



APPENDIX A

DENNY ISLAND – SITE LOCATION AND PHOTOS



Figure 1 - Site Location



Figure 2 - Overall Site



Figure 3 - Overall Site



Figure 4 - Overall Site



Figure 5 - Overall Site

A 3D model of the site can be found at this link:

<https://cloud.pix4d.com/dataset/744233/model?shareToken=918d7447-25c3-4cf5-ac9f-57b5e9ef81f6>



APPENDIX B

DENNY ISLAND – GEOTECHNICAL REPORT

October 27, 2020
File: SGL20-017

Canadian Coast Guard
25 Huron St.
Victoria, BC V8V 4V9

Attention: Mr. Brian Teng, P.Eng.

Re: Proposed Denny Island, Antenna Tower and Equipment Building, Report of Geotechnical Assessment

INTRODUCTION

As requested, Simpson Geotechnical Ltd. has conducted a geotechnical assessment for a proposed new antenna tower and equipment building on Denny Island at approximately 51° 6' 14" N and 128° 4' 31" W. The proposed new antenna tower is understood to be a self-supported steel lattice tower. The equipment building is understood to be a one-level pre-fabricated metal building that would be supported on local pad footings and piers. Several site layout options for the tower and building were proposed by Coast Guard personnel, shown as tower location option 1 through 3 and building location options 1 and 2 on Drawing G-1.

This assessment has been conducted in general accordance with CSA S37-18 Antennas, Towers, and Antenna-Supporting Structures and our proposal of September 14, 2020.

SITE ASSESSMENT

Site Assessment

The site assessment was conducted on September 29, 2020 and consisted of observations of the general setting and ground surface geometry of the site as well as

bedrock condition and discontinuities near the proposed antenna tower and building locations. Weather conditions at the time of the assessment were sunny and mild. A photolog of key observations is appended.

The site was located on the crest of an east-west trending ridge on the western side of Denny Island as shown on Drawing G-1 and Photo 1. The ridge and general area were heavily forested with primarily conifers with trunks in the order of 0.2 to 0.3m diameter. There was a landslide evident on the southern flank of the ridge that appeared to be a surficial debris flow event unrelated to global or deep-seated stability of the ridge slopes.

The site itself had been recently cleared and stripped to bedrock prior to our assessment as seen in Photo 2. All three potential antenna tower locations and the two potential building locations exposed similar bedrock conditions of strong to very strong (Grade R4 to R5) medium-grained quartz diorite with a rounded and undulating topography and a slightly weathered surface.

The bedrock discontinuities had a blocky to very blocky structure with predominantly widely spaced discontinuities, although local areas of close to moderately close discontinuities were observed. Release surface discontinuities tended to be near vertical, while sliding planes were near horizontal or gently sloped down to the north. Photographs of the proposed tower and building areas are provided in Photos 3 through 5.

The Rock Quality Designation (RQD) was measured by surface scanline method in several locations around the potential tower and building area in lengths of at least 4m. Those measurements resulted in RQD that ranged from approximately 75% to over 90%, indicative of good to excellent quality rock.

Local surface depressions in the bedrock surface were filled with loose soil comprised of organic silt with roots found to typically be less than 200mm thick based on several local test excavations with a shovel. The tower and building sites were all relatively level with no significant slopes as seen in the topography on Drawing G-1, with the exception of a minor, approximately 2m high “step” in the bedrock surface approximately 5m southeastwards of proposed tower location option 1. A foundation setback from that “step” is considered warranted, as described in the recommendations below.

There were several areas of ponded water in local depressions on the ground surface in the area, as seen on Drawing G-1 and the photographs. No flowing water was observed.

LABORATORY TESTING

A sample of the dioritic rock was retained from the central area between the three possible tower sites and tested for relative density. That test indicated a relative density of 2.6 g/cm³. The test report is appended.

DISCUSSION AND RECOMMENDATIONS

General

Based on the site assessment described above, all three proposed tower location options and the two building location options shown on Drawing G-1 are considered geotechnically suitable, provided the following recommendations are implemented.

Footings bearing on clean, intact bedrock are considered the most practical foundation system for both the tower and building, with uplift resistance provided by bonded rock anchors.

Seismic Hazard

A Seismic Hazard Calculation for the site was obtained from Natural Resources Canada. That calculation indicated a Peak Ground Acceleration (PGA) of 0.289g for the 2% in 50-year probability seismic event. The Seismic Hazard Calculation is appended.

The bedrock encountered in the site assessment is not considered to be susceptible to strength loss from seismic liquefaction.

Slope Stability

The foundations for tower location option 1 should not encroach within 4m of the crest of the low rock “step” to the southeast without specific geotechnical review. The tower location option 1 shown on Drawing G-1 meets that recommendation. No slope stability considerations are warranted for the other proposed tower and building location options shown on Drawing G-1.

Excavation

All excavations should be conducted in accordance with the BC Occupational Health and Safety Regulation. Groundwater perched atop the bedrock surface may be encountered in local surface depressions, especially during periods of wet weather.

Drainage

Groundwater at the site is not anticipated due to its location near a topographic high point and the very small catchment area. However, local ponded and perched water may be encountered during wet weather that may lead to wet anchor drill holes and ponded surface water in local depressions in the rock surface. Final site grading should provide positive drainage to prevent water ponding around the structures.

Antenna Tower Foundations

The self-supported communications tower foundation may consist of a combination of concrete footings bearing on approved undisturbed intact bedrock with uplift resistance provided by cementitious grout or plastic resin bonded rock anchors. SGL should review the final location of the antenna tower prior to rock drilling or concrete placement for conformance to the intent of the recommendations of this report and to determine if any significant new information on rock quality and jointing becomes apparent during construction.

The foundation design should be based on the geotechnical parameters tabled below in accordance with CSA S37-18 Antennas, Towers, and Antenna-Supporting Structures.

Uplift resistance provided by bonded rock anchors should be based on the inverted cone approach using the parameters in this report, based on a maximum cone apex angle of 90 degrees (45 degrees each side of the long axis of the anchor). The apex of the inverted cone should be located no deeper than the midpoint of the anchor bond length. Anchors located laterally closer than $1.2 \times T$ (where T is the anchor depth) should be considered to act as a group.

**Recommended Geotechnical Foundation Design Parameters for Proposed Denny Island
 Antenna Tower in Accordance with CSA S37-18**

Parameter	Value
Bedrock type	Medium-grained diorite
Design depth to sound bedrock (including weathered rock)	0 to 0.2m, may be locally greater
Ultimate, unfactored, bearing resistance (bearing on approved, undisturbed, intact diorite bedrock)	15 MPa
Serviceability bearing resistance	500 KPa
Ultimate, unfactored compressive strength of intact, un-weathered diorite bedrock	40 MPa
Ultimate unfactored tensile strength of rock mass on surface of cone (based on good quality rock mass with minimum RQD=75%)	25 kPa
Bulk unit weight of rock mass	25.5 KN/m ³
Bulk unit weight of mass concrete	22.5 KN/m ³
Sliding resistance friction angle (between cast-in-place concrete and clean, sound, medium-grained dioritic bedrock)	32°
Ultimate, unfactored grout to rock bond stress (with percussion drilled holes)	3.1 MPa
Recommended design depth to groundwater	>6m with appropriate drainage
Rock Quality Designation (RQD)	75%
Design cone apex angle	maximum 90 degrees
Seismic site class (NBCC 4.1.8.4)	A

Plain bars should not be considered to develop bonding with the grout. The development length for bar to grout bond should be determined in accordance with the recommendations of the Post Tensioning Institute, or the bar manufacturer.

Rock anchor grout should have a minimum compressive strength of 40 MPa at 28 days and may be a cementitious non-shrink type, or two-part plastic resin type, mixed and utilized in accordance with the manufacturer's directions and placed in clean and dry drillholes, free of flowing water. Cementitious grout strength should be verified by field testing in accordance with CSA A23.2. All drilled holes should be completely filled with grout.

Confirmation or revision of the grout to rock bond strength and design bond length based on a shallow sacrificial anchor installed adjacent to the tower site and pull tested prior to installation of the production rock anchors is recommended. The pull test results of the sacrificial anchor should be provided to Simpson Geotechnical Ltd. for review

prior to drilling the test anchors. All production rock anchors should be proof loaded to 110% of the factored load under the review of Simpson Geotechnical Ltd.

Although groundwater is not anticipated to be encountered during rock anchor installation, wet conditions may be encountered in the rock anchor drill holes from perched surface water, especially during periods of wet weather.

Geotechnical resistance factors should be in accordance with Sentence 11.2.6 of CSA S37-18.

The prepared foundation subgrade and rock anchor proof loading should be reviewed by Simpson Geotechnical Ltd. prior to the placement of foundation concrete to verify conformance to the intent of the recommendations provided.

Equipment Building Foundations

The equipment building foundations should bear directly on approved, clean, level, undisturbed and intact bedrock. Footings bearing directly on an approved bedrock surface or concrete fill may be designed in accordance with NBCC 2015 based on the parameters provided below.

For Limit States Design, foundations bearing on approved intact dioritic bedrock subgrade may be designed based on an Ultimate (unfactored) Limit State (ULS) bearing resistance of 15 MPa. A Serviceability Limit State (SLS) bearing resistance of 500 KPa may be used for the communications building, based on limiting total and differential settlement to less than 15mm.

Sliding resistance may be based on a friction angle of 32° between cast-in-place concrete footings and clean, sound, diorite bedrock. Geotechnical resistance factors (Φ) of 0.5 for bearing and 0.8 for sliding are recommended. Additional sliding resistance, if needed, should be provided with reinforcing steel dowels as detailed by a structural engineer and grouted in place with a high strength non-shrink anchor grout to at least 500mm depth into the intact diorite bedrock.

The site may be considered Site Class A in accordance with the 2015 National Building Code of Canada Section 4.1.8.4.

All footings should be located so that the smallest lateral clear distance between footings will be at least equal to the difference in their bearing elevations. Soil cover for frost protection is not required for concrete footings directly on bedrock. The stability of footings located near the crest of local slopes should be reviewed by Simpson Geotechnical Ltd, if applicable.

Uplift resistance for the communications building, if required, may be provided with bonded rock anchors designed in accordance with geotechnical parameters provided above for the self-supported antenna tower. Alternatively, uplift resistance may be provided by concrete mass.

All foundation bearing surfaces should be reviewed by SGL prior to the placement of footing formwork or concrete. Following approval of subgrade surfaces concrete should be placed as quickly as possible to avoid disturbance of the foundation subgrade. Footing concrete should not be placed atop ice or snow.

LIMITATIONS AND CHANGED CONDITIONS

Our recommendations are based on the proposed development described in this report, and the expectation that future development will not result in significant changes to the site geometry, soil and groundwater conditions.

The conclusions and recommendations in this report are based upon the data obtained from local observations at exposed areas of the proposed antenna tower and building areas. The nature and extent of variations between those observation areas may not become evident until construction. Although not expected, should undiscovered changed conditions become apparent our office should be contacted to allow reassessment of our recommendations in light of the new information.

Our recommendations only apply to the specific antenna tower and equipment building described in this report. Other structures or locations may have unique requirements and our recommendations should not be considered applicable to other locations and developments, even if located within the same property.

It is a condition of this report that Simpson Geotechnical Ltd.'s performance of its professional services is subject to the attached Statement of General Conditions.

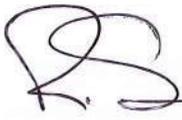
CLOSURE

We appreciate the opportunity to provide our services on this project. Should you have any questions, please do not hesitate to contact us.

Yours truly,

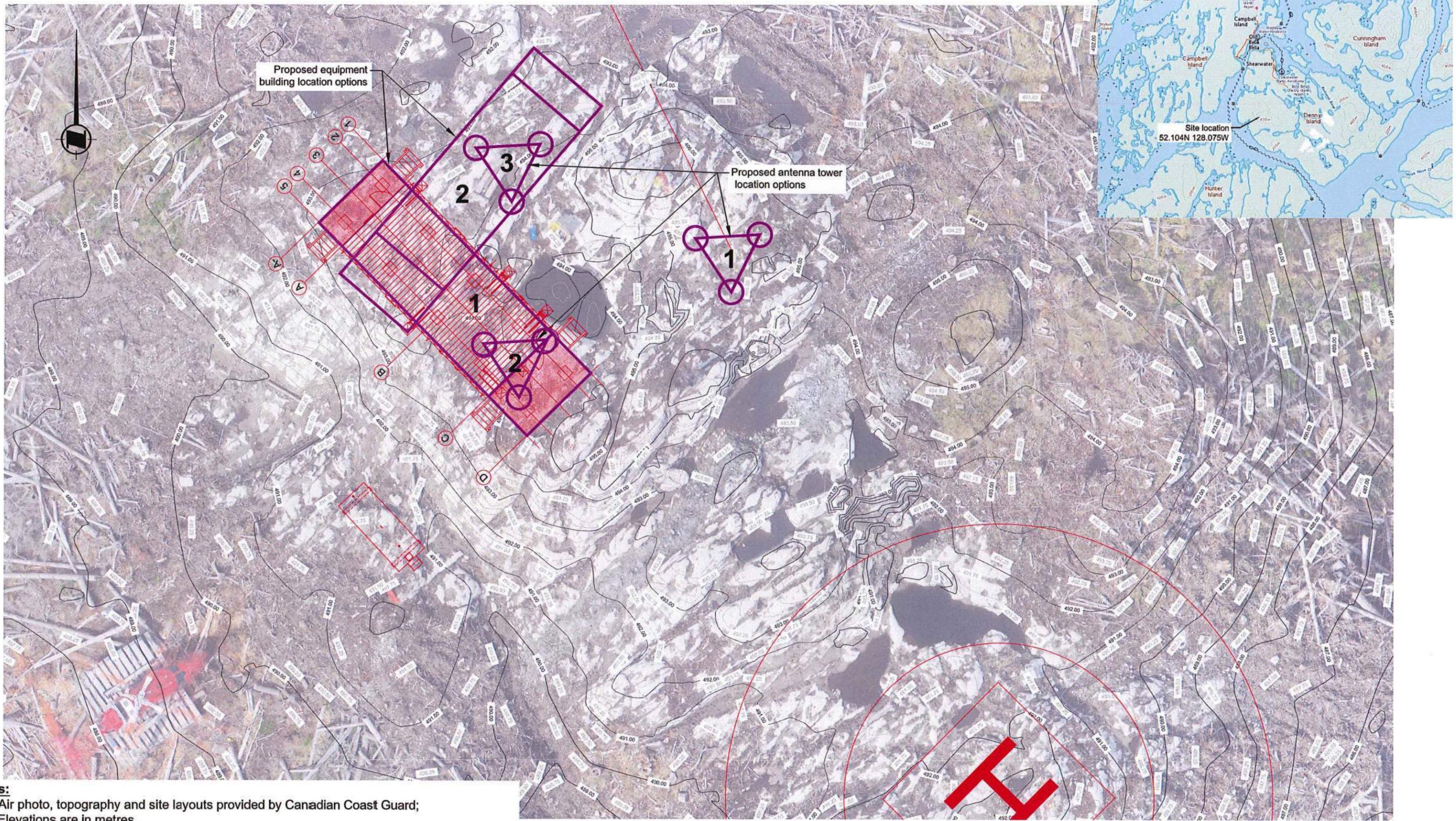
Simpson Geotechnical Ltd.

