 1676.44 | 10.09 |
| 872 | 511.858 | 3.045 | 1678.90 | 9.99 |
| 873 | 512.105 | 3.037 | 1679.70 | 9.96 |
| 874 | 512.947 | 3.017 | 1682.47 | 9.90 |
| 875 | 512.948 | 3.017 | 1682.47 | 9.90 |
| 876 | 513.082 | 3.014 | 1682.91 | 9.89 |
| 877 | 514.016 | 2.990 | 1685.97 | 9.81 |
| 878 | 514.063 | 2.988 | 1686.13 | 9.80 |
| 879 | 514.063 | 2.988 | 1686.13 | 9.80 |
| 880 | 514.659 | 2.968 | 1688.08 | 9.73 |
| 881 | 514.659 | 2.968 | 1688.08 | 9.73 |
| 882 | 515.070 | 2.954 | 1689.43 | 9.69 |
| 883 | 515.090 | 2.953 | 1689.50 | 9.69 |
| 884 | 516.056 | 2.923 | 1692.66 | 9.59 |
| 885 | 516.056 | 2.923 | 1692.66 | 9.59 |
| 886 | 516.128 | 2.921 | 1692.90 | 9.58 |
| 887 | 516.128 | 2.921 | 1692.90 | 9.58 |
| 888 | 517.028 | 2.893 | 1695.85 | 9.49 |
| 889 | 517.161 | 2.889 | 1696.29 | 9.48 |
| 890 | 518.013 | 2.865 | 1699.08 | 9.40 |
| 891 | 518.198 | 2.860 | 1699.69 | 9.38 |
| 892 | 518.985 | 2.843 | 1702.27 | 9.32 |
| 893 | 519.182 | 2.841 | 1702.92 | 9.32 |
| 894 | 520.052 | 2.832 | 1705.77 | 9.29 |
| 895 | 520.466 | 2.824 | 1707.13 | 9.26 |
| 896 | 520.466 | 2.824 | 1707.13 | 9.26 |
| 897 | 521.036 | 2.810 | 1709.00 | 9.22 |
| 898 | 521.517 | 2.795 | 1710.58 | 9.17 |
| 899 | 521.915 | 2.783 | 1711.88 | 9.13 |
| 900 | 522.321 | 2.774 | 1713.21 | 9.10 |
| 901 | 522.322 | 2.774 | 1713.21 | 9.10 |
| 902 | 522.894 | 2.762 | 1715.09 | 9.06 |
| 903 | 523.342 | 2.754 | 1716.56 | 9.03 |
| 904 | 523.864 | 2.742 | 1718.27 | 8.99 |
| 905 | 523.864 | 2.742 | 1718.27 | 8.99 |
| 906 | 524.389 | 2.736 | 1720.00 | 8.97 |
| 907 | 524.851 | 2.738 | 1721.51 | 8.98 |
| 908 | 525.410 | 2.743 | 1723.34 | 9.00 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 909 | 525.410 | 2.743 | 1723.34 | 9.00 |
| 910 | 525.817 | 2.748 | 1724.68 | 9.01 |
| 911 | 526.416 | 2.753 | 1726.65 | 9.03 |
| 912 | 526.770 | 2.752 | 1727.81 | 9.03 |
| 913 | 526.770 | 2.752 | 1727.81 | 9.03 |
| 914 | 527.443 | 2.749 | 1730.01 | 9.02 |
| 915 | 527.749 | 2.753 | 1731.02 | 9.03 |
| 916 | 528.479 | 2.763 | 1733.41 | 9.06 |
| 917 | 528.479 | 2.763 | 1733.41 | 9.06 |
| 918 | 528.731 | 2.778 | 1734.24 | 9.11 |
| 919 | 529.471 | 2.844 | 1736.67 | 9.33 |
| 920 | 529.674 | 2.873 | 1737.33 | 9.42 |
| 921 | 530.476 | 3.033 | 1739.96 | 9.95 |
| 922 | 530.631 | 3.067 | 1740.47 | 10.06 |
| 923 | 531.459 | 3.314 | 1743.19 | 10.87 |
| 924 | 531.578 | 3.351 | 1743.58 | 10.99 |
| 925 | 531.579 | 3.351 | 1743.58 | 10.99 |
| 926 | 532.433 | 3.671 | 1746.38 | 12.04 |
| 927 | 532.504 | 3.700 | 1746.61 | 12.13 |
| 928 | 533.389 | 4.071 | 1749.52 | 13.35 |
| 929 | 533.389 | 4.071 | 1749.52 | 13.35 |
| 930 | 533.433 | 4.090 | 1749.66 | 13.42 |
| 931 | 533.433 | 4.090 | 1749.66 | 13.42 |
| 932 | 534.352 | 4.439 | 1752.67 | 14.56 |
| 933 | 534.352 | 4.439 | 1752.68 | 14.56 |
| 934 | 534.369 | 4.444 | 1752.73 | 14.58 |
| 935 | 534.369 | 4.444 | 1752.73 | 14.58 |
| 936 | 534.767 | 4.557 | 1754.04 | 14.95 |
| 937 | 534.768 | 4.557 | 1754.04 | 14.95 |
| 938 | 535.281 | 4.650 | 1755.72 | 15.25 |
| 939 | 535.322 | 4.654 | 1755.86 | 15.27 |
| 940 | 536.175 | 4.727 | 1758.65 | 15.51 |
| 941 | 536.175 | 4.727 | 1758.65 | 15.51 |
| 942 | 536.301 | 4.732 | 1759.07 | 15.52 |
| 943 | 536.301 | 4.732 | 1759.07 | 15.52 |
| 944 | 537.068 | 4.754 | 1761.58 | 15.59 |
| 945 | 537.280 | 4.759 | 1762.28 | 15.61 |
| 946 | 537.977 | 4.776 | 1764.57 | 15.66 |
| 947 | 538.267 | 4.782 | 1765.52 | 15.69 |
| 948 | 538.869 | 4.798 | 1767.49 | 15.74 |
| 949 | 539.246 | 4.807 | 1768.73 | 15.77 |
| 950 | 539.246 | 4.807 | 1768.73 | 15.77 |
| 951 | 539.761 | 4.830 | 1770.42 | 15.84 |
| 952 | 540.222 | 4.852 | 1771.93 | 15.92 |
| 953 | 540.222 | 4.852 | 1771.93 | 15.92 |
| 954 | 540.662 | 4.875 | 1773.37 | 15.99 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 955 | 540.662 | 4.875 | 1773.37 | 15.99 |
| 956 | 541.179 | 4.901 | 1775.07 | 16.08 |
| 957 | 541.179 | 4.901 | 1775.07 | 16.08 |
| 958 | 541.536 | 4.918 | 1776.24 | 16.13 |
| 959 | 541.536 | 4.918 | 1776.24 | 16.13 |