Per:


Richard Simpson, P.Eng.



Attachments: Drawing G-1 – Geotechnical Site Plan
Photolog
Relative density test report
Seismic Hazard Calculation
Statement of General Conditions



Notes:

1. Air photo, topography and site layouts provided by Canadian Coast Guard;
2. Elevations are in metres.

Project: Denny Island MCTS Site	File: SGL20-018	SIMPSON GEOTECHNICAL LTD	rev	description	by	date
	Title: Geotechnical Site Plan					
Client: Canadian Coast Guard	Date: October 27, 2020	Dwg. No.: G-1				

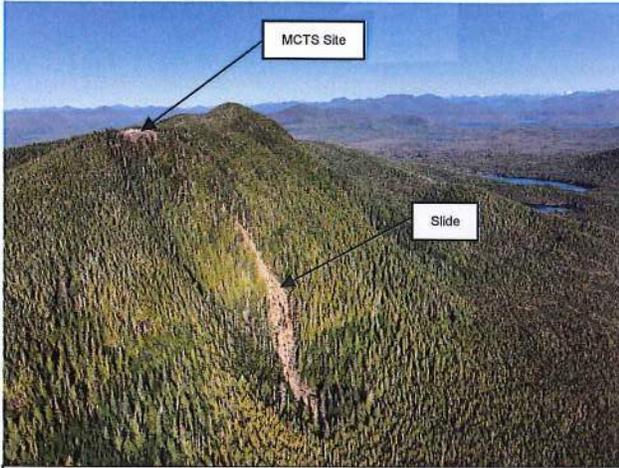


Photo 1 – Denny Island MCTS site at 52.1039N 128.0753W looking northwards showing small landslide on southern flank



Photo 2 – Typical strong dioritic bedrock with widely spaced discontinuities at Denny Island MCTS site



Photo 3 – Proposed antenna tower location 1 area looking southwest



Photo 4 – Proposed antenna tower location 2 and building location 1 area looking westwards



Photo 5 – Proposed antenna tower location 3 and building location 2 area looking southwest

Project Denny Island **Project No.** SGL20-017
Client Canadian Coast Guard **Date** 07-Oct-20
Sample Location Surface between tower option 1, 2 and 3
Sample Description quartz diorite
Pan No. C

Drying Start Time Oct 5, 2020 0813hrs

Drying Stop Time Oct 6, 2020 1040hrs

Sample Dry, 110° for 24 hours (A) g 2221.1 g

Soak Start Time Oct 6, 2020 1248hrs

Soak Stop Time Oct 7, 2020 1559hrs

Saturated Surface Dry 24 hour soak (B) g 2247.7 g

Water Temperature 23 °C

Submerged Weight at 23° g (C) 1403.8 g

Relative Density (specific gravity) = A/(B-C) 2.63 g/cm³

Absorption (%) = (B-A)/Ax100 1.20 %

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 52.104N 128.075W

User File Reference: Denny Island

2020-10-19 18:21 UT

Requested by: Simpson Geotechnical Ltd.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.104	0.074	0.055	0.028
Sa (0.1)	0.162	0.114	0.085	0.040
Sa (0.2)	0.211	0.153	0.116	0.061
Sa (0.3)	0.229	0.171	0.132	0.072
Sa (0.5)	0.235	0.177	0.136	0.073
Sa (1.0)	0.188	0.141	0.108	0.056
Sa (2.0)	0.131	0.095	0.071	0.034
Sa (5.0)	0.050	0.035	0.025	0.012
Sa (10.0)	0.017	0.012	0.009	0.004
PGA (g)	0.104	0.075	0.056	0.027
PGV (m/s)	0.289	0.212	0.159	0.072

Notes: Spectral ($S_a(T)$, where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s . Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information



Natural Resources
Canada

Ressources naturelles
Canada

Canada

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made. Geological and geotechnical studies do not include environmental consulting unless specifically stated in the report.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE ARE NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. We will consent to any reasonable request by the client to approve the use of this report by other parties as "approved users. Any use that a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorized use of the Report.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil Description: Identification of soils, rocks, terrain and geological units have been based on investigations performed in accordance with the standards set out in Paragraph 1. The field investigation cannot practically cover the entire area and will only identify soil conditions at the point and time of sampling. Identification of these factors are judgmental in nature and even comprehensive sampling and testing programs may fail to locate some conditions. All investigations involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual sample points. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the time of assessment.

- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of persons providing information.
- c) Design Services: The Report may form part of the design and construction documents for information purposes even though it may have been issued prior to the final design being completed. We must be retained to review the final design, project plans and documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the report recommendations and the final design detailed in the contract documents must be reported to us immediately so that we can address potential conflicts.
- d) Construction Services: During construction we must be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Simpson Geotechnical Ltd. to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. CONSTRUCTION INSPECTIONS

Our scope of work may include inspections of the work during construction or after completion. Such field reviews do not replace the need for appropriate construction inspection and supervision on the part of the client or his agents. We accept no responsibility for damages caused by unforeseen conditions unless we are on site during construction.

7. INHERENT RISKS

Geotechnical hazard assessments typically occur where there are hazards. As such, inherent risks exist and landslides or other geotechnical hazards can occur even where the likelihood of has been identified as low. The client must operate with an understanding of this risk.

8. CONTROL OF WORK AND JOBSITE SAFETY

We are responsible only for the activities of our employees on the jobsite. The presence of our personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control of the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously, unknown hazardous conditions and that such a discovery may require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

9. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited assessment conducted within a defined scope of services. We cannot accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes decisions made to either purchase or sell land.



APPENDIX C

DENNY ISLAND – SITE SPECIFIC WIND LOADING

Site-Specific 10-yr. Wind Pressure Report (V2.2 2019-04-22)

Site Information:

Name: WM637 Denny Island, BC
 Latitude: 52° 6' 13.46" N
 Longitude: 128° 4' 30.57" W
 Tower Height (m): 39.4
 Elevation MSL (m): 496.1

Results:

Note: Following direction from the S37 Committee, Q_e can no longer be provided.

Q_{nbc} (Pa): 390	$Q_{nbc} = 390(Z/10)^{0.2}$	$V_{nbc} = 54.94$ mph
Icing: As per CAN/CSA S37-18		
Q_{Min} (Pa) 250	$Q_{Min} = 250(Z/10)^{0.2}$	$V_{Min} = 43.99$ mph

Wind Pressure Formula (for z in metres and result in Pa):

$$Q_h = 0.12919 \{ [0.6207 e^{(-0.0121z)} + 1.0000 \ln(z/0.6000) / \ln(z/0.6000)] 44.65 \}^2 (z/10)^{0.298}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{ [a_1 e^{(-a_2z)} + a_3 \ln(z/z_h) / \ln(z/z_{01})] v_{01} \}^2 (z/10)^{0.298}$$

Site Values of Coefficients:

$$a_1 = 0.6207, a_2 = 0.0121, a_3 = 1.0000, z_h = 0.6000, z_{01} = 0.6000, v_{01} = 44.65 \text{ mph}$$

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc} : Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $z/10$ power law.

Q_{Min} : Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $z/10$ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

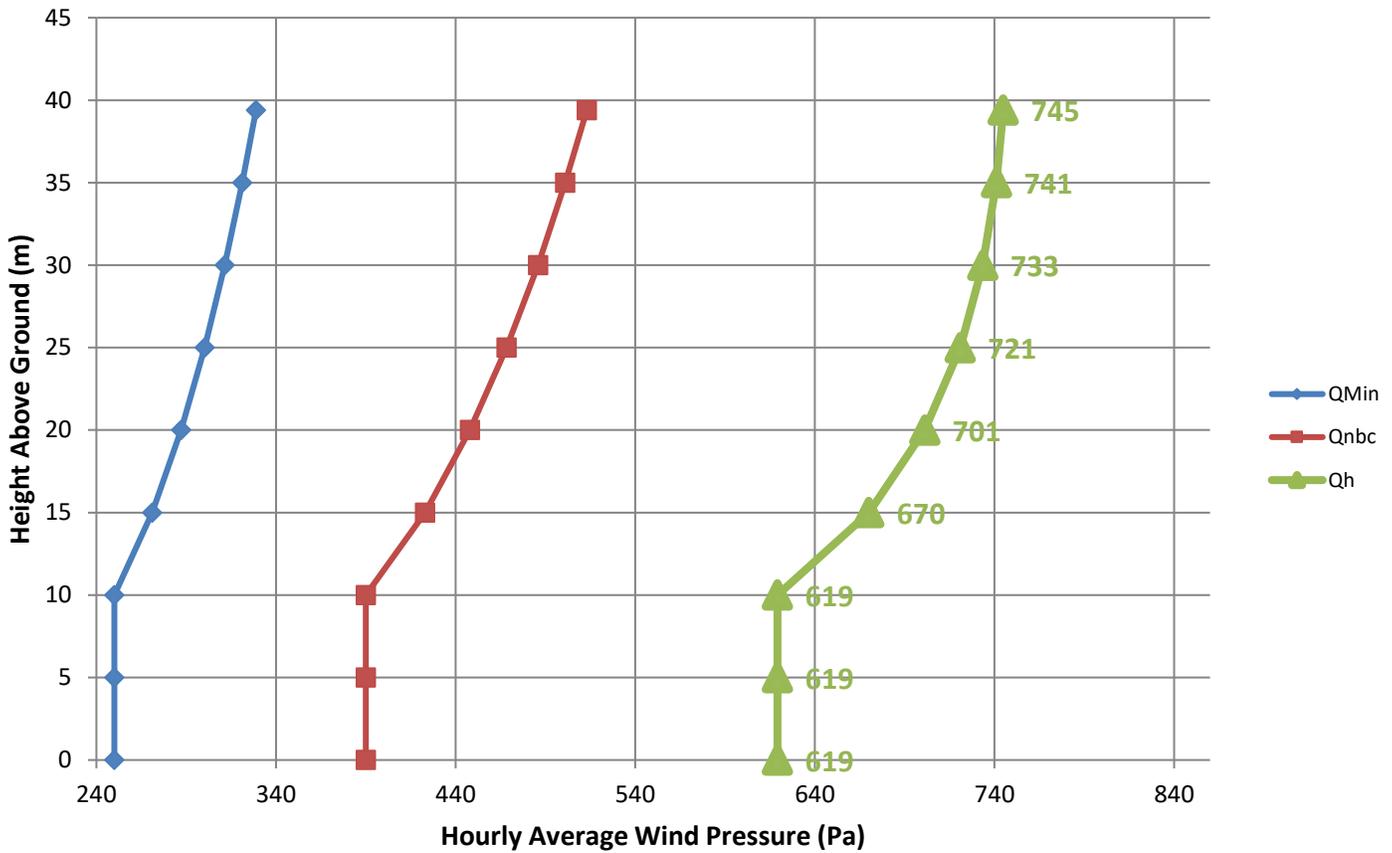
Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

Environment Canada has not made and does not make any representations or warranties, either expressed or implied, arising by law or otherwise, respecting the accuracy of recommended climatic information. In no event will Environment Canada be responsible for any prejudice, loss or damages which may occur as a result of the use of design wind pressure recommendations.

10-yr. Wind Pressure Profile Graph for WM637 Denny Island, BC 39.4m Tower



Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the ²/₁₀ power law.
Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the ²/₁₀ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

Environment Canada has not made and does not make any representations or warranties, either expressed or implied, arising by law or otherwise, respecting the accuracy of recommended climatic information. In no event will Environment Canada be responsible for any prejudice, loss or damages which may occur as a result of the use of design wind pressure recommendations.

Site-Specific 30-yr. Wind Pressure Report (V2.2 2019-04-22)

Site Information:

Name: WM637 Denny Island, BC
 Latitude: 52° 6' 13.46" N
 Longitude: 128° 4' 30.57" W
 Tower Height (m): 39.4
 Elevation MSL (m): 496.1

Results:

Note: Following direction from the S37 Committee, Q_e can no longer be provided.

Q_{nbc} (Pa): 460	$Q_{nbc} = 460(Z/10)^{0.2}$	$V_{nbc} = 59.67$ mph
Icing: As per CAN/CSA S37-18		
Q_{Min} (Pa) 300	$Q_{Min} = 300(Z/10)^{0.2}$	$V_{Min} = 48.19$ mph

Wind Pressure Formula (for z in metres and result in Pa):

$$Q_h = 0.12919 \{ [0.6207 e^{(-0.0121 z)} + 1.0000 \ln(z/0.6000) / \ln(z/0.6000)] 48.87 \}^2 (z/10)^{0.298}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{ [a_1 e^{(-a_2 z)} + a_3 \ln(z/z_h) / \ln(z/z_{01})] v_{01} \}^2 (z/10)^{0.298}$$

Site Values of Coefficients:

$$a_1 = 0.6207, a_2 = 0.0121, a_3 = 1.0000, z_h = 0.6000, z_{01} = 0.6000, v_{01} = 48.87 \text{ mph}$$

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc} : Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $z/10$ power law.

Q_{Min} : Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $z/10$ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

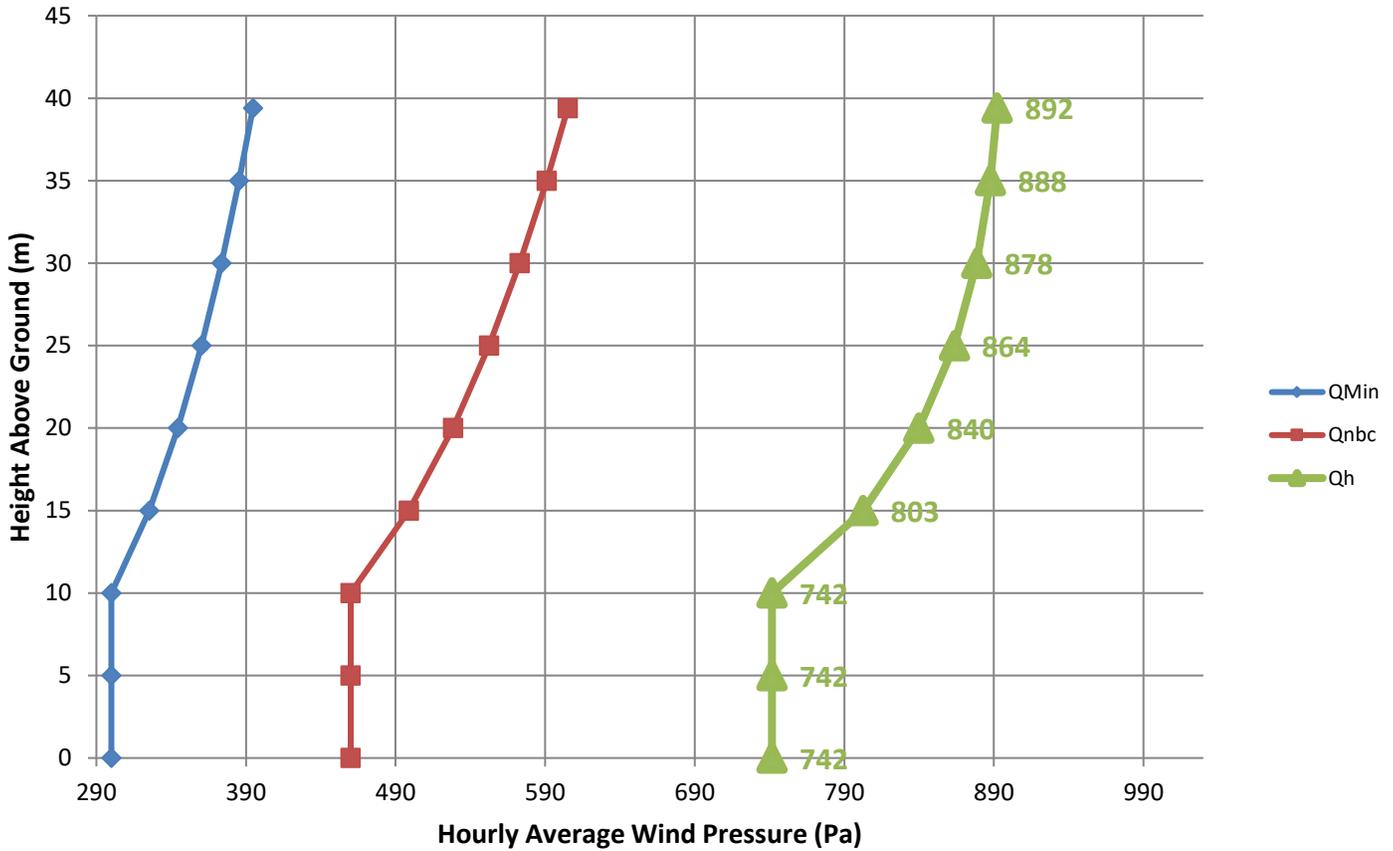
Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

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30-yr. Wind Pressure Profile Graph for WM637 Denny Island, BC 39.4m Tower



Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the ²/₁₀ power law.

Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the ²/₁₀ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

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Site-Specific 50-yr. Wind Pressure Report (V2.2 2019-04-22)

Site Information:

Name: WM637 Denny Island, BC
 Latitude: 52° 6' 13.46" N
 Longitude: 128° 4' 30.57" W
 Tower Height (m): 39.4
 Elevation MSL (m): 496.1

Results:

Note: Following direction from the S37 Committee, Q_e can no longer be provided.

Q_{nbc} (Pa): 500	$Q_{nbc} = 500(Z/10)^{0.2}$	$V_{nbc} = 62.21$ mph
Icing: As per CAN/CSA S37-18		
Q_{Min} (Pa) 320	$Q_{Min} = 320(Z/10)^{0.2}$	$V_{Min} = 49.77$ mph

Wind Pressure Formula (for z in metres and result in Pa):

$$Q_h = 0.12919 \{ [0.6207 e^{(-0.0121z)} + 1.0000 \ln(z/0.6000) / \ln(z/0.6000)] 50.80 \}^2 (z/10)^{0.298}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{ [a_1 e^{(-a_2z)} + a_3 \ln(z/z_h) / \ln(z/z_{01})] v_{01} \}^2 (z/10)^{0.298}$$

Site Values of Coefficients:

$$a_1 = 0.6207, a_2 = 0.0121, a_3 = 1.0000, z_h = 0.6000, z_{01} = 0.6000, v_{01} = 50.80 \text{ mph}$$

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc} : Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $z/10$ power law.

Q_{Min} : Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $z/10$ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

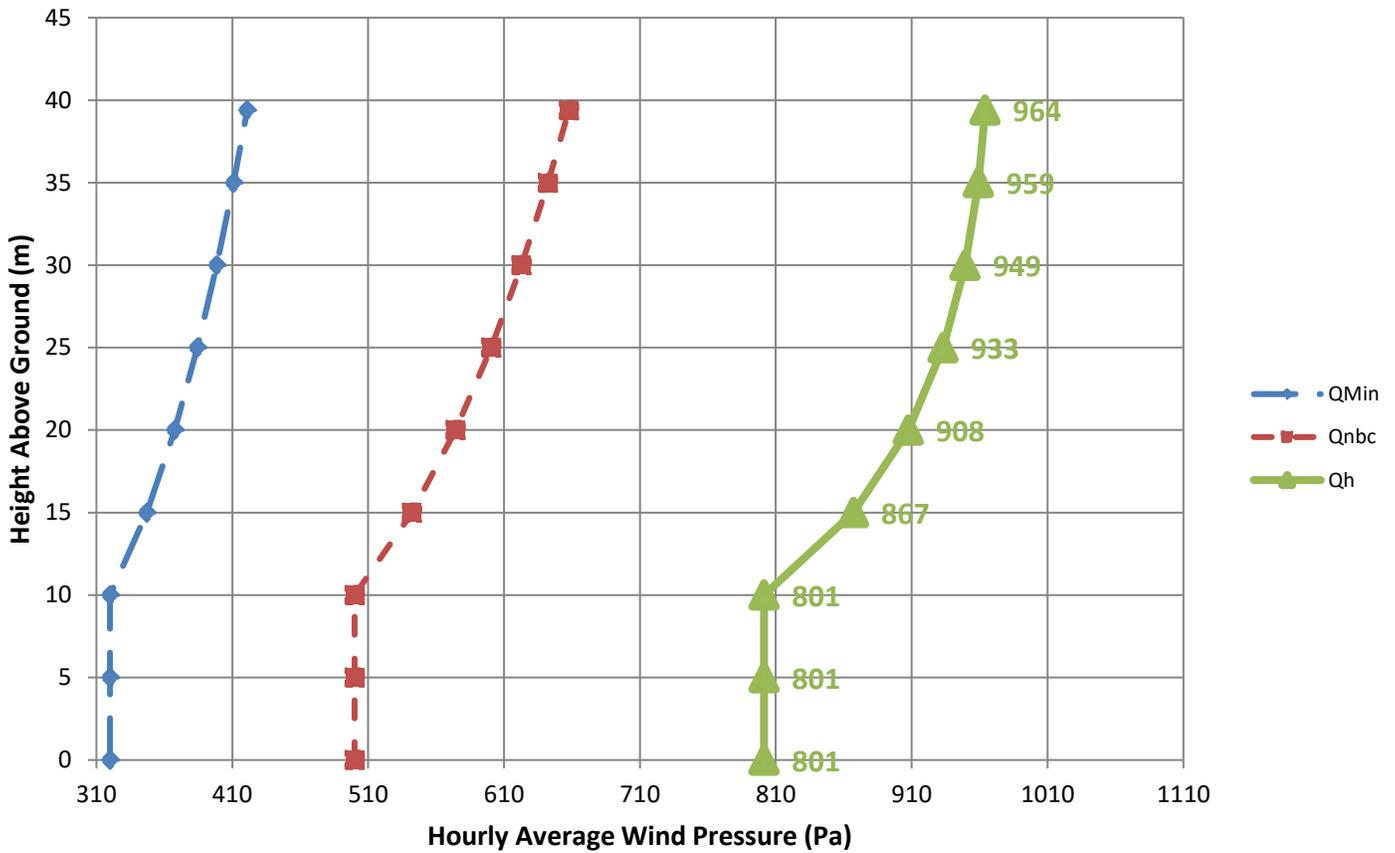
Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

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50-yr. Wind Pressure Profile Graph for WM637 Denny Island, BC 39.4m Tower



Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the ²/₁₀ power law.

Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the ²/₁₀ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

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APPENDIX D

SAFETY MOUNTAIN – SITE LOCATION AND PHOTOS



Figure 1 - Site Location



Figure 2 - Overall Site



Figure 3 - Overall Site



Figure 4 - Overall Site



Figure 5 - Overall Site

A 3D model of the site can be found at this link:

<https://cloud.pix4d.com/dataset/731126/map?shareToken=6706c7c4-d6dc-4b15-903a-9ffd46e8148e>



APPENDIX E

SAFETY MOUNTAIN – GEOTECHNICAL REPORT

July 11, 2018
File: SGL18-011

Canadian Coast Guard
25 Huron St.
Victoria, BC V8V 4V9

Attention: Mr. Clint Hoffman, P.Eng.

**Re: Proposed Safety Mountain, Calvert Island, Communications Tower
Report of Geotechnical Assessment**

INTRODUCTION

As requested, Simpson Geotechnical Ltd. has conducted a geotechnical assessment for a proposed new communications tower on Safety Mountain, Calvert Island on the north coast of BC at approximately 51° 32' 35" N and 127° 57' 33" W. We understand that the proposed new tower would be a self-supported steel lattice tower in the order of 24.4m (80 feet) in height and would be located on the site approximately as shown in the photograph on Figure 1.

This assessment has been conducted in general accordance with CSA S37-13 Antennas, Towers, and Antenna-Supporting Structures.

SITE ASSESSMENT

The site assessment was conducted on June 20, 2018 and consisted of observations of the general setting and ground surface geometry of the site as well as bedrock condition and discontinuities near the proposed tower location. Weather conditions at the time of the assessment were overcast and warm.

The proposed tower site was located on a gently rolling saddle ridge generally aligned east-west between two local topographic high points on Safety Mountain, as seen on Figures 1 and 2. The saddle was vegetated with grasses, low brush and occasional conifer trees up to approximately 3m in height with trunk diameters up to approximately 200mm. The spacing and size of the trees increased quickly to the north and south as the elevation decreased.

There was a shallow gully aligned in a generally northeast to southwest approximately 20m southwestward of the proposed tower site, with local exposures of relatively fine-grained dioritic complex bedrock.

A knob of dioritic bedrock was also noted approximately 30m westwards of the proposed tower location. Observations of those bedrock exposures noted general orthogonal and steeply inclined persistent discontinuities. The visible discontinuities were dry with no filler and occasionally gapped up to 8mm, at a moderate spacing commonly in the 200 to 600mm range. The exposed rock surfaces were rough, weathered for 2 to 3 mm. Below the weathered surface the rock was hard and required many blows of a geologic hammer to chip, indicative of Grade R5 (very strong) rock in accordance with the Canadian Foundation Engineering Manual rock classification system.

The Rock Quality Designation (RQD) was measured by surface scanline method at the two exposures described above. Those measurements resulted in RQD = 84% in the gully and 100% at the rock knob, indicative of good to excellent quality rock.

At the topographic peak in the order of 300m to the west of the proposed tower site there was a large exposure of very steeply inclined columnar jointed bedrock with evidence of extensive rockfall to a talus slope below.

The immediate area of the proposed tower was gently sloped downwards in all directions from the tower site, at slopes typically in the order of 13 to 25 degrees overall for at least 30m from the proposed tower location, with localized variation. The slope rolled off to gradually increasing grades to the north and south, while maintaining a gentle slope along the saddle alignment.

Hand excavation and probing in the immediate vicinity of the proposed tower encountered dioritic rock that we infer as the probable bedrock surface at depths that ranged from approximately 0.3 to 0.5m below the ground surface. Excavated test holes in the area exposed wet, black, fibrous peat-like topsoil up to approximately 0.2m thick, overlying stiff, brown, damp, sandy silt, overlying the dioritic bedrock surface.

LABORATORY TESTING

A sample of the dioritic rock was retained from the rock knob exposure and was tested for relative density. That test indicated a relative density of 2.8 g/cm³. The test report is appended.

DISCUSSION AND RECOMMENDATIONS

Based on the site assessment described above, the proposed tower location shown on Figure 1 is considered geotechnically suitable provided that the following recommendations are implemented.

A Seismic Hazard Calculation for the site was obtained from Natural Resources Canada. That calculation indicated a Peak Ground Acceleration (PGA) of 0.079g for the 10% in 50 year (1 in 475 year) probability seismic event. The Seismic Hazard Calculation is appended.

Groundwater at the site is not anticipated due to its location near a topographic high point and the very small catchment area. However, local ponded and perched water may be encountered during wet weather that may lead to wet anchor drill holes.

The self-supported communications tower foundation may consist of a combination of concrete footings bearing on approved undisturbed intact bedrock with uplift resistance provided by cementitious bonded rock anchors. A two-part plastic resin grout may be used in dry conditions, if desired. The foundation design should be based on the geotechnical parameters tabled below in accordance with CSA S37-13 Antennas, Towers, and Antenna-Supporting Structures.

The uplift resistance should be based on the inverted cone approach using the parameters in this report, based on a maximum cone apex angle of 80 degrees (40 degrees each side of the long axis of the anchor) due to the near vertical discontinuities and gapped joints observed at the site. The anchor to rock bond length should be centered on the apex of the cone. Anchors located laterally closer than $1.2 \times D$ (where D is the anchor depth) should be considered to act as a group.

Truncation of the uplift cone by slopes may occur, dependent on the actual location of the footing and the depth of the rock anchor. Truncation of the uplift cone may reduce the volume of rock mobilized by the anchor and reduce the uplift resistance of the affected anchor and should be considered in the anchor design.

Recommended Geotechnical Foundation Design Parameters for Proposed Safety Mountain, Calvert Island, Communications Tower (In accordance with CSA S37-13)

Parameter	Value
Bedrock type	Fine-grained diorite complex
Design depth to sound bedrock (including weathered rock)	0.3m to 0.5m
Ultimate, unfactored, bearing resistance (bearing on approved, undisturbed, intact dioritic bedrock)	4000 KPa
Serviceability bearing resistance	1000 KPa
Ultimate, unfactored compressive strength of intact dioritic bedrock	100 MPa
Ultimate unfactored tensile strength of rock mass on surface of cone (based on good quality rock mass with RQD=>84%)	25 KPa
Bulk unit weight of rock mass	27 KN/m ³
Ultimate, unfactored, grout to rock bond stress	1.7 MPa
Recommended design depth to groundwater	>6m
Rock Quality Designation (RQD)	84%
Design cone apex angle	maximum 80 degrees
Seismic site class (NBCC 4.1.8.4)	A

Rock anchors should be installed in accordance with the tendon and grout manufacturers' recommendations and be proof loaded to 110% of the factored load under the review of Simpson Geotechnical Ltd. Although groundwater is not anticipated to be encountered during rock anchor installation, wet conditions may be encountered in the rock anchor drill holes from perched surface water, especially during periods of wet weather.

CLOSURE

This report was prepared for the exclusive use of the Canadian Coast Guard and their appointed agents for design of the proposed Safety Mountain, Calvert Island, self-supported communications tower described herein. Any use or reliance made on this report by an unauthorized third party is the responsibility of that third party. Contractors should make their own assessment of the property for the purposes of bidding on and performing work on the site.