| 960 | 542.154 | 4.928 | 1778.27 | 16.16 |
| 961 | 542.426 | 4.932 | 1779.16 | 16.18 |
| 962 | 543.137 | 4.939 | 1781.49 | 16.20 |
| 963 | 543.326 | 4.941 | 1782.11 | 16.21 |
| 964 | 544.119 | 4.955 | 1784.71 | 16.25 |
| 965 | 544.219 | 4.957 | 1785.04 | 16.26 |
| 966 | 544.219 | 4.957 | 1785.04 | 16.26 |
| 967 | 545.078 | 4.995 | 1787.86 | 16.38 |
| 968 | 545.099 | 4.997 | 1787.92 | 16.39 |
| 969 | 545.381 | 5.021 | 1788.85 | 16.47 |
| 970 | 546.019 | 5.072 | 1790.94 | 16.64 |
| 971 | 546.019 | 5.072 | 1790.94 | 16.64 |
| 972 | 546.047 | 5.074 | 1791.04 | 16.64 |
| 973 | 546.959 | 5.122 | 1794.03 | 16.80 |
| 974 | 547.772 | 5.135 | 1796.69 | 16.84 |
| 975 | 548.059 | 5.138 | 1797.63 | 16.85 |
| 976 | 548.059 | 5.138 | 1797.63 | 16.85 |
| 977 | 548.818 | 5.149 | 1800.12 | 16.89 |
| 978 | 549.578 | 5.151 | 1802.61 | 16.90 |
| 979 | 549.789 | 5.149 | 1803.31 | 16.89 |
| 980 | 550.018 | 5.145 | 1804.06 | 16.88 |
| 981 | 550.741 | 5.151 | 1806.43 | 16.90 |
| 982 | 551.380 | 5.158 | 1808.53 | 16.92 |
| 983 | 551.380 | 5.158 | 1808.53 | 16.92 |
| 984 | 551.815 | 5.168 | 1809.95 | 16.95 |
| 985 | 552.111 | 5.172 | 1810.92 | 16.96 |
| 986 | 552.111 | 5.172 | 1810.92 | 16.96 |
| 987 | 552.860 | 5.178 | 1813.38 | 16.98 |
| 988 | 552.994 | 5.179 | 1813.82 | 16.99 |
| 989 | 552.994 | 5.179 | 1813.82 | 16.99 |
| 990 | 553.550 | 5.178 | 1815.64 | 16.98 |
| 991 | 553.550 | 5.178 | 1815.65 | 16.98 |
| 992 | 554.001 | 5.172 | 1817.12 | 16.97 |
| 993 | 554.001 | 5.172 | 1817.12 | 16.97 |
| 994 | 554.508 | 5.167 | 1818.79 | 16.95 |
| 995 | 554.999 | 5.174 | 1820.40 | 16.97 |
| 996 | 555.441 | 5.183 | 1821.85 | 17.00 |
| 997 | 555.983 | 5.192 | 1823.62 | 17.03 |
| 998 | 556.380 | 5.198 | 1824.93 | 17.05 |
| 999 | 556.972 | 5.199 | 1826.87 | 17.05 |
| 1000 | 557.329 | 5.197 | 1828.04 | 17.05 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 1001 | 557.959 | 5.195 | 1830.10 | 17.04 |
| 1002 | 557.959 | 5.195 | 1830.10 | 17.04 |
| 1003 | 558.267 | 5.196 | 1831.11 | 17.04 |
| 1004 | 558.960 | 5.200 | 1833.39 | 17.06 |
| 1005 | 559.211 | 5.204 | 1834.21 | 17.07 |
| 1006 | 559.939 | 5.213 | 1836.60 | 17.10 |
| 1007 | 560.149 | 5.218 | 1837.29 | 17.12 |
| 1008 | 560.149 | 5.218 | 1837.29 | 17.12 |
| 1009 | 560.911 | 5.242 | 1839.79 | 17.19 |
| 1010 | 560.911 | 5.242 | 1839.79 | 17.19 |
| 1011 | 561.065 | 5.246 | 1840.29 | 17.21 |
| 1012 | 561.891 | 5.263 | 1843.00 | 17.26 |
| 1013 | 562.001 | 5.266 | 1843.36 | 17.27 |
| 1014 | 562.894 | 5.283 | 1846.29 | 17.33 |
| 1015 | 562.894 | 5.283 | 1846.29 | 17.33 |
| 1016 | 562.954 | 5.284 | 1846.49 | 17.33 |
| 1017 | 563.843 | 5.304 | 1849.40 | 17.40 |
| 1018 | 563.843 | 5.304 | 1849.40 | 17.40 |
| 1019 | 563.862 | 5.304 | 1849.47 | 17.40 |
| 1020 | 564.319 | 5.314 | 1850.97 | 17.43 |
| 1021 | 564.319 | 5.314 | 1850.97 | 17.43 |
| 1022 | 564.804 | 5.320 | 1852.56 | 17.45 |
| 1023 | 564.814 | 5.321 | 1852.59 | 17.45 |
| 1024 | 565.763 | 5.325 | 1855.70 | 17.46 |
| 1025 | 565.796 | 5.325 | 1855.81 | 17.47 |
| 1026 | 566.666 | 5.338 | 1858.66 | 17.51 |
| 1027 | 566.739 | 5.340 | 1858.90 | 17.52 |
| 1028 | 566.897 | 5.345 | 1859.42 | 17.53 |
| 1029 | 566.898 | 5.345 | 1859.42 | 17.53 |
| 1030 | 567.572 | 5.372 | 1861.64 | 17.62 |
| 1031 | 567.913 | 5.386 | 1862.75 | 17.67 |
| 1032 | 567.913 | 5.386 | 1862.75 | 17.67 |
| 1033 | 568.494 | 5.410 | 1864.66 | 17.74 |
| 1034 | 568.939 | 5.434 | 1866.12 | 17.82 |
| 1035 | 569.412 | 5.468 | 1867.67 | 17.94 |
| 1036 | 569.412 | 5.468 | 1867.67 | 17.94 |
| 1037 | 569.905 | 5.503 | 1869.29 | 18.05 |
| 1038 | 570.309 | 5.524 | 1870.62 | 18.12 |
| 1039 | 570.310 | 5.524 | 1870.62 | 18.12 |
| 1040 | 570.846 | 5.540 | 1872.38 | 18.17 |
| 1041 | 571.531 | 5.510 | 1874.62 | 18.07 |
| 1042 | 572.216 | 5.477 | 1876.87 | 17.96 |
| 1043 | 572.892 | 5.443 | 1879.09 | 17.85 |
| 1044 | 573.405 | 5.429 | 1880.77 | 17.81 |
| 1045 | 573.405 | 5.429 | 1880.77 | 17.81 |
| 1046 | 573.737 | 5.416 | 1881.86 | 17.76 |