Geological and hydrological conditions can vary significantly over short distances and may also change with time. Actual conditions remote from the test locations may vary across the site. Any encountered variation from the subsurface conditions described in this report should be brought to the attention of Simpson Geotechnical Ltd. to consider potential significance to the recommendations provided in this report.

This report has been prepared in accordance with standard geotechnical engineering practice. No other warranty is provided, either expressed or implied.

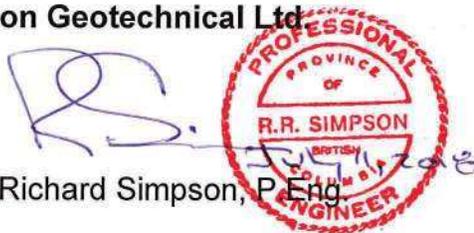
We appreciate the opportunity to provide our services on this project. Should you have any questions, please do not hesitate to contact us.

Yours truly,

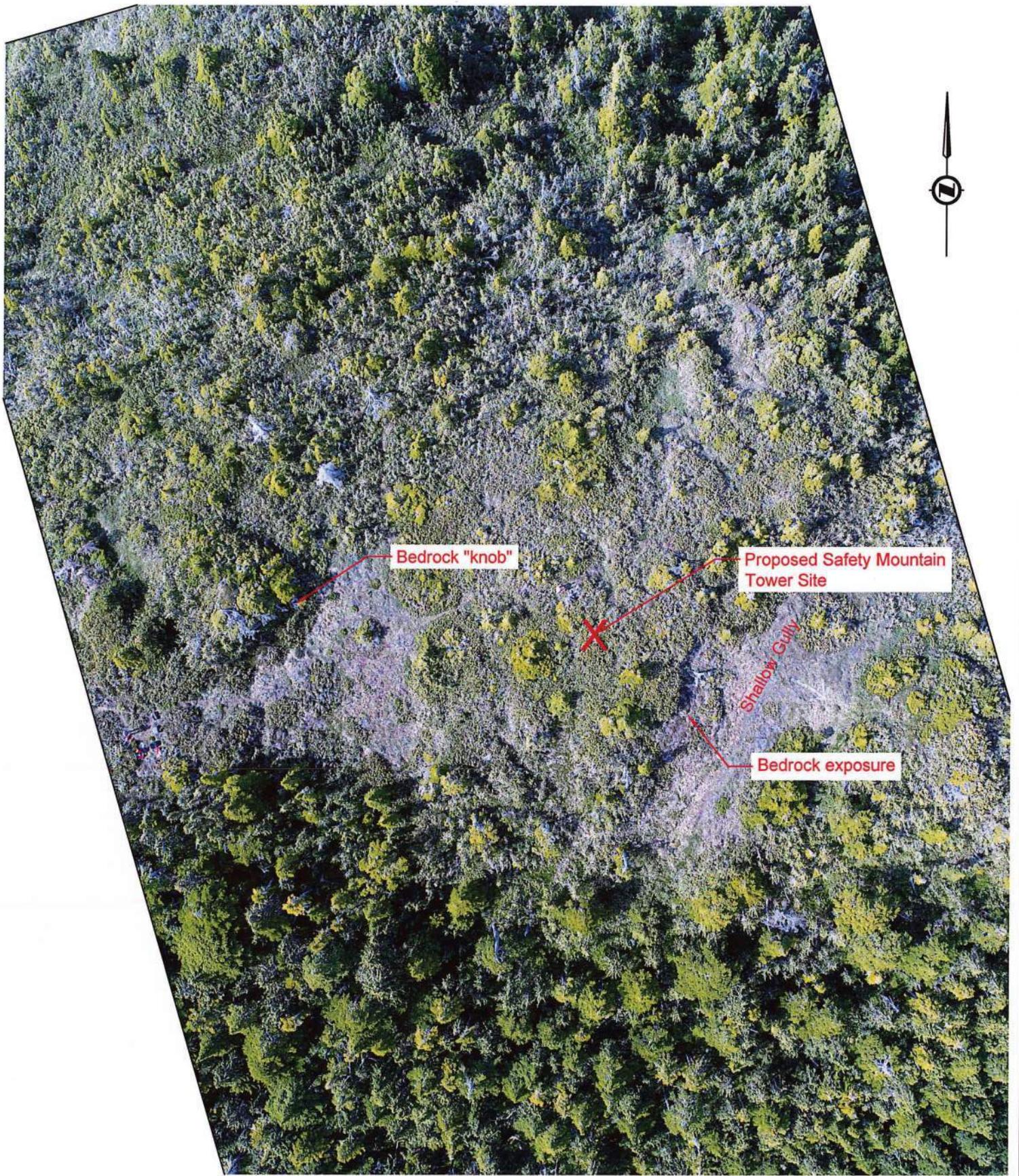
Simpson Geotechnical Ltd

Per:

Richard Simpson, P. Eng.



Attachments: Figure 1 – Proposed Tower Location
Figure 2 – Site Photos
Relative density test report
Seismic Hazard Calculation



Bedrock "knob"

Proposed Safety Mountain Tower Site

Shallow Gully

Bedrock exposure



Project: Proposed Communications Tower, Safety Mountain, Calvert Island, BC

Title: Site Plan

Client: Canadian Coast Guard

File: SGL18-011

Drawn by: RRS

Scale: 1 : 500±

Date: July 11, 2018

Dwg. No.: Figure 1

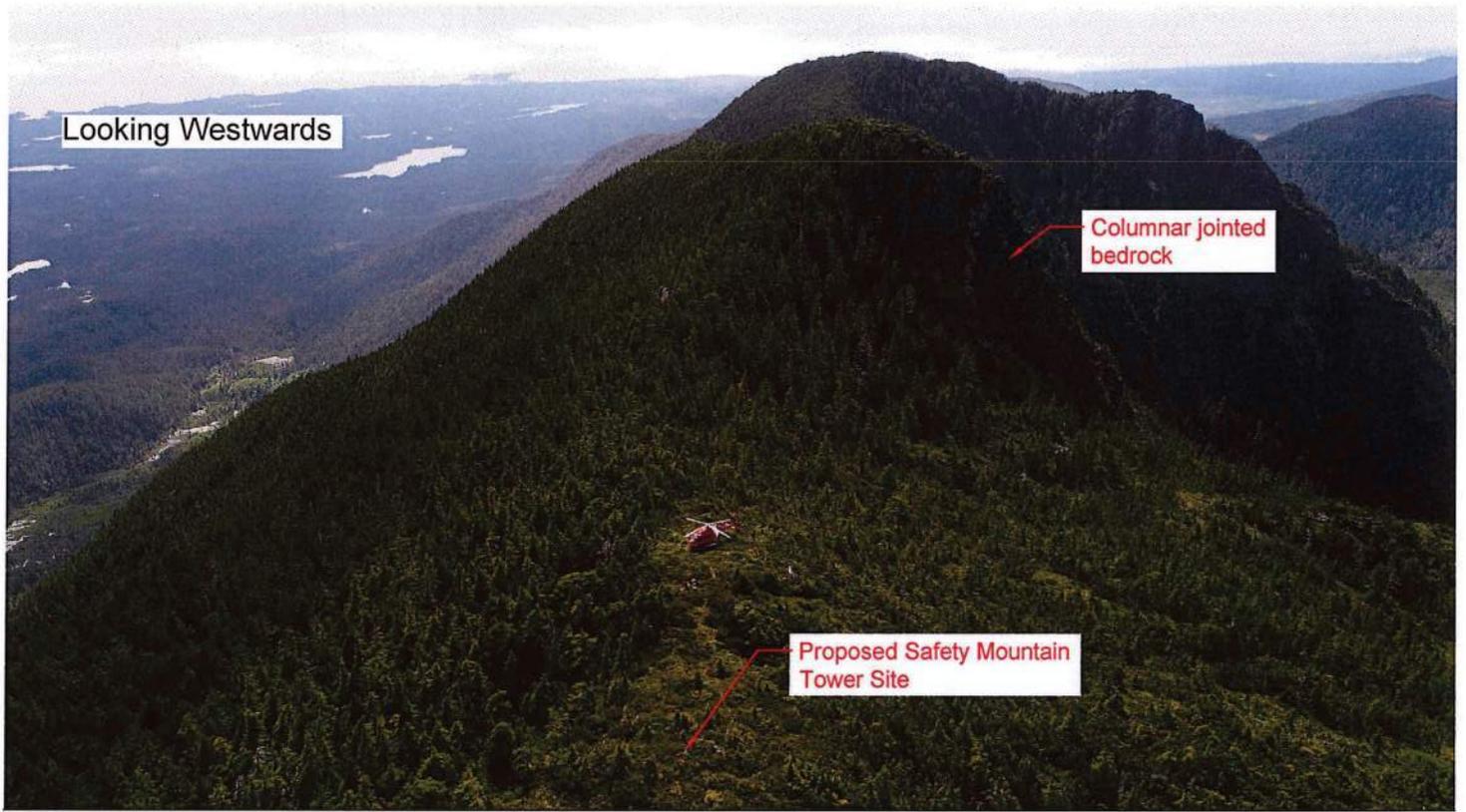
SIMPSON GEOTECHNICAL LTD



Looking Eastwards

Bedrock "knob"

Proposed Safety Mountain Tower Site



Looking Westwards

Columnar jointed bedrock

Proposed Safety Mountain Tower Site

Project:		Proposed Communications Tower, Safety Mountain, Calvert Island, BC	
Title:		Site Photos	
Client:		Canadian Coast Guard	
File:	SGL18-011	Drawn by:	RRS
Scale:	NTS	Date:	July 11, 2018

SIMPSON GEOTECHNICAL LTD

Dwg. No.: Figure 2

Project Calvert (Safety Mountain) Comm. Tower **Project No.** SGL18-011
Client Canadian Coast Guard **Date** 27-Jun-18
Sample Location Proposed Tower Site
Sample Description Granitic
Pan No. E

Drying Start Time June 25, 2018 0800hrs
Drying Stop Time June 26, 2018 0730 hrs
Sample Dry, 110° for 24 hours (A) g 1935.5 g
Soak Start Time June 26, 2018 0807 hrs
Soak Stop Time June 27, 2018 0814hrs
Saturated Surface Dry 24 hour soak (B) g 1957.2 g
Water Temperature 23 ° C
Submerged Weight at 23° g (C) 1265.5 g

Relative Density (specific gravity) = A/(B-C) 2.80 g/cm³
Absorption (%) = (B-A)/Ax100 1.12 %

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

July 09, 2018

Site: 51.543 N, 127.9591 W User File Reference: Safety Mountain, Calvert Island

Requested by: , Simpson Geotechnical Ltd.

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	Sa(0.2)	Sa(0.3)	Sa(0.5)	Sa(1.0)	Sa(2.0)	Sa(5.0)	Sa(10.0)	PGA (g)	PGV (m/s)
0.142	0.227	0.298	0.321	0.320	0.241	0.159	0.059	0.020	0.140	0.342

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s²). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. *These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.*

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.05)	0.041	0.080	0.105
Sa(0.1)	0.060	0.124	0.165
Sa(0.2)	0.089	0.171	0.222
Sa(0.3)	0.098	0.187	0.242
Sa(0.5)	0.091	0.181	0.238
Sa(1.0)	0.065	0.131	0.175
Sa(2.0)	0.037	0.082	0.112
Sa(5.0)	0.012	0.028	0.040
Sa(10.0)	0.0046	0.010	0.014
PGA	0.039	0.079	0.104
PGV	0.078	0.182	0.248

References

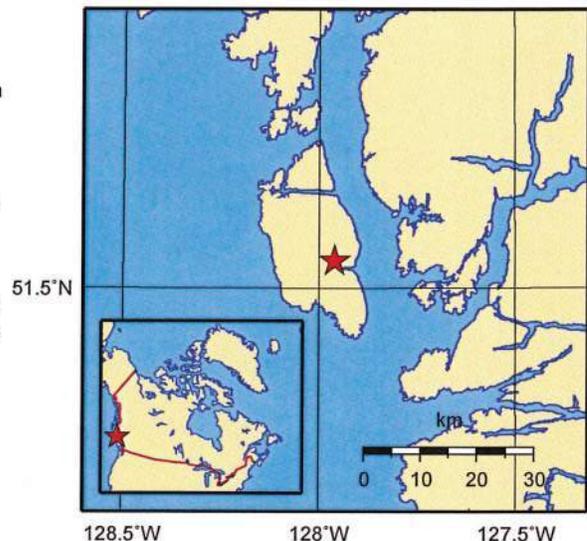
National Building Code of Canada 2015 NRCC no. 56190;
Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

User's Guide - NBC 2015, Structural Commentaries NRCC no. xxxxxx (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

Aussi disponible en français





APPENDIX F

SAFETY MOUNTAIN – SITE SPECIFIC WIND LOADING

Site-Specific 10-yr. Wind Pressure Report (V2.2 2019-04-22)

Site Information:

Name: WM628 SafetyMountain, BC
 Latitude: 51° 32' 39.25" N
 Longitude: 127° 56' 51.76" W
 Tower Height (m): 39.4
 Elevation MSL (m): 814.1

Results:

Note: Following direction from the S37 Committee, Q_e can no longer be provided.

Q_{nbc} (Pa): 390	$Q_{nbc} = 390(Z/10)^{0.2}$	$V_{nbc} = 54.94$ mph
Icing: As per CAN/CSA S37-18		
Q_{Min} (Pa) 250	$Q_{Min} = 250(Z/10)^{0.2}$	$V_{Min} = 43.99$ mph

Wind Pressure Formula (for z in metres and result in Pa):

$$Q_h = 0.12919 \{ [0.9000 e^{(-0.0023 z)} + 1.0000 \ln(z/0.6000) / \ln(z/0.6000)] 45.10 \}^2 (z/10)^{0.298}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{ [a_1 e^{(-a_2 z)} + a_3 \ln(z/z_h) / \ln(z/z_{01})] v_{01} \}^2 (z/10)^{0.298}$$

Site Values of Coefficients:

$$a_1 = 0.9000, a_2 = 0.0023, a_3 = 1.0000, z_h = 0.6000, z_{01} = 0.6000, v_{01} = 45.10 \text{ mph}$$

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc} : Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $z/10$ power law.

Q_{Min} : Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $z/10$ power law as per Section 5.4.1 of S37-18.