| Index | X - meters | Y- meters | X-feet | Y-feet |
|---|---|---|---|---|
| 1047 | 573.737 | 5.416 | 1881.86 | 17.76 |
| 1048 | 574.315 | 5.393 | 1883.75 | 17.69 |
| 1049 | 574.894 | 5.369 | 1885.65 | 17.61 |
| 1050 | 574.894 | 5.369 | 1885.65 | 17.61 |
| 1051 | 574.942 | 5.367 | 1885.81 | 17.60 |
| 1052 | 574.942 | 5.367 | 1885.81 | 17.60 |
| 1053 | 574.993 | 5.365 | 1885.98 | 17.60 |
| 1054 | 575.874 | 5.326 | 1888.87 | 17.47 |
| 1055 | 575.984 | 5.321 | 1889.23 | 17.45 |
| 1056 | 576.812 | 5.326 | 1891.94 | 17.47 |

Profile 6 - farthest north
Source: 2013 LiDAR Data

| Index | X - meters | Y- meters | X- feet | Y - feet |
|---|---|---|---|---|
| 626 | 417.085 | 0.000 | 1368.04 | 0.00 |
| 627 | 417.925 | 0.025 | 1370.80 | 0.08 |
| 628 | 417.926 | 0.025 | 1370.80 | 0.08 |
| 629 | 418.146 | 0.039 | 1371.52 | 0.13 |
| 630 | 418.147 | 0.039 | 1371.52 | 0.13 |
| 631 | 418.903 | 0.089 | 1374.00 | 0.29 |
| 632 | 419.194 | 0.113 | 1374.96 | 0.37 |
| 633 | 419.855 | 0.227 | 1377.12 | 0.74 |
| 634 | 420.233 | 0.330 | 1378.37 | 1.08 |
| 635 | 420.233 | 0.330 | 1378.37 | 1.08 |
| 636 | 420.835 | 0.470 | 1380.34 | 1.54 |
| 637 | 420.836 | 0.470 | 1380.34 | 1.54 |
| 638 | 421.288 | 0.529 | 1381.82 | 1.73 |
| 639 | 421.804 | 0.585 | 1383.52 | 1.92 |
| 640 | 421.804 | 0.585 | 1383.52 | 1.92 |
| 641 | 422.245 | 0.606 | 1384.96 | 1.99 |
| 642 | 422.944 | 0.642 | 1387.26 | 2.11 |
| 643 | 423.380 | 0.665 | 1388.69 | 2.18 |
| 644 | 423.380 | 0.665 | 1388.69 | 2.18 |
| 645 | 423.749 | 0.684 | 1389.90 | 2.24 |
| 646 | 423.749 | 0.684 | 1389.90 | 2.24 |
| 647 | 424.427 | 0.713 | 1392.12 | 2.34 |
| 648 | 424.427 | 0.713 | 1392.12 | 2.34 |
| 649 | 424.706 | 0.724 | 1393.03 | 2.37 |
| 650 | 425.475 | 0.755 | 1395.56 | 2.48 |
| 651 | 425.671 | 0.764 | 1396.20 | 2.51 |
| 652 | 425.671 | 0.764 | 1396.20 | 2.51 |
| 653 | 426.524 | 0.810 | 1399.00 | 2.66 |
| 654 | 426.656 | 0.818 | 1399.43 | 2.68 |
| 655 | 427.567 | 0.873 | 1402.42 | 2.86 |
| 656 | 427.603 | 0.875 | 1402.54 | 2.87 |
| 657 | 427.995 | 0.898 | 1403.82 | 2.95 |
| 658 | 427.995 | 0.898 | 1403.83 | 2.95 |
| 659 | 428.607 | 0.935 | 1405.83 | 3.07 |
| 660 | 428.607 | 0.935 | 1405.83 | 3.07 |
| 661 | 428.649 | 0.937 | 1405.97 | 3.07 |
| 662 | 429.637 | 0.992 | 1409.21 | 3.26 |
| 663 | 429.727 | 0.998 | 1409.50 | 3.27 |
| 664 | 429.727 | 0.998 | 1409.51 | 3.27 |
| 665 | 430.516 | 1.048 | 1412.09 | 3.44 |
| 666 | 430.516 | 1.048 | 1412.09 | 3.44 |
| 667 | 431.464 | 1.114 | 1415.20 | 3.65 |
| 668 | 431.673 | 1.126 | 1415.89 | 3.69 |