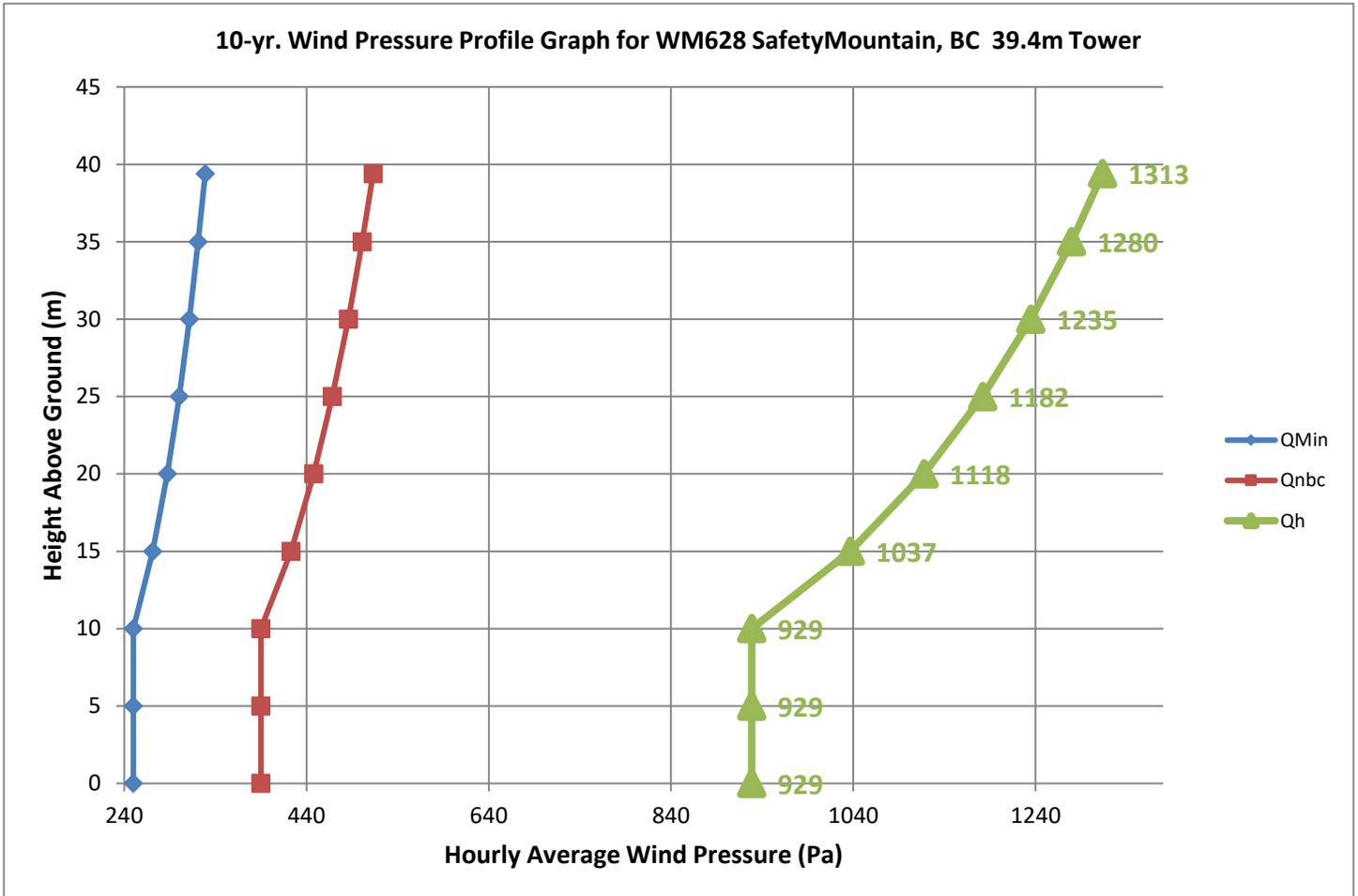
Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

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Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the ²/₁₀ power law.

Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the ²/₁₀ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

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Site-Specific 30-yr. Wind Pressure Report (V2.2 2019-04-22)

Site Information:

Name: WM628 SafetyMountain, BC
 Latitude: 51° 32' 39.25" N
 Longitude: 127° 56' 51.76" W
 Tower Height (m): 39.4
 Elevation MSL (m): 814.1

Results:

Note: Following direction from the S37 Committee, Q_e can no longer be provided.

Q_{nbc} (Pa): 470	$Q_{nbc} = 470(Z/10)^{0.2}$	$V_{nbc} = 60.32$ mph
Icing: As per CAN/CSA S37-18		
Q_{Min} (Pa) 300	$Q_{Min} = 300(Z/10)^{0.2}$	$V_{Min} = 48.19$ mph

Wind Pressure Formula (for z in metres and result in Pa):

$$Q_h = 0.12919 \{ [0.9000 e^{(-0.0023 z)} + 1.0000 \ln(z/0.6000) / \ln(z/0.6000)] 49.36 \}^2 (z/10)^{0.298}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{ [a_1 e^{(-a_2 z)} + a_3 \ln(z/z_h) / \ln(z/z_{01})] v_{01} \}^2 (z/10)^{0.298}$$

Site Values of Coefficients:

$$a_1 = 0.9000, a_2 = 0.0023, a_3 = 1.0000, z_h = 0.6000, z_{01} = 0.6000, v_{01} = 49.36 \text{ mph}$$

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc} : Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $z/10$ power law.

Q_{Min} : Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $z/10$ power law as per Section 5.4.1 of S37-18.

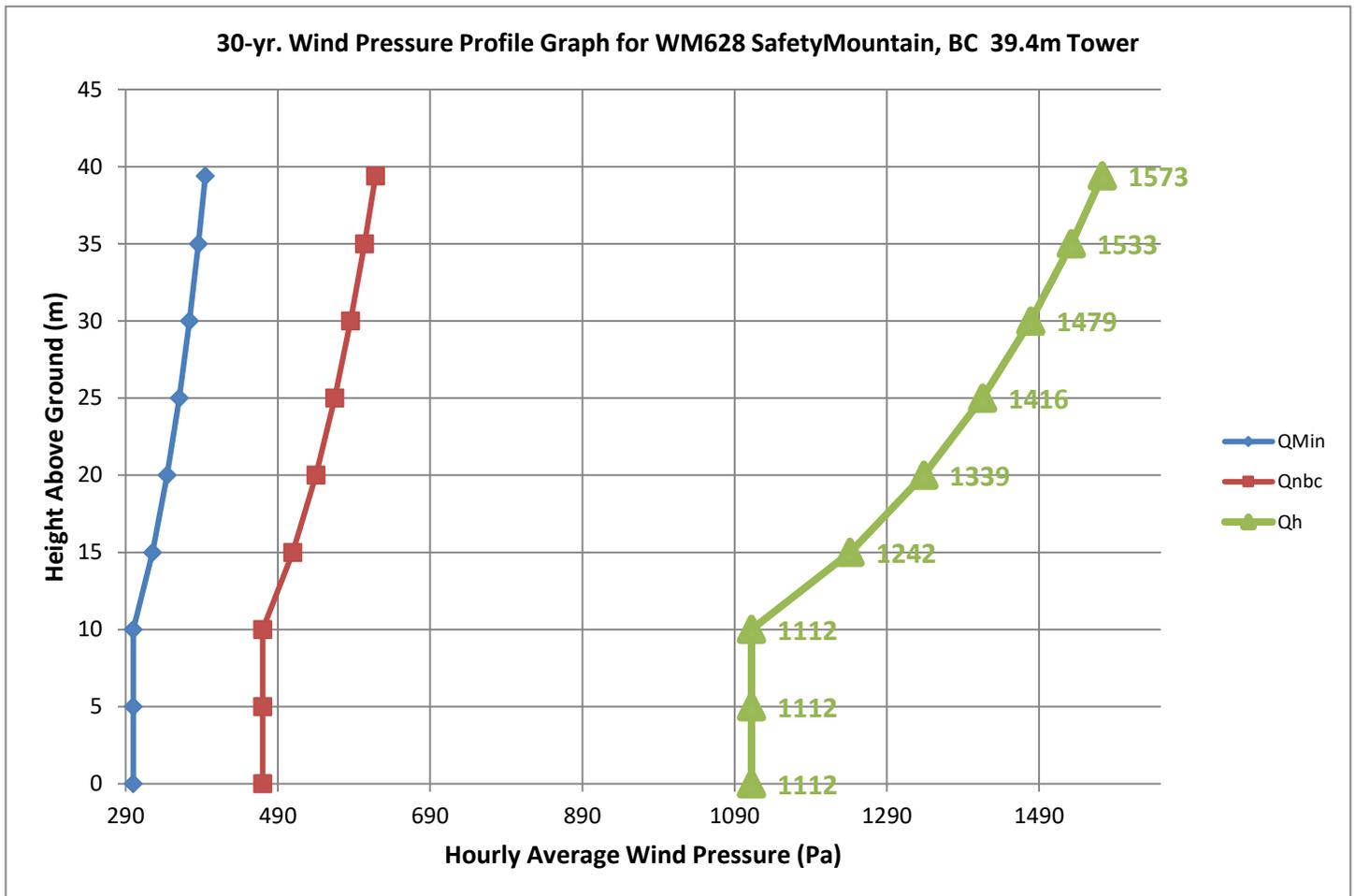
Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

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Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the ²/₁₀ power law.

Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the ²/₁₀ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

Environment Canada has not made and does not make any representations or warranties, either expressed or implied, arising by law or otherwise, respecting the accuracy of recommended climatic information. In no event will Environment Canada be responsible for any prejudice, loss or damages which may occur as a result of the use of design wind pressure recommendations.

Site-Specific 50-yr. Wind Pressure Report (V2.2 2019-04-22)

Site Information:

Name: WM628 SafetyMountain, BC
 Latitude: 51° 32' 39.25" N
 Longitude: 127° 56' 51.76" W
 Tower Height (m): 39.4
 Elevation MSL (m): 814.1

Results:

Note: Following direction from the S37 Committee, Q_e can no longer be provided.

Q_{nbc} (Pa): 510	$Q_{nbc} = 510(Z/10)^{0.2}$	$V_{nbc} = 62.83$ mph
Icing: As per CAN/CSA S37-18		
Q_{Min} (Pa) 320	$Q_{Min} = 320(Z/10)^{0.2}$	$V_{Min} = 49.77$ mph

Wind Pressure Formula (for z in metres and result in Pa):

$$Q_h = 0.12919 \{ [0.9000 e^{(-0.0023 z)} + 1.0000 \ln(z/0.6000) / \ln(z/0.6000)] 51.31 \}^2 (z/10)^{0.298}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{ [a_1 e^{(-a_2 z)} + a_3 \ln(z/z_h) / \ln(z/z_{01})] v_{01} \}^2 (z/10)^{0.298}$$

Site Values of Coefficients:

$$a_1 = 0.9000, a_2 = 0.0023, a_3 = 1.0000, z_h = 0.6000, z_{01} = 0.6000, v_{01} = 51.31 \text{ mph}$$

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc} : Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $z/10$ power law.

Q_{Min} : Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $z/10$ power law as per Section 5.4.1 of S37-18.

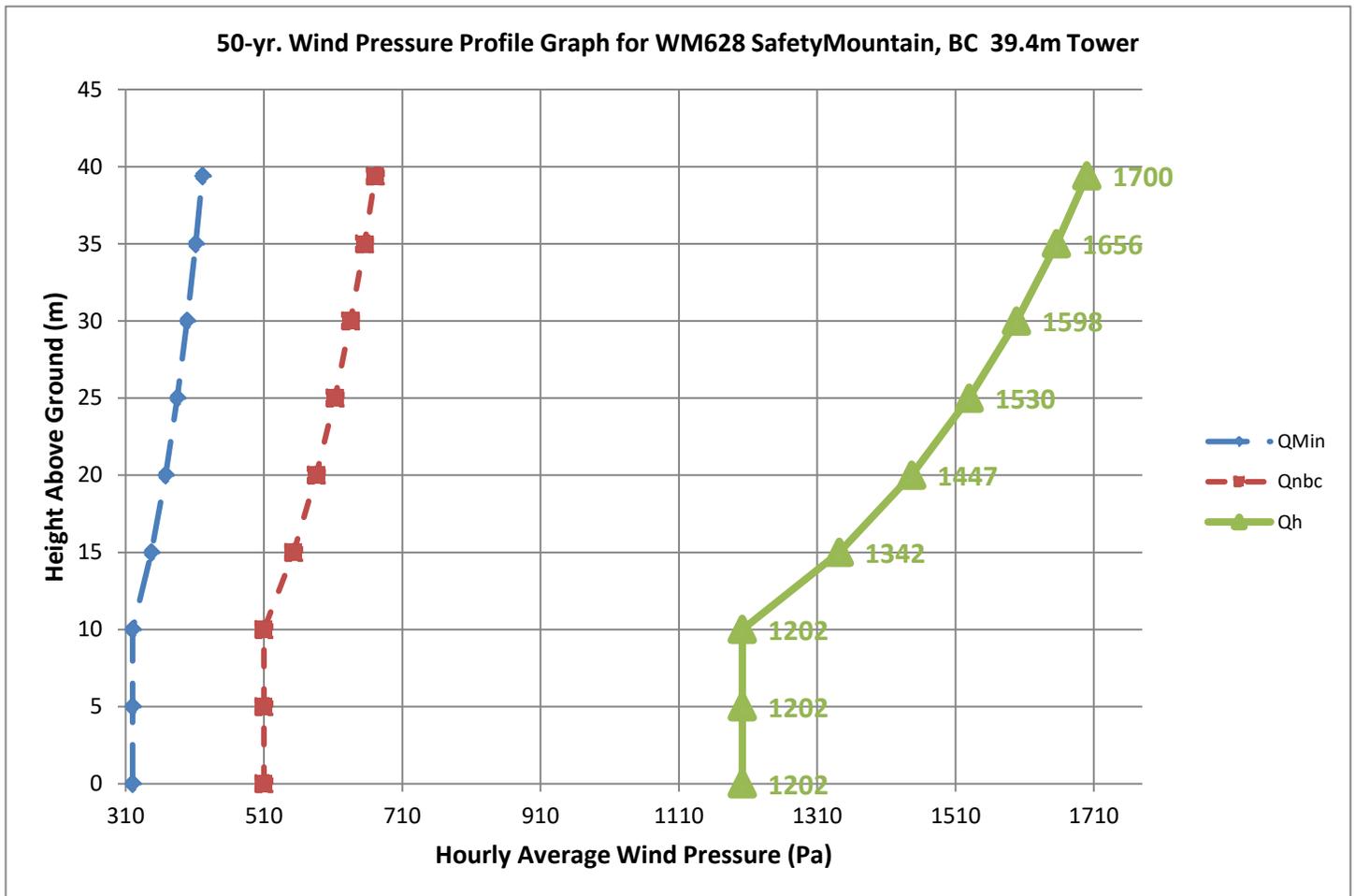
Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

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Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.

Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the ²/₁₀ power law.

Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the ²/₁₀ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)

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These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

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APPENDIX G

ENVIRONMENTAL ASSESSMENT



**Environmental Overview
Assessment in Support of the
Development of Canadian Coast
Guard Radar Sites, British
Columbia**

January 23, 2019

Prepared for:

Canadian Coast Guard—Marine & Civil
Infrastructure
Fisheries & Oceans Canada
25 Huron St.,
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Prepared by:

Stantec Consulting Ltd.
Suite 11, 2260 Mills Road
Sidney, BC V8L 5X4

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Abbreviations

BC	British Columbia
CCA	Central Coast Archaeology
CCG	Canadian Coast Guard
CDC	Conservation Data Centre
CDFmm	moist maritime Coastal Douglas-Fir
CMT	Culturally modified tree
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWHdm	dry maritime Coastal Western Hemlock
CWHvh2	very wet hypermaritime Coastal Western Hemlock
CWHvm1	submontane very wet maritime Coastal Western Hemlock
CWHvm2	very wet Coastal Western Hemlock
CWHxm	very dry maritime Coastal Western Hemlock
FISS	Fish Information Summary System
GOC	Government of Canada
GPS	Global Positioning System
MHwh1	wet hypermaritime Mountain Hemlock



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PFR	preliminary field reconnaissance
RAAD	Remote Access to Archaeological Data
SARA	<i>Species at Risk Act</i>



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Introduction

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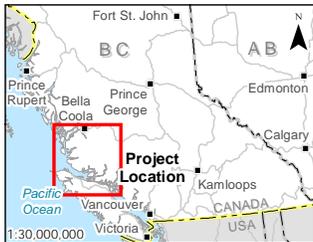
1.0 INTRODUCTION

Canadian Coast Guard (CCG) retained Stantec Consulting Ltd. (Stantec) to undertake an environmental overview assessment, including desktop and field-based assessments, for four proposed radar sites within British Columbia (BC) (the Project). The work was carried out in accordance with Stantec's proposal titled, *Scope of Work and Cost Estimate for Environmental Services in Support of the Development of Canadian Coast Guard Radar Sites, British Columbia*, dated July 27, 2018.

2.0 PROJECT LOCATIONS

Canadian Coast Guard is planning to construct four new radar stations at Denny Island, Mount Collinson, Safety Mountain, and Seymour Narrows. These sites are located along the west coast of BC near Campbell River (Seymour Narrows), Telegraph Cove (Mount Collinson), and Bella Bella (Denny Island and Safety Mountain). All locations are situated on the top of hills or are at high elevations to enhance range of radar signals (Figure 1).





- City, Town, or Village
- CCG Radar Tower Location
- Highway
- Road
- +— Railway



Project Location: West Coast of British Columbia
 Project Number: 123221193
 Prepared by: LTRUDEL on 20180913
 Discipline Review by: SNABESS on 20190107
 GIS Review by: SPARKER on 20190107

Client/Project/Report: Canadian Coast Guard Radar Stations, British Columbia: Environmental Overview Assessment
 Figure No.: 1

Title: Overview Map

ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Methods

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3.0 METHODS

The environmental overview assessment is focused on four valued environmental components: vegetation, wildlife, fish, and archaeology. The findings of the environmental overview assessment will inform the permitting process and be used in the development of a site-specific construction environmental management plan.

The environmental overview assessment was conducted using a combination of desktop and field-based (site reconnaissance) analysis. The desktop assessment was used to characterize the known environmental resources within the four Project locations using publicly available data and government databases. The site reconnaissance was used to confirm the presence of identified features and habitats, as well as to determine the presence of any unknown or unmapped features, habitats or species. The methods used for each of the components are described in the following sub-sections.

3.1 DESKTOP REVIEW

3.1.1 Vegetation

The study area for the desktop review is a 500 m buffer on the proposed radar tower location. Prior to the site reconnaissance, a desktop review of existing data sources was completed to identify any species or ecological communities of conservation concern, critical habitat for plant species at risk, old forest, wetlands, or invasive plants.

In this report, species and ecosystems of conservation concern include vascular plants and ecological communities that are:

- Red or blue-listed by the BC Conservation Data Centre (BC CDC)
- Designated as identified wildlife under the *Forest and Range Practices Act*
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or *Species at Risk Act* (SARA) listed

The BC CDC assigns plant species and ecological communities to provincial lists depending on their provincial conservation status. Red-listed plant species and ecological communities are those that are extirpated, endangered, or threatened in BC (BC CDC 2004). The BC Blue List includes any plant species and ecological communities considered to be of special concern in BC (BC CDC 2004). Blue-listed plant species possess characteristics that make them sensitive to either human activities or natural disturbance.

Plant species of conservation concern may also be federally listed as endangered, threatened or special concern under SARA and by COSEWIC (Government of Canada [GOC] 2017a).



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

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Existing data sources which were reviewed included:

- Element occurrences for plant species and ecological communities (BC CDC 2018a)
- Potential plant species and ecological communities of conservation concern (BC CDC 2018b)
- Critical habitat for species at risk designated under SARA (Government of Canada 2018)
- Freshwater Atlas (GeoBC 2018a)
- Vegetation Resources Inventory (GeoBC 2018b) (used to identify areas of known old forest)
- Invasive Alien Plant Program database (BC MFLNRORD 2018)
- Publicly available digital aerial photographs

3.1.2 Wildlife

The wildlife study area for the desktop review includes the site tenure area plus a 500 m buffer. A review of existing information within the study area was completed prior to undertaking the site reconnaissance to identify critical habitat, species composition and distribution, and known or likely occurrences of species of management concern in the study area. Species of management concern are defined as terrestrial vertebrates that are:

- Listed as Endangered, Threatened or Special Concern by COSEWIC
- Designated on Schedule 1 of SARA
- Red or blue-listed by the Province of BC
- Known to be important to Aboriginal groups for hunting and trapping
- Species for which special mitigations are required

Provincial, federal, and non-government organization databases and information sources were reviewed for species occurrence records and species reports. The following information sources were consulted:

- BC Conservation Data Centre (BC CDC)
- DataBC (e.g., for spatial data related to critical habitat and provincially designated wildlife areas)
- NatureCounts (e.g., eBird, BC Breeding Bird Atlas)
- Wildlife Tree Stewardship Atlas
- BC Wildlife Species Inventory database

This information was reviewed to determine if the proposed radar sites overlap with any of the following:

- Parks and protected areas
- Designated Ungulate Winter Range
- Approved Wildlife Habitat Areas
- Wildlife tree retention areas and wildlife tree patches
- Critical habitat designated under SARA
- Grizzly bear population units
- Important Bird Areas
- Occurrences of species of management concern



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Methods

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3.1.3 Fish

A desktop background review was used to characterize the Project area and species that may occur at or within 1 km of the four sites. This review focused on Commercial, recreational and aboriginal fishery species and species at risk. Information sources reviewed included government databases, community databases and scientific literature. Databases that were reviewed include:

- iMap BC (GeoBC 2018c)
- British Columbia Species and Ecosystems Explorer (BC CDC 2018b)
- Fish Information Summary System (FISS) (FISS 2018)

Mapping databases (e.g., iMap) were used to identify species and habitat, including evaluating land contours to identify potential fish habitat, near each Project site. The British Columbia Species and Ecosystems Explorer database and FISS were further used to identify species that may occur within each site.

3.1.4 Archaeology

A desktop review was conducted to determine the presence of recorded archaeological sites within each radar site study area, the site type of the nearest archaeological sites to each study area, and to assess the potential for unrecorded heritage sites to be present. The following archaeological and environmental resources were reviewed:

- Provincial Heritage Register through the Remote Access to Archaeological Data (RAAD) application maintained by the Archaeology Branch of British Columbia
- Central Coast Land and Resource Management Plan archaeological potential model (Bailey et al. 1999)
- Campbell River Forest District potential model (Eldridge et al. 2007)
- Satellite imagery
- Post-glacial environment studies (McLaren et al. 2014; Shugar et al. 2014; Fedje et al. 2018)

Key factors that were considered in this assessment include archaeological potential ratings as indicated in the existing potential models, proximity to known archaeological sites, proximity to terrain and hydrological features associated with archaeological sites in the region, and post-glacial environment (sea-level changes).



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

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3.2 SITE RECONNAISSANCE

Site reconnaissance surveys were undertaken by a team consisting of a vegetation ecologist, a wildlife biologist, and an archaeologist from Stantec accompanied by a representative from CCG, archaeologists from Central Coast Archaeology (CCA) for the Denny Island and Safety Mountain sites, and local First Nations participants. The surveys were completed in October:

- October 2 and 3, 2018 for Denny Island and Safety Mountain
 - Colleen Bryden—wildlife ecologist
 - Jennifer Mundy—vegetation ecologist
 - George Kaufmann—archaeologist
 - Elroy White—Coastal Archaeology Consulting and Heiltsuk Nation
 - Charlie Brown—Coastal Archaeology Consulting and Heiltsuk Nation
- October 15, 2018 for Mount Collinson
 - Christina Ball—wildlife ecologist
 - Dmitry Petelin—vegetation ecologist
 - Adam Wharram—archaeologist
 - Harry Alfred—‘Namgis First Nation
 - Rachel Dalton—‘Namgis First Nation
- October 22, 2018 for Seymour Narrows
 - Christina Ball—wildlife ecologist
 - Dmitry Petelin—vegetation ecologist
 - Ian Streeter—archaeologist

3.2.1 Vegetation

A vegetation ecologist completed a site reconnaissance at each of the four proposed radar sites during October. The focus of the site reconnaissance was the proposed locations for the hard infrastructure (radar tower, building, access road, and permanent helipad), as identified by the CCG representative in the field. Site information, vegetation species, photographs, and global positioning system (GPS) coordinates were taken of the vegetation resources.

3.2.2 Wildlife

A registered professional wildlife biologist completed a site reconnaissance of the four radar sites. The objectives of the site reconnaissance were to identify potential wildlife habitat features (e.g., bear dens, raptor nests, mineral licks), identify wildlife trails or movement corridors, and assess the habitat at the site for marbled murrelet (*Brachyramphus marmoratus*) and other wildlife species of conservation concern.

At each radar site the wildlife biologist surveyed the proposed development area on foot, focusing on the proposed locations for the radar tower, building and permanent helipad. The wildlife biologist surveyed the area for wildlife habitat features (e.g., bald eagle nests, bear dens) and marbled murrelet nesting



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions
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habitat. Notes and photographs were taken of general habitat conditions and wildlife habitat features. The coordinates of wildlife habitat features were recorded using a handheld GPS unit. Incidental wildlife detections were also recorded.

At each site marbled murrelet nesting habitat was assessed from the ground using methods adapted from Burger et al. (2009). The assessment considers vertical canopy complexity, tree age class and size, canopy cover, moss development, nesting platform abundance, site position, and tree species.

3.2.3 Archaeology

Archaeologists conducted a non-permitted preliminary field reconnaissance (PFR) of the four proposed radar sites to identify archaeological sites through a surface inspection of the Project areas, provide a field-level assessment of archaeological potential within the Project areas, and to provide recommendations for further work, if necessary.

At each radar site, the archaeologist(s) conducted a pedestrian survey of the proposed development area which included an assessment of terrain and drainage attributes as well as the examination of soil exposures where available. Standing and fallen trees and stumps were inspected for cultural modifications. The field assessment was documented with written notes and photographs, and spatial data was collected with a hand-held GPS device.

4.0 ENVIRONMENTAL CONDITIONS

Combined results from the desktop review and the field reconnaissance are presented in this section. Representative photos from the field survey are in Appendix A.

4.1 DENNY ISLAND

4.1.1 Vegetation

According to desktop information, old forest (greater than 250 years of age) is present in the proposed development area, immediately to the west of the temporary helipad (Figure 2) and in the south end of the study area, outside the proposed development area. The forest immediately around the proposed radar tower is not old forest. There is one mapped watercourse in the south-west of the proposed development area, however this high-gradient headwater stream is unlikely to support listed floodplain ecological communities. The Denny Island study area does not overlap any mapped wetlands, known occurrences of plant species or ecological communities of conservation concern, invasive plants, or critical habitat for plant species at risk (Figure 2).



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

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This site is in the very wet hypermaritime Coastal Western Hemlock (CWHvh2) biogeoclimatic unit. The CWHvh2 occupies the outer coastal portion of the region and is found between 0 and 600 m elevation. The climate is hypermaritime; cool, very mild, with very little snow, with fog and rain year-round. CWHvh2 terrain is mostly subdued and rocky and is characterized by low to mid-elevation rainforest stands of western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), and amabilis fir (*Abies amabilis*). Due to the extremely wet climate the vegetation is a mosaic of poor forest and bog, with productive forests restricted to moderate and steep slopes or floodplains (Banner et al. 2014). Many of the forested ecological communities in the CWHvh2 are listed by the BC CDC. According to a BC CDC search, there are 15 ecological communities of conservation concern which may occur in the study area (CWHvh2): 11 upland and four wetland communities (Appendix B, Table B-1). There are 20 vascular plant species of conservation concern which may occur in the study area (Table B-2).

The site reconnaissance confirmed the proposed Denny Island radar site is located in a mature western redcedar/western hemlock forested community (Appendix A, Photo A-1) with an understorey composed primarily of blueberry and a forest floor covered by feather mosses. The site has small inclusions of low areas (of up to a few meters wide) with indicator species of other (wetter) site series (e.g., sedges [*Carex* sp.], and sphagnum moss [*Sphagnum* sp.]).

Because of the timing of the site reconnaissance, the presence of plant species of conservation concern could not be determined.





CWHvh2

Denny Island

Denny Island Radar Tower



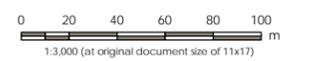
\\cd1183\03\workgroup\1232\193\figures\reports\Environmental_Overview_Assessment\Fig_1_23221193_eoa_02_Site_Map.mxd Revised: 2019.01.17 By: ltrudell



- Topographic Contour (TRIM)
- Watercourse (TRIM)
- Waterbody (TRIM)

- CCG Radar Tower Location
- Tenure Area

- Old Growth (VRI Age > 250 years)
- Marbled Murrelet Critical Habitat
- Biogeoclimatic Ecosystem Classification Zone *
- Coastal Western Hemlock



Project Location: Denny Island, British Columbia
 Project Number: 123221193
 Prepared by: LTRUDELL on 20180913
 Discipline Review by: SNABESS on 20190107
 GIS Review by: SPARKER on 20190107

Client/Project/Report: Canadian Coast Guard Radar Stations, British Columbia; Environmental Overview Assessment

Figure No.: 2

Title: Denny Island Environmental Conditions from Desktop Review and Site Reconnaissance

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions
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4.1.2 Wildlife

The desktop assessment of the Denny Island site indicate there are 16 species of conservation concern which may occur in the Denny Island study area: 12 bird species, two mammal species, and two amphibian species (Appendix C). Of the 16 species of conservation concern which may occur in the study area, 11 are designated on Schedule 1 of SARA. The Denny Island study area does not overlap any wildlife habitat areas, ungulate winter range, important bird areas, or grizzly bear population units. The study area does not overlap any parks or ecological reserves. There are no available occurrence records for wildlife species of conservation concern which overlap the study area. The Denny Island study area overlaps 69.4 ha of marbled murrelet critical habitat, and the tenure area overlaps 4.0 ha of marbled murrelet critical habitat (Figure 2).