| Index | X - meters | Y- meters | X- feet | Y - feet |
|---|---|---|---|---|
| 669 | 431.673 | 1.126 | 1415.89 | 3.69 |
| 670 | 431.914 | 1.141 | 1416.68 | 3.74 |
| 671 | 432.700 | 1.195 | 1419.25 | 3.92 |
| 672 | 432.990 | 1.220 | 1420.21 | 4.00 |
| 673 | 433.717 | 1.280 | 1422.59 | 4.20 |
| 674 | 434.080 | 1.306 | 1423.78 | 4.28 |
| 675 | 434.738 | 1.355 | 1425.94 | 4.45 |
| 676 | 435.306 | 1.406 | 1427.80 | 4.61 |
| 677 | 435.779 | 1.447 | 1429.36 | 4.75 |
| 678 | 436.260 | 1.487 | 1430.93 | 4.88 |
| 679 | 436.781 | 1.531 | 1432.64 | 5.02 |
| 680 | 437.325 | 1.579 | 1434.43 | 5.18 |
| 681 | 437.325 | 1.579 | 1434.43 | 5.18 |
| 682 | 437.784 | 1.620 | 1435.93 | 5.31 |
| 683 | 438.389 | 1.677 | 1437.92 | 5.50 |
| 684 | 438.389 | 1.677 | 1437.92 | 5.50 |
| 685 | 438.807 | 1.717 | 1439.29 | 5.63 |
| 686 | 438.807 | 1.717 | 1439.29 | 5.63 |
| 687 | 439.496 | 1.780 | 1441.55 | 5.84 |
| 688 | 439.829 | 1.811 | 1442.64 | 5.94 |
| 689 | 439.829 | 1.811 | 1442.64 | 5.94 |
| 690 | 440.563 | 1.881 | 1445.05 | 6.17 |
| 691 | 440.835 | 1.908 | 1445.94 | 6.26 |
| 692 | 440.835 | 1.908 | 1445.94 | 6.26 |
| 693 | 441.661 | 1.986 | 1448.65 | 6.52 |
| 694 | 441.878 | 2.006 | 1449.36 | 6.58 |
| 695 | 441.878 | 2.006 | 1449.36 | 6.58 |
| 696 | 442.739 | 2.086 | 1452.18 | 6.84 |
| 697 | 442.880 | 2.100 | 1452.65 | 6.89 |
| 698 | 443.837 | 2.193 | 1455.79 | 7.19 |
| 699 | 443.909 | 2.200 | 1456.02 | 7.21 |
| 700 | 444.822 | 2.285 | 1459.02 | 7.50 |
| 701 | 444.923 | 2.294 | 1459.35 | 7.53 |
| 702 | 444.933 | 2.295 | 1459.38 | 7.53 |
| 703 | 444.934 | 2.295 | 1459.38 | 7.53 |
| 704 | 445.437 | 2.339 | 1461.03 | 7.67 |
| 705 | 445.941 | 2.380 | 1462.69 | 7.80 |
| 706 | 446.016 | 2.385 | 1462.93 | 7.82 |
| 707 | 446.989 | 2.466 | 1466.12 | 8.09 |
| 708 | 447.146 | 2.480 | 1466.64 | 8.13 |
| 709 | 448.002 | 2.550 | 1469.45 | 8.36 |
| 710 | 448.278 | 2.572 | 1470.35 | 8.44 |
| 711 | 449.037 | 2.632 | 1472.84 | 8.63 |
| 712 | 449.401 | 2.661 | 1474.04 | 8.73 |
| 713 | 450.071 | 2.713 | 1476.23 | 8.90 |
| 714 | 450.500 | 2.748 | 1477.64 | 9.01 |

| Index | X - meters | Y- meters | X- feet | Y - feet |
|---|---|---|---|---|
| 715 | 451.079 | 2.797 | 1479.54 | 9.17 |
| 716 | 451.079 | 2.797 | 1479.54 | 9.17 |
| 717 | 451.603 | 2.841 | 1481.26 | 9.32 |
| 718 | 452.102 | 2.883 | 1482.89 | 9.46 |
| 719 | 452.726 | 2.943 | 1484.94 | 9.65 |
| 720 | 452.726 | 2.943 | 1484.94 | 9.65 |
| 721 | 453.145 | 2.985 | 1486.32 | 9.79 |
| 722 | 453.828 | 3.054 | 1488.56 | 10.02 |
| 723 | 454.157 | 3.088 | 1489.63 | 10.13 |
| 724 | 454.938 | 3.174 | 1492.20 | 10.41 |
| 725 | 455.172 | 3.200 | 1492.96 | 10.50 |
| 726 | 455.172 | 3.200 | 1492.96 | 10.50 |
| 727 | 456.048 | 3.285 | 1495.84 | 10.77 |
| 728 | 456.202 | 3.299 | 1496.34 | 10.82 |
| 729 | 457.154 | 3.372 | 1499.47 | 11.06 |
| 730 | 457.154 | 3.372 | 1499.47 | 11.06 |
| 731 | 457.210 | 3.376 | 1499.65 | 11.07 |
| 732 | 457.959 | 3.428 | 1502.11 | 11.24 |
| 733 | 457.960 | 3.428 | 1502.11 | 11.24 |
| 734 | 458.220 | 3.447 | 1502.96 | 11.31 |
| 735 | 458.235 | 3.448 | 1503.01 | 11.31 |
| 736 | 459.226 | 3.514 | 1506.26 | 11.53 |
| 737 | 459.315 | 3.520 | 1506.55 | 11.54 |
| 738 | 459.316 | 3.520 | 1506.55 | 11.54 |
| 739 | 460.219 | 3.580 | 1509.52 | 11.74 |
| 740 | 460.372 | 3.590 | 1510.02 | 11.78 |
| 741 | 461.227 | 3.625 | 1512.82 | 11.89 |
| 742 | 461.449 | 3.632 | 1513.55 | 11.91 |
| 743 | 462.232 | 3.653 | 1516.12 | 11.98 |
| 744 | 462.232 | 3.653 | 1516.12 | 11.98 |
| 745 | 462.496 | 3.660 | 1516.99 | 12.00 |
| 746 | 463.223 | 3.670 | 1519.37 | 12.04 |
| 747 | 463.566 | 3.672 | 1520.50 | 12.04 |
| 748 | 464.213 | 3.679 | 1522.62 | 12.07 |
| 749 | 464.604 | 3.686 | 1523.90 | 12.09 |
| 750 | 464.604 | 3.686 | 1523.90 | 12.09 |
| 751 | 465.221 | 3.694 | 1525.92 | 12.12 |
| 752 | 465.668 | 3.694 | 1527.39 | 12.12 |
| 753 | 466.223 | 3.693 | 1529.21 | 12.11 |
| 754 | 466.734 | 3.691 | 1530.89 | 12.11 |
| 755 | 467.216 | 3.690 | 1532.47 | 12.10 |
| 756 | 467.793 | 3.688 | 1534.36 | 12.10 |
| 757 | 468.217 | 3.687 | 1535.75 | 12.09 |
| 758 | 468.849 | 3.687 | 1537.82 | 12.09 |
| 759 | 469.203 | 3.689 | 1538.98 | 12.10 |
| 760 | 469.900 | 3.686 | 1541.27 | 12.09 |

| Index | X - meters | Y- meters | X- feet | Y - feet |
|---|---|---|---|---|
| 761 | 470.197 | 3.684 | 1542.24 | 12.08 |
| 762 | 470.197 | 3.684 | 1542.24 | 12.08 |
| 763 | 470.969 | 3.684 | 1544.78 | 12.08 |
| 764 | 470.969 | 3.684 | 1544.78 | 12.08 |
| 765 | 471.218 | 3.688 | 1545.59 | 12.10 |
| 766 | 472.029 | 3.701 | 1548.26 | 12.14 |
| 767 | 472.211 | 3.703 | 1548.85 | 12.14 |
| 768 | 473.089 | 3.704 | 1551.73 | 12.15 |
| 769 | 473.089 | 3.704 | 1551.73 | 12.15 |
| 770 | 473.200 | 3.703 | 1552.10 | 12.15 |
| 771 | 474.151 | 3.706 | 1555.21 | 12.16 |
| 772 | 474.193 | 3.706 | 1555.35 | 12.16 |
| 773 | 474.193 | 3.706 | 1555.35 | 12.16 |
| 774 | 474.923 | 3.716 | 1557.75 | 12.19 |
| 775 | 474.924 | 3.716 | 1557.75 | 12.19 |
| 776 | 475.175 | 3.720 | 1558.58 | 12.20 |
| 777 | 475.196 | 3.720 | 1558.64 | 12.20 |
| 778 | 476.105 | 3.737 | 1561.62 | 12.26 |

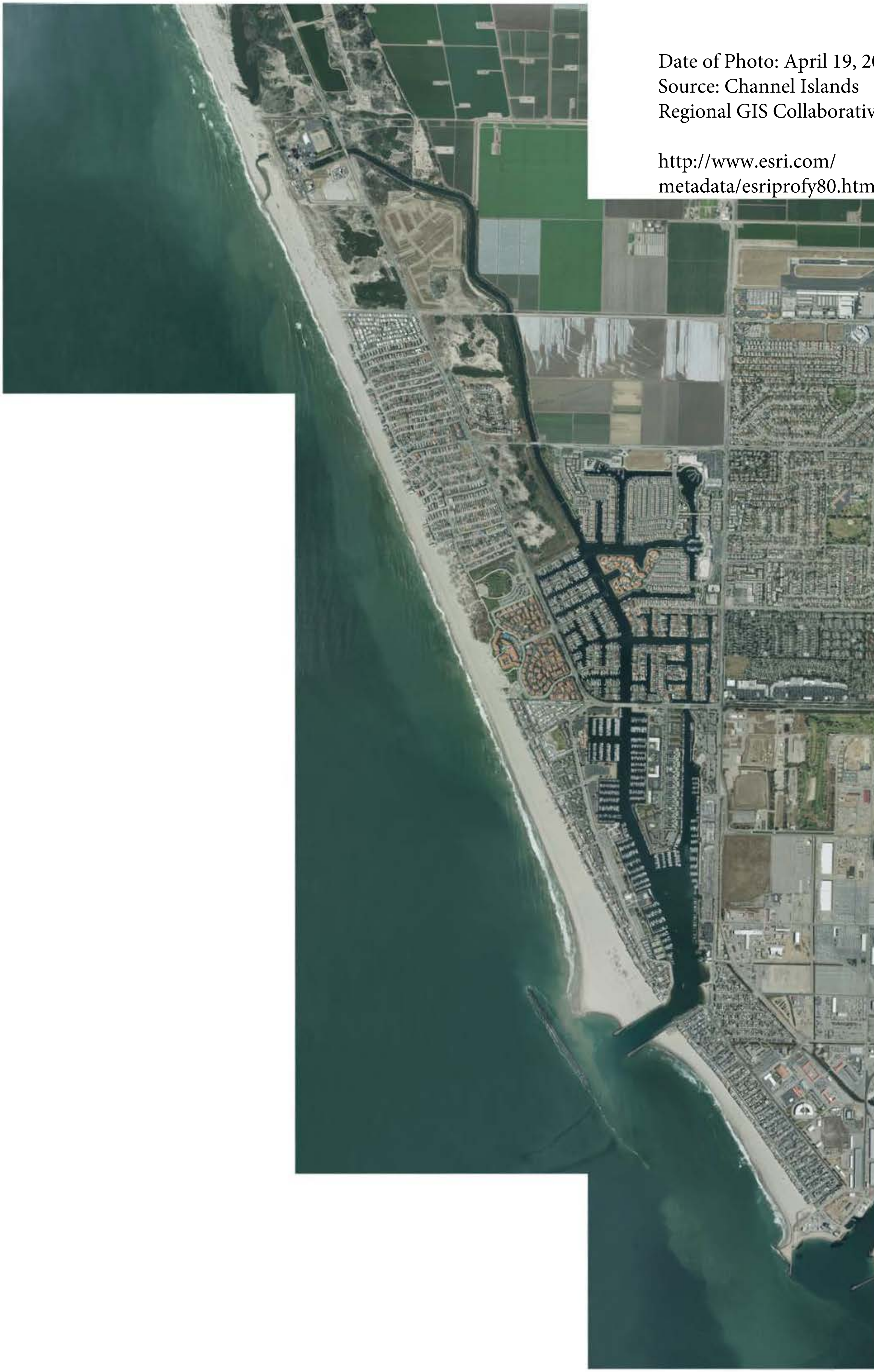
Estimated Beach Slope

| Profile: | Estimated slope | X1 | Y1 | X2 | Y2 |
|---|---|---|---|---|---|
| 1 | 0.025 | 1199.26 | 0.45 | 1768.72 | 14.95 |
| 2 | 0.014 | 1201.34 | 0.60 | 1680.63 | 7.66 |
| 3 | 0.019 | 1253.10 | 0.12 | 1787.85 | 10.19 |
| 4 | 0.026 | 1250.03 | 0.00 | 1824.93 | 15.15 |
| 5 | 0.031 | 1320.71 | -0.02 | 1889.23 | 17.45 |
| 6 | 0.063 | 1368.04 | 0.00 | 1561.62 | 12.26 |
| Average slope | 0.030 | | | | |