The site reconnaissance results show the proposed Denny Island radar site is on a high point of land, dropping off steeply on all sides, and likely subject to strong winds, particularly in the winter. The site is an open understorey mature forest typical of higher elevations on the outer coast; the understorey is dominated by *Vaccinium* and moss (Appendix A Photo A-1). There are some small wetter areas present but, with little evidence of standing water coupled with their small dimensions, the suitability of these microsites for amphibian breeding is predicted to be low. Trees with dead tops and snags were common. No evidence of wildlife use of these trees was confirmed during the site visit although there are likely usable cavities. Wildlife may forage on the *Vaccinium* although berry production appears to be low, even accounting for the time of year the site was visited. The proposed tower and related facilities are not located in critical habitat for marbled murrelet (Figure 2). This was confirmed during the site reconnaissance; the field ranking for the site is very low suitability as nesting habitat, for example, the forest was lacking vertical canopy complexity and tree limbs when large enough to potentially support marbled murrelet nests had minimal mossy pad development and unsuitable structure (Appendix A, Photo A-2). Downslope from the site, there were larger western hemlock that appeared to have better potential as suitable nesting trees (Appendix A, Photo A-3), which is consistent with the federal mapping (see Figure 2).

No amphibians, species of conservation concern or wildlife habitat features were detected during the site reconnaissance. Common raven (*Corvus corax*) and an unidentified chickadee species (*Poecile* sp.) were recorded at the site.

4.1.3 Fish

There are no fish resources near the Denny Island site. The closest waterbodies are headwater first-order streams, one located 175 m to the west and one 300 m to the southeast (GeoBC 2018c). There are no fish records for either of these watercourses (FISS 2018). The site is located along a steep slope and therefore any unmapped watercourses at the location would not support fish species due to gradient barriers.



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions
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4.1.4 Archaeology

The nearest recorded archaeological site to the Denny Island radar site is approximately 1.7 km to the southwest. FaTa-43 is a pictograph site located near the shoreline on Twilight Point. The modelled archaeological potential suggests the Denny Island radar site will have low archaeological potential for buried heritage resources, however the model tends to assign high archeological potential to mainly coastal regions, and inland or high elevation sites are restricted to within 200 m of modern freshwater sources (Bailey et al. 1999). As such, while the likelihood of subsurface archaeological sites is likely low, given the location of the radar on a high elongated ridge, the potential for trail, culturally modified tree (CMT), or rock art sites was assessed as moderate.

The PFR included a pedestrian survey of the proposed location of the radar tower, building, and permanent helipad. The mountain-top site is situated on a 10° to 12° slope with steeply sloping forested terrain just beyond the radar site development boundaries. During the field study, the CCA archaeologists noted that there are both recorded and unrecorded pictographs in the vicinity of the proposed radar site, along the Lama Passage shoreline, opposite of McLouglin Bay. Small patches of Indian Hellebore were observed on the slope around the site. These plants are used traditionally to treat arthritis and for sacred cleansing purposes (CCA crew pers. comm.), however given the location of the plants in the high-altitude area, along with their relative abundance on the west coast, the area is unlikely to be of cultural significance. No above-ground archaeological resources or locations with high potential for buried archaeological resources were identified at the proposed tower, building, and helipad location.

4.2 MOUNT COLLINSON

4.2.1 Vegetation

According to desktop information, all forested ecosystems in the study area are old forest (greater than 250 years of age) (Figure 3). The Mount Collinson site is dominated by old coniferous forest on a local peak above Johnstone Strait. The radar tower location is in the submontane very wet maritime Coastal Western Hemlock (CWHvm1) biogeoclimatic unit. The CWHvm1 occupies both sides of northern Vancouver Island, and is found between sea level (or above CWHxm [dry maritime Coastal Western Hemlock] or CWHdm [dry maritime Coastal Western Hemlock] if present) to approximately 600 m on Vancouver Island. The CWHvm1 has a wet, humid climate with cool summers and mild winters featuring relatively little snow. Growing seasons are long. Forests on zonal sites are dominated by western hemlock, amabilis fir, and lesser amounts of western redcedar. Subdued terrain on the west coast and northern end of Vancouver Island features very old successional stages dominated by western redcedar, western hemlock, and salal (*Gaultheria shallon*) (Green and Klinka 1994).



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions

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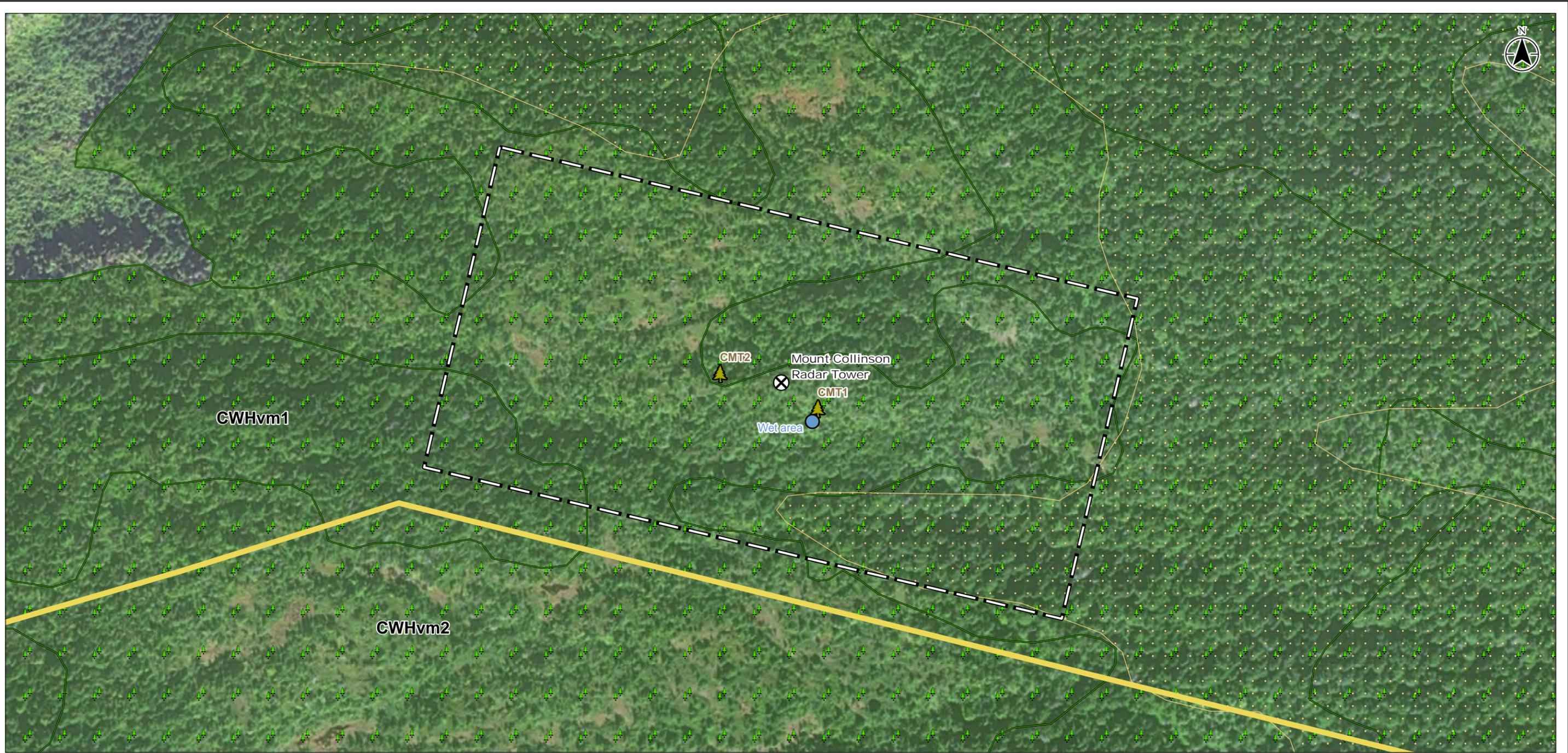
According to a BC CDC search, there are eight ecological communities of conservation concern which may occur in the study area (CWHvm1 and CWHvm2): five forested upland and three wetland communities (Appendix B, Table B-2). There are 14 vascular plant species of conservation concern which may occur in the study area (**Error! Reference source not found.** Table B-4). The Mount Collinson study area does not overlap any mapped wetlands, riparian areas, known occurrences of plant species or ecological communities of conservation concern, invasive plants, or critical habitat for plant species at risk.

The site reconnaissance found the proposed Mount Collinson site is within a sparsely treed, blue-listed forested community at the top of a hill—the western hemlock—western redcedar/salal unit (CWHvm1/03) (Appendix A, Photo A-4). The forest is composed of mountain hemlock, western hemlock, and yellow cedar (*Chamaecyparis nootkatensis*) trees, with a shrub layer composed primarily of salal, blueberry, and crowberry (*Empetrum nigrum*). The ground was covered in feathermosses and lichen. Some tree clearing for the temporary helipad had already been conducted at the time of the site reconnaissance.

The site had small inclusions (of up to a few meters wide) of low areas with indicator species of other (wetter) site series (e.g., sedges [*Carex* sp.], skunk cabbage [*Lysichiton americanum*], and Indian hellebore [*Veratrum viride*]).

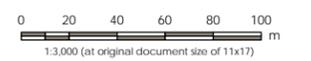
Because of the timing of the site reconnaissance, the presence of plant species of conservation concern could not be determined.





- Topographic Contour (TRIM)
- Watercourse (TRIM)
- Waterbody (TRIM)
- CCG Radar Tower Location
- Tenure Area
- Old Growth (VRI Age > 250 years)
- Marbled Murrelet Critical Habitat
- Coastal Western Hemlock
- Wet area
- Culturally Modified Tree

Notes
 1. Coordinate System: NAD 1983 BC Environment Albers
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 3. Imagery Source: ESRI World Imagery
 * Boundaries may not be visible within current map extent.



Project Location: Mount Collinson, British Columbia
 Project Number: 123221193
 Prepared by: LTRUDELL on 20180913
 Discipline Review by: SNABESS on 20190107
 GIS Review by: SPARKER on 20190107

Client/Project/Report: Canadian Coast Guard Radar Stations, British Columbia; Environmental Overview Assessment

Figure No.: 3

Title: Mount Collinson Environmental Conditions from Desktop Review and Site Reconnaissance

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ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions
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4.2.2 Wildlife

The desktop assessment of the Mount Collinson site indicates there are 24 species of conservation concern which may occur in the Mount Collinson study area: 14 bird species, seven mammal species, and three amphibian species (Appendix C). Of the 24 species of conservation concern which may occur in the study area, 14 are designated on Schedule 1 of SARA.

The Mount Collinson study area does not overlap any wildlife habitat areas, ungulate winter range, important bird areas, or grizzly bear population units. The study area does not overlap any parks or ecological reserves. There are no available occurrence records for wildlife species of conservation concern which overlap the study area. The Mount Collinson study area overlaps 64.7 ha of marbled murrelet critical habitat, and the proposed development area overlaps 1.5 ha of marbled murrelet critical habitat (Figure 3).

Site reconnaissance of the site indicates it is within an open, coniferous forest at the top of a rocky hill. The forest was made up of western hemlock, mountain hemlock, and yellow cedar trees supporting arboreal lichens. The shrub layer was composed mainly of salal and blueberry, and the ground was moss. The trees at the site were smaller in diameter with limbs too small to support marbled murrelet nests and lacking moss pads (Appendix A, Photo A-5); the site is therefore not suitable for marbled Murrelet nesting.

Black bear (*Ursus americanus*) scat was found at the site, but no potential bear dens were observed. A small wet area was located within the site (Figure 3; Appendix A, Photo A-6). This may provide breeding habitat for amphibians during the breeding period, though this is unlikely due to the wet area's small size. Unidentified bird tracks and Columbian black-tailed deer (*Odocoileus hemionus columbianus*) tracks were observed in the wet area. No amphibians, species of conservation concern, or wildlife habitat features were detected during the site reconnaissance.

4.2.3 Fish

There are no fish resources near the Mount Collinson site. The closest waterbodies are the headwater reaches of three first-order streams, one located 360 m west, one 500 m north and one 400 m south (GeoBC 2018c). There are no fish records for these watercourses (FISS 2018), and the steep slopes at these locations would prevent fish access to these headwater areas. The site is located at the top of a peak along the shoreline with steep slopes on all sides, therefore any unmapped watercourses at the location would not support fish species due to gradient barriers.



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions
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4.2.4 Archaeology

The nearest recorded archaeological site to the Mount Collinson radar site is approximately 3.4 km to the northwest. EdSq-22 is a CMT site located near the shoreline just east of Telegraph Cove. No potential model has been created for this area, but most of the sites in the region are recorded along the shoreline or along major streams and rivers. Given the elevation and terrain near the radar site, there is low potential for subsurface archaeological sites. However, as the radar site is on the northern slope of Mount Collinson, possibly providing vantage points of Johnstone Strait, the potential for trail, CMT, spiritual, or rock art sites was assessed as moderate.

The PFR included a pedestrian survey of several proposed locations of the radar tower, building, and permanent helipad. Generally, the proposed development area consists of high, level ground with areas on hummocky and undulating terrain with steep slopes down to the north and south. The ground was well- to moderately-drained, except for an area on standing water near Building Location 2. Two likely CMTs were identified within the proposed development area, both large diameter yellow cedar bark-stripped trees (Photo 1). No other above-ground archaeological resources were identified. One area of low to moderate potential was identified adjacent to the likely CMT-1, near the area of standing water. Recommendations are discussed in Section 5.4. No other locations with high potential for buried archaeological resources were identified at the proposed tower, building, and helipad locations.



Photo 1 Likely culturally modified tree CMT-1



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

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4.3 SAFETY MOUNTAIN

4.3.1 Vegetation

The Safety Mountain site is located on top of a ridge, just east of the peak on Calvert Island. The radar tower footprint is in the wet hypermaritime Mountain Hemlock (MHwh1) biogeoclimatic unit, and the site is dominated by mature coniferous forest. The site area also includes the CWHvh2. The MHwh is a forested subalpine area characterized by yellow-cedar and mountain hemlock (*Tsuga mertensiana*) (Banner et al. 2014). The MHwh occurs at high elevations on Haida Gwaii and in hypermaritime areas of the coast, north of Smith Inlet. The elevational limits range from approximately 500 to 900 m. The MHwh has long, very wet, cold winters and short, cool, moist summers. Frozen soils are rare due to the insulating snowpack, but growing season frosts are common. Total snowfall is high, resulting in a substantial snowpack that can persist into July. Forests on zonal sites are dominated by mountain hemlock (*Tsuga mertensiana*) and yellow-cedar (*Chamaecyparis nootkatensis*), with Alaskan blueberry (*Vaccinium alaskaense*) and mosses (e.g., *Rhytidiadelphus loreus*, *Hylocomium splendens*, *Scapania bolanderi*, *Sphagnum girgensohnii*) common in the understorey. Vegetation and stand characteristics in the MHwh are strongly influenced by local topography, which affects timing and pattern of snowmelt. Upper elevations grade into discontinuous forests of the parkland subzone (Banner et al. 2014).