# APPENDIX 90-1
# AERIAL PHOTO - APRIL 19, 2013

Date of Photo: April 19, 2013
Source: Channel Islands
Regional GIS Collaborative

http://www.esri.com/
metadata/esriprofy80.html



# APPENDIX 94-1
# PRELIMINARY CALCULATIONS

URS

Job: Mandalay Shores Gen Station
Description: Tsunami eval - Berm Stability Preliminary
Project No.: 60412126
Computed by: [illegible]
Checked by: HKT
Page 1 of 1
Sheet ___ of ___
Date: 11/5/15
Date: ___
Reference: = FEMA 646; = Terzaghi & Peck

Wave Force

$F_{hydrostatic} = \frac{1}{2} \gamma_{sw} h_{water}^2$

$= \frac{1}{2} (64)(1)(10)^2$

$= 3.1$ k / lf dune

$F_{hydrodynamic} = 1.25 (1.5) (64) 10$

avg $1.25 I \gamma h u^2$ $=$ 11.7 klf

Dune - neglect uplift, drag, debris impact

Passive Resistance

$F_p = K_p \sigma \tan \phi$

$= 3 (5400 \text{ psf}) (.57)$

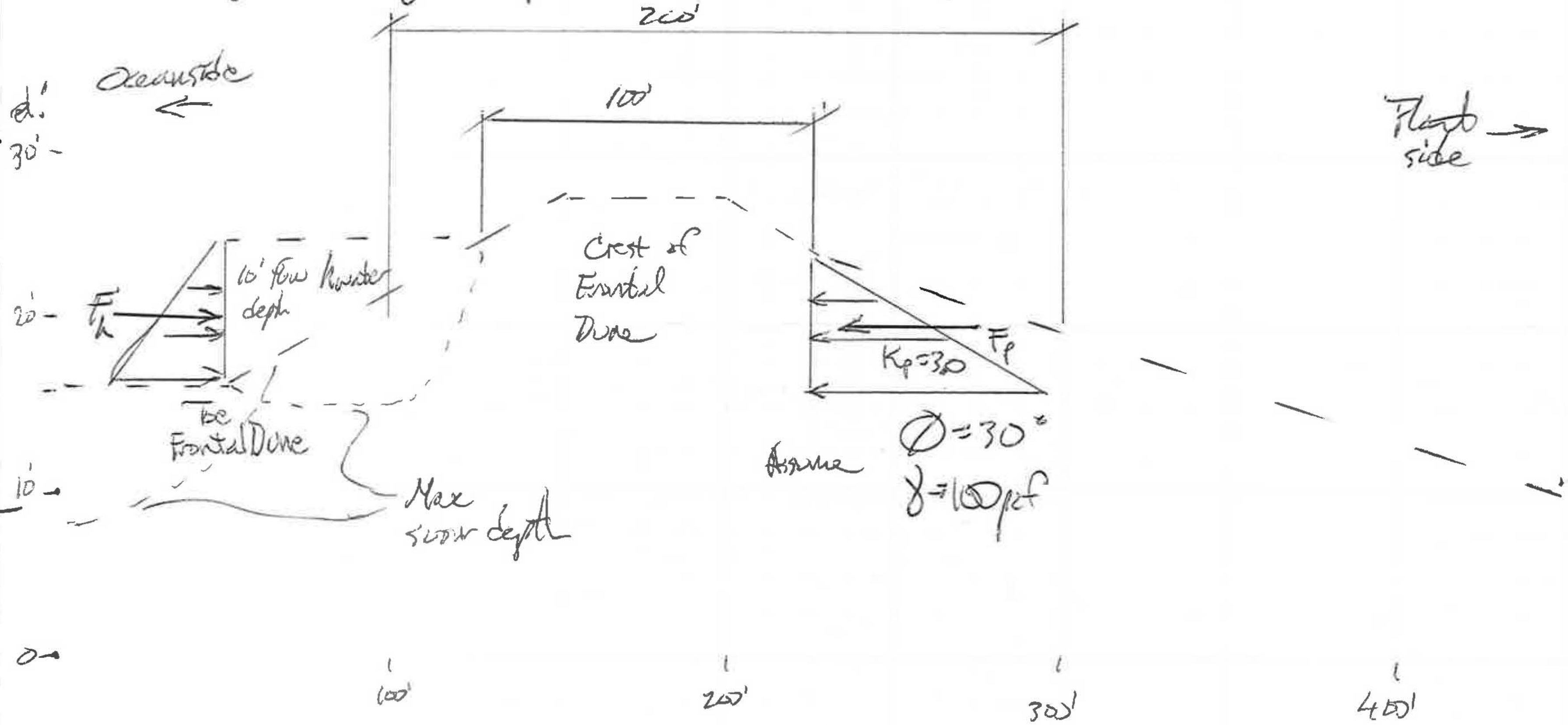
$= 9$ klf

$F_s$ sliding $= L \sigma \tan \phi$

$= 100 (500)(.57)$

$= 28$ klf

$FS = \frac{29}{15} = 1.9$ ✓




Scour: Tsunami scour depth ≈ 1× h water = 10'

Erosion width assume 3:1 angle of repose = 30' encroachment << width of dune ✓

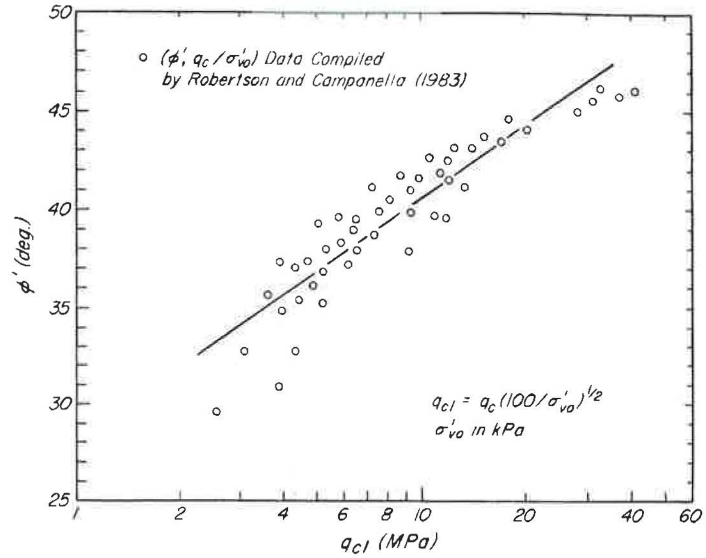



**Figure 19.5** Empirical correlation between friction angle $\phi'$ of sands and normalized push cone tip penetration resistance.

ory (de Beer 1948, Meyerhof 1961, Janbu and Senneset 1974, Durgunoglu and Mitchell 1975, Mitchell and Keaveny 1986). Data compiled by Robertson and Campanella (1983) are plotted in terms of $q_{c1}$ in Fig. 19.5. The correlation is mainly applicable to normally consolidated young sand deposits composed of quartz and feldspars. It underestimates by several degrees the friction angle of compressible carbonate sands with crushable particles, and it overestimates by several degrees the friction angle of overconsolidated or aged sands with values of $\sigma'_{ho}$ higher than those in normally consolidated young deposits (Schmertmann 1975).

The correlation between $\phi'$ and $(N_1)_{60}$ in Fig. 19.6 is based on various proposals for the relationship between $\phi'$ and standard penetration blow count $N$ (Peck et al. 1953, De Mello 1971, Schmertmann 1975, Stroud 1988). It underestimates $\phi'$ for calcareous sands with crushable particles and overestimates $\phi'$ for overconsolidated sands (Stroud 1988). Figure 19.6 also includes relations between $\phi'$ and $(N_1)_{60}$ determined from the empirical correlation in Fig. 19.6 together with $q_c/N_{60}$ values of 400 and 500 kPa for sand deposits. The two different empirical correlations between $\phi'$ and $q_c$ and between $\phi'$ and $N_{60}$, which have originated from separate databases, lead to comparable values of $\phi'$ for sands.

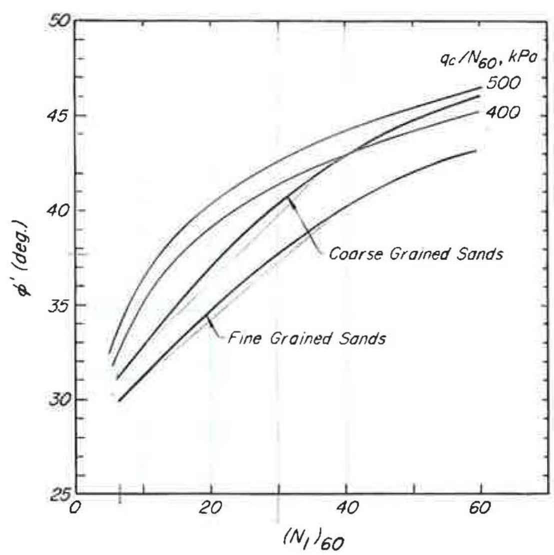



**Figure 19.6** Empirical correlation between friction angle $\phi'$ of sands and normalized standard penetration blowcount.

## 19.2 Drained Shear Strength of Cohesive Soils

The drained shear strength of normally consolidated cohesive soils is defined by the friction angle $\phi'$, as follows:

$$s = \sigma' \tan \phi' \qquad (19.6)$$

The effective normal stress $\sigma'$ on the plane of shear is determined by the total normal stress and the equilibrium hydrostatic or steady porewater pressure condition. The friction angle $\phi'$, which corresponds to a more or less random arrangement of particles, is mainly a function of the clay mineral content and clay mineralogy of the composition. Values of $\phi'$ for the full range of clay compositions are shown in Fig. 19.7. Among the pure clay minerals, sodium montmorillonite (consisting of filmy particles) has the lowest value of $\phi'$, whereas attapulgite (with interlocking fibers) exhibits the highest value. Typical values of $\phi'$ for soft clay, stiff clay, and shale constituents are in the range of 25° to 35°, 20° to 35°, and 15° to 35°, respectively. The water-filled and rough surface-

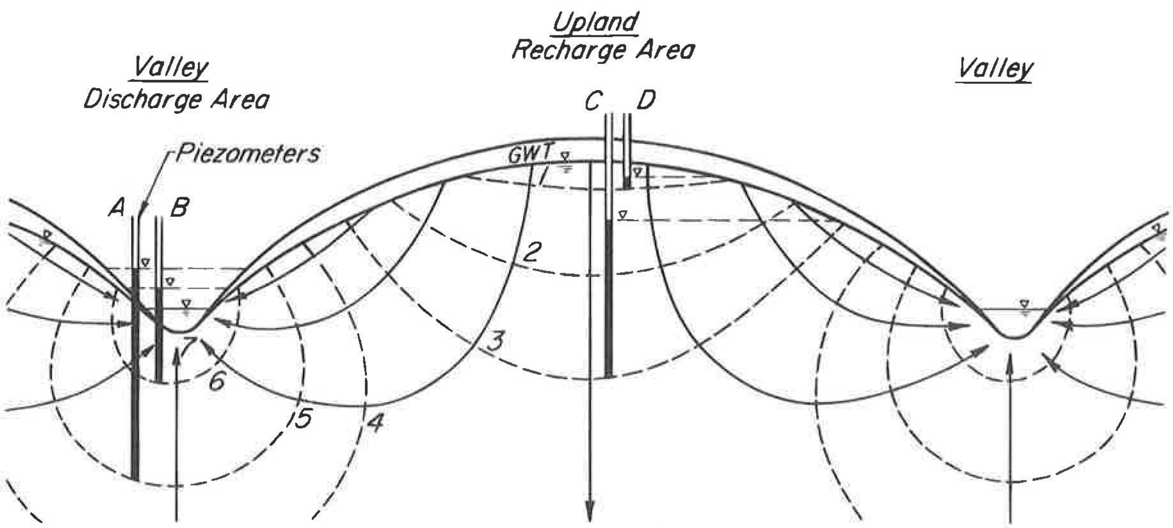



**Figure 47.2** Simplified regional flow system in uniformly permeable materials (after Hubbert 1940).

troublesome soil, estimates are likely to show that costs will be excessive unless the margin of safety is reduced to considerably less than the margin of error in stability computations.

Consequently, in cuts through troublesome soil, local slides are often considered acceptable. At the same time sound engineering requires that the slides should not involve loss of life or serious damage to property. This requirement can be satisfied only by means of extensive and conscientiously executed field observations during and after construction. Such observations make it possible to detect the symptoms of impending slides and to take appropriate measures for avoiding fatal consequences.

## 47.4 Stability of Slopes and Cuts in Sand

Sand located permanently above the water table is stable ground in which cuts can be made safely at standard slopes. Dense and medium sands located below the water table are also stable. Slides occur only in loose saturated sand that liquefies (Article 20.9). The disturbance required to release a sand slide can be produced either by a shock or by a rapid change in the position of the water table. Once the movement has started, the sand flows as if it were a liquid.

The sand slides along the coast of the island of Zeeland in Holland belong in this category (Müller 1898). The coast is located on a thick stratum of fine quartz sand that consists of rounded grains. The slope of the beach is only about 15°. Yet, once every few decades after exceptionally high tides, the sand liquefies beneath a short section of the coastal belt, flows out, and spreads with great speed in a fan-shaped sheet over the bottom of the adjacent body of water. The tongue of the slide is always very much broader than the root. Figure 47.3 shows a section through one such slide. The final slope of the ground surface was less than 5°. A slide that occurred at Borssele in 1874 involved nearly 1,500,000 $m^3$.

Because flow slides in sand occur only if the sand is very loose, the tendency toward sliding can be reduced by increasing the density of the sand. This can be accomplished by several different means, such as vibroflotation, dynamic compaction, pile driving, or exploding small charges of blasting powder at many points in the interior of the mass (Article 44.3.3). On slopes of marginal stability, these means may, however, induce a slide.

## 47.5 Stability of Cuts in Loess

Loess is a cohesive wind-laid soil consisting chiefly of angular and subangular quartz grains with an effective grain size between about 0.02 and 0.006 mm and a low uniformity coefficient. It contains an intricate network of more or less vertical root holes. The cohesion is due to thin films of clay or slightly soluble cementing material that covers the quartz grains and the walls of the root holes. Because the root holes are predominantly vertical, loess has a tendency to break by splitting along vertical surfaces, and its permeability in a vertical direction is large compared with that in a horizontal direction. Its porosity may be as great as 52%.

When loess is located permanently above the water table, it is a very stable soil except that it is readily attacked by erosion. To reduce the erosion as much as possible, cuts in loess are usually given a very steep slope (0.25 $H{:}1V$). The foot of the slope requires careful protection against temporary saturation during rainstorms. In spite of this precaution, slices break down from time to time, again leaving nearly vertical faces that remain stable for years. To prevent blocking of traffic by the debris it is customary to make the width of cuts in loess greater than that called for by the traffic requirements.

on the plasticity index (Holts and Gibbs 1956*a*, Seed et al. 1962), as indicated in Table 48.1.

If a clay with high to very high inherent swelling capacity must be used, the effects of swelling may be minimized by placing the clay at the highest practicable moisture content and by using any available nonswelling materials in the outer portions of the fill. The weight of even a meter or so of surcharge over a swelling material substantially reduces the amount of expansion and consequent loss of strength of the clay.

### 48.4 Levees or Dikes

Levees serve to protect lowlands against periodic inundation by high water, storm floods, or high tides. They differ from earth storage dams in three principal respects: Their inner slopes are submerged during only a few days or weeks per year; their location is determined by flood-protection requirements regardless of whether or not the foundation conditions are favorable; and the fill material must be derived from shallow borrow pits located near the site of the levees. These conditions introduce a considerable element of uncertainty into the design of such structures. Nevertheless, levees were needed in some regions during the earliest days of human civilization, and consequently the art of levee construction was highly developed in these regions.

If the soil conditions in the borrow-pit area change from place to place, the cross-section of a levee is customarily chosen to suit the requirements of the most unfavorable materials that will have to be used. Consideration is also given to the degree of freedom permitted the contractor in choosing the time and method of construction. In some levee districts the method of placing the soil is rigidly controlled, whereas in others the contractor is free to choose among widely different methods of construction. In the past, the influence of the method of construction on the cost of a levee depended chiefly on the ratio between the cost of hand and machine labor. Because this ratio was very different in different countries, efforts to build satisfactory levees at minimum expense led to different rules in different parts of the world. For example, before World War II in countries such as Germany and Holland, where hand labor was cheap, levees were carefully compacted and built with steep slopes. At the same time, in the Mississippi Valley no efforts were made to compact levees, because uncompacted levees with gentle slopes were commonly cheaper than carefully compacted ones with much smaller cross-sections (Buchanan 1938). In Europe and Asia many levees of clay were constructed with side slopes of 2:1, whereas clay levees along the Mississippi River were generally given an inner slope of 3:1 and an outer slope of 6:1. Both types of construction grew out of a process of trial and error, and both served their purpose equally well under the conditions that prevailed in the regions where they originated.

**Table 48.1 Approximate Relation Between Plasticity Index and Inherent Swelling Capacity**

| Plasticity Index | Inherent Swelling Capacity |
|---|---|
| 0–10 | Low |
| 10–20 | Medium |
| 20–35 | High |
| 35– | Very high |

After Seed et al. 1962.

Even in the United States, however, steep slopes were justified economically in areas of high land and property values. Whereas levees along the lower Mississippi River were being constructed with flat slopes, the slopes in the industrialized Ohio River valley were much steeper. This trend became more pronounced as time went on and led to increased use of theoretical methods in the design of levees even in regions where levee systems already existed. On the other hand, where economic factors have not changed significantly, soil mechanics can still be used to advantage only for correlating construction and maintenance experience with the index properties of the soils that serve as the construction materials. The information obtained in this manner leads to the elimination of guesswork in classifying the soils encountered in new borrow-pit areas.

The use of theoretical methods in the design of levees on stable subsoil can be justified in a region where few levees have been built previously. Under such circumstances the method of trial and error is too slow and expensive, and there is no experience based on existing levee systems to be used as a guide. The designer is then compelled to use the methods practiced in connection with the design of earth dams (Chapter 11).

### 48.5 Types of Base Failure

Whenever possible, embankments and earth dams are constructed on firm, relatively incompressible subsoils. However, in many regions railway or highway embankments must be built on broad swampy flats or buried valleys filled with soft silt or clay. Levees must be constructed near the flood channels, irrespective of subsoil conditions. Even earth dams must occasionally be located at sites underlain by undesirable materials. In all these instances the design of the embankment must be adapted not only to the character of the available fill material, but also to the subsoil conditions.

Base failures may occur in several different ways. The fill may sink bodily into the supporting soil. Such an accident is referred to as *failure by sinking* or *breaking into the ground*. On the other hand, the fill together with the layer of soil on which it rests may spread on an



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