The CWHvh2 is found below the MH zone. It occupies the outer coastal portion of the region and is found between 0 and 600 m elevation. The climate is hypermaritime; cool, very mild, with very little snow, with fog and rain year-round. CWHvh2 terrain is mostly subdued and rocky, and characterized by low to mid-elevation rainforest stands of western hemlock, western redcedar, and amabilis fir. The climate is extremely wet, and the vegetation is a mosaic of poor forest and bog, with productive forests restricted to moderate and steep slopes or floodplains (Banner et al. 2014).

According to desktop information, no old forest (greater than 250 years of age) is present in the study area (Figure 4). There is one mapped wetland on the eastern edge of the study area, however there are no mapped wetlands in the proposed development area. There are two mapped watercourses on the northern edges of the development area, however they are not located near the proposed location for the radar tower. These high-gradient headwater streams are unlikely to support listed floodplain ecological communities (Figure 4).

According to the BC CDC search, there are two ecological communities of conservation concern, both forested upland communities (Appendix B, Table B-5), and three vascular plant species of conservation concern which may occur in the study area (MHwh1) (Appendix B Table B-6). The Safety Mountain study area does not overlap any known occurrences of plant species or ecological communities of conservation concern, invasive plants, or critical habitat for plant species at risk (Figure 4).



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions
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Site reconnaissance of the proposed Safety Mountain site indicates it is located in high elevation krummholz composed of stunted, scrub forest of mountain hemlock and yellow cedar trees, with a herb layer dominated by pink mountain heather (*Phyllodoce empetrifomis*), crowberry, and blueberries, and ground lichen cover (Appendix A Photo A-7).

Because of the timing of the site reconnaissance, the presence of plant species of conservation concern could not be determined.

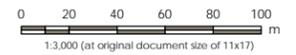




- Topographic Contour (TRIM)
- Watercourse (TRIM)
- Waterbody (TRIM)

- CCG Radar Tower Location
- Tenure Area

- Old Growth (VRI Age > 250 years)
 - Marbled Murrelet Critical Habitat
- Biogeoclimatic Ecosystem Classification Zone *
- Coastal Western Hemlock
 - Mountain Hemlock



Project Location: Safety Mountain, British Columbia
 Project Number: 123221193
 Prepared by: LTRUDELL on 20180913
 Discipline Review by: SNABESS on 20190107
 GIS Review by: SPARKER on 20190107

Client/Project/Report: Canadian Coast Guard Radar Stations, British Columbia; Environmental Overview Assessment

Figure No.: 4
 Title: Safety Mountain Environmental Conditions from Desktop Review and Site Reconnaissance

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ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions
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4.3.2 Wildlife

The desktop assessment of the Safety Mountain site indicates there are 16 species of conservation concern which may occur in the Safety Mountain study area: 12 bird species, two mammal species, and two amphibian species (Appendix C). Of the 16 species of conservation concern which may occur in the study area, 11 are designated on Schedule 1 of SARA.

The Safety Mountain study area does not overlap any wildlife habitat areas, ungulate winter range, important bird areas, or grizzly bear population units. The study area does not overlap any parks or ecological reserves. There are no available occurrence records for wildlife species of conservation concern which overlap the study area.

The Safety Mountain study area overlaps 13.3 ha of marbled murrelet critical habitat (Figure 4). The tenure area does not overlap any marbled murrelet critical habitat.

Site reconnaissance of the proposed Safety Mountain radar site indicates it is on a high point of land, dropping off steeply on all sides, and likely subject to strong winds, particularly in the winter. The site is a parkland community with patches of stunted trees and openings dominated by heather and low-growing berry-producing shrubs (Appendix A Photo A-7, Photo A-8). The production of crowberry was good and is likely a source of forage for wildlife. There is a small non-continuous drainage in a low area between two knolls which may have flowing water under very wet conditions; the suitability of this feature for amphibian breeding is predicted to be low to nil (Appendix A Photo A-9). The proposed tower and related facilities are not located in critical habitat for marbled murrelet (Figure 4). This was confirmed during the site reconnaissance; the field ranking for the site is nil suitability as nesting habitat, specifically because the patchy tree cover is generally less than 3 m in height.

No amphibians or species of conservation concern were detected during the site reconnaissance. There were trails crossing through and around the site, some likely reinforced by recent human activity, but there was also evidence of deer use of some trails. No other wildlife habitat features were observed. Golden-crowned kinglet (*Regulus satrapa*) and black-capped chickadee (*Poecile atricapillus*) were recorded at the site. Ptarmigan scat and an owl pellet and feather pile were found at the site.

4.3.3 Fish

There are no fish resources near the Safety Mountain site. The closest waterbodies are the headwater ends of three first-order streams, one located 135 m north and one 220 m west and one 430 m south (GeoBC 2018c). There are no fish records for the first two watercourses (FISS 2018), and the steep slopes at these locations would prevent fish access to these headwater areas. The watercourse to the south drains into a fish bearing stream which supports pink (*Oncorhynchus gorbuscha*) and coho salmon (*O. kisutch*), however the tributary drains over 1 km of steep slopes before reaching potentially fish bearing lower gradient areas. The site is located at the top of a peak with steep slopes on all sides, therefore any unmapped watercourses at the location would not support fish species due to gradient barriers.



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

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4.3.4 Archaeology

The nearest recorded archaeological sites to the Safety Mountain radar site are approximately 1.6 km to the south along the head of Safety Cove. EjSx-9 is a CMT site, and EjSx-10, and 11 are subsurface shell midden sites eroding from the shoreline. The modelled archaeological potential suggests the Safety Mountain radar site will have low archaeological potential for buried heritage resources, however the model tends to assign high archaeological potential to mainly coastal regions, and inland or high elevation sites are restricted to within 200 m of modern freshwater sources (Bailey et al. 1999). As such, while the likelihood of subsurface archaeological sites may be low, given the location of the radar site on a high mountain ridge with vantages over much of the surrounding landscape, the potential for trail, CMT, spiritual or rock art sites was assessed as moderate.

The PFR included a pedestrian survey of the proposed location of the radar tower, building, and permanent helipad. Terrain at this location consisted of rolling high elevation landscape with no significant landforms. Vegetation consisted of high-altitude scrub vegetation with several small and shallow ponds. No above-ground archaeological resources or locations with high potential for buried archaeological resources were identified at the proposed tower, building, and helipad location.

4.4 SEYMOUR NARROWS

4.4.1 Vegetation

The Seymour Narrows site is located near the top of a hill and is dominated by mature forest, with occasional cliffs and rock outcrops. The site sits within the very dry maritime Coastal Western Hemlock (CWHxm1) biogeoclimatic unit. The CWHxm1 occurs at lower elevations along the east side of Vancouver Island (above the Coastal Douglas-fir where present) as far north as Kelsey Bay, and on the islands around southern Johnstone Strait (Green and Klinka 1994). Elevational limits range from sea level (or above the CDFmm [moist maritime Coastal Douglas Fir] where present) to approximately 700 m. The CWHxm1 has warm, dry summers and moist, mild winters with relatively little snowfall. Growing seasons are long, and feature water deficits on zonal sites. Forests on zonal sites are dominated by Douglas-fir (*Pseudotsuga menziesii*), accompanied by western hemlock and minor amounts of western redcedar (Green and Klinka 1994).

According to desktop information, none of the forested ecosystems in the tenure area are old forest (greater than 250 years of age), though there is some old forest in the south-east portion of the study area (Figure 5). Most forested ecological communities in the CWHxm1 are listed by the BC CDC. According to a BC CDC search, there are 23 ecological communities of conservation concern which may occur in the study area (CWHxm1): 14 upland and nine wetland communities (Appendix B, Table B-7). There are 44 vascular plant species of conservation concern which may occur in the study area (Appendix B, Table B-8). The Seymour Narrows study area does not overlap any mapped wetlands, riparian areas, known occurrences of plant species or ecological communities of conservation concern, invasive plants, or critical habitat for plant species at risk.



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions

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The site reconnaissance determined the proposed Seymour Narrows site is within a young red-listed forested community at the top of a hill—the Douglas-fir—lodgepole pine/grey rock-moss unit (CWHxm1/02) (Figure 5, Appendix A, Photo A-10). The Douglas—fir—lodgepole pine/grey rock-moss community is composed of Douglas fir and shore pine, with an understorey dominated by salal, grasses, mosses and ground lichen on the numerous rock outcrops. Some tree clearing for the temporary helipad had already been conducted at the time of the site reconnaissance.

The proposed access road to the radar site from the existing forest service road runs through closed canopy blue-listed forests. Douglas-fir/sword fern (CWHxm1/04) forest is present in drier areas (Appendix A, Photo A-11) and western redcedar/sword fern (CWHxm1/05) is present in wetter areas. The understorey of both communities is composed primarily of sword fern (*Polystichum munitum*) and twinflower (*Linnaea borealis*), with a moss layer. The forest along the proposed access road had small inclusions (of up to a few meters wide) of low areas with indicator species of other (wetter) site series.

Because of the timing of the site reconnaissance, the presence of plant species of conservation concern could not be determined.





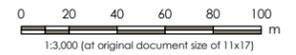
- Forest Tenure Road
- Topographic Contour (TRIM)
- Watercourse (TRIM)
- Waterbody (TRIM)

- CCG Radar Tower Location
- Access Road
- Tenure Area
- Proposed Powerline (approx. location)
- Project Component (approx. location)

- Old Growth (VRI Age > 250 years)
- Marbled Murrelet Critical Habitat
- Douglas-fir—lodgepole pine/grey rock-moss young forest (Red-listed)
- Biogeoclimatic Ecosystem Classification Zone *
- Coastal Western Hemlock

- Swampy area

Notes
 1. Coordinate System: NAD 1983 BC Environment Albers
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 3. Imagery Source: ESRI World Imagery
 * Boundaries may not be visible within current map extent.



Project Location: Seymour Narrows, British Columbia
 Project Number: 123221193
 Prepared by: LTRUDELL on 20180913
 Discipline Review by: SNABESS on 20190107
 GIS Review by: SPARKER on 20190107

Client/Project/Report: Canadian Coast Guard Radar Stations, British Columbia; Environmental Overview Assessment

Figure No.: 5
 Title: Seymour Narrows Environmental Conditions from Desktop Review and Site Reconnaissance

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ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions
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4.4.2 Wildlife

The desktop assessment of the Seymour Narrows site indicates there are 25 species of conservation concern which may occur in the Seymour Narrows study area: 14 bird species, eight mammal species, and three amphibian species (Appendix C). Of the 25 species of conservation concern which may occur in the study area, 14 are designated on Schedule 1 of SARA.

The Seymour Narrows study area does not overlap any wildlife habitat areas, ungulate winter range, important bird areas, or grizzly bear population units. The study area does not overlap any parks or ecological reserves. There are no available occurrence records for wildlife species of conservation concern which overlap the study area. There are two bald eagle nests within 1 km of the tenure area along the shoreline of Seymour Narrows (WTSP 2018), which is well beyond the usual setback distance of 100 m for bald eagle.

The Seymour Narrows study area overlaps 12.6 ha of marbled murrelet critical habitat (Figure 5). The tenure area does not overlap marbled murrelet critical habitat.

Site reconnaissance of the site indicates it is located within an open, coniferous forest at the top of a rocky hill. The forest was made up of lodgepole pine and Douglas-fir supporting arboreal lichens. The shrub layer was composed mainly of salal. The ground was covered in a thick layer of moss. The trees at the site were smaller in diameter with limbs too small to support marbled murrelet nests and lacking moss pads (Appendix A, Photo A-12). The site is not suitable for marbled murrelet nesting.

Black bear scat was found at the site, but no potential bear dens were observed. Deer pellets were observed throughout the site. A northern Pacific treefrog (*Pseudacris regilla*), chestnut-backed chickadee (*Poecile rufescens*) and red-breasted nuthatch (*Sitta canadensis*) were heard calling. No species of conservation concern and no wildlife habitat features were detected during the site reconnaissance of the radar site.

The access road to the radar site goes through a closed canopy, conifer forest made up of regenerating Douglas-fir (Appendix A Photo A-13). The trees were small diameter with small limbs not suitable for marbled murrelet nesting. The shrub layer was sparse and was made up primarily of sword fern; there was little vegetative ground cover, but coarse woody debris was abundant. The access road goes past a swampy area with pools of water (Figure 4; Appendix A, Photo A-14). The water was discoloured and is unlikely to support breeding amphibians. No amphibians, species of conservation concern or wildlife habitat features were detected during the site reconnaissance of the access road.

4.4.3 Fish

There are no fish resources near the Seymour Narrows site. The closest waterbodies are the headwater ends of two first-order streams located 400 to 500 m southwest (GeoBC 2018c). There are no fish records for either of these watercourses (FISS 2018), and the steep slopes at these locations would prevent fish access to these headwater areas. There are two fish bearing watercourses within 1.2 to 1.9 km of the site however there is no connection to these waterbodies. The site is located at the top of a



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Environmental Conditions

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hill with steep slopes along the base, therefore any unmapped watercourses at the location would not support fish species due to gradient barriers.

4.4.4 Archaeology

The nearest recorded archaeological sites to the Seymour Narrows radar site are within 2 km to the southwest and to the east-northeast. EaSi-2 is a large subsistence feature (fish trap) within the intertidal zone of Menzies Bay, and EaSh-69 is a large subsistence feature (fishing weir and clam garden) within the intertidal zone of Plumper Bay. The modelled archaeological potential suggests the radar site will have low potential for buried archaeological sites, however the model tends to assign high archaeological potential to mainly coastal regions and near major rivers and streams (Eldridge et al. 2007). As such, while the likelihood of subsurface archaeological sites may be low, given the high elevation of the radar site with vantages over Seymour Narrows and Menzies Bay, the potential for trail, CMT, spiritual or rock art sites was assessed as moderate.

The PFR included a pedestrian survey of the proposed location of the radar tower, building, and permanent helipad. An access road extending west from the proposed tower to an existing road was also assessed. Terrain at this location is undulating and rocky with numerous bedrock exposures. The central portion of the site has been recently cleared for the placement of the helipad. Surrounding vegetation consists of mature second growth and Douglas-fir, with evidence of past commercial logging activities. No above-ground archaeological resources or locations with high potential for buried archaeological resources were identified at the proposed tower, building, and helipad location.

The proposed access road is proposed to be 3 to 5 m wide extending west from the tower location for approximately 300 m. Terrain along the road is sloped with a gentle to moderate west aspect, down from the hill summit. Vegetation along the road transitioned along with drainage, becoming increasingly wet with more abundant western redcedar. No above-ground archaeological resources or locations with high potential for buried archaeological resources were identified along the proposed road.



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Recommendations
1/23/2019 12:00:00 AM

5.0 RECOMMENDATIONS

5.1 VEGETATION

Recommended mitigation measures to avoid, limit, restore, or offset potential effects of the Project on vegetation are:

- Avoid effects to old forest by planning Project activities (i.e., vegetation clearing and construction of Project infrastructure) outside of the limits of old forest on Denny Island
- Reduce tree clearing by locating Project infrastructure in areas previously cleared for the temporary helipads
- Conduct a pre-disturbance rare plant survey of the footprint prior to construction. If any rare plants are found, create a rare plant management plan
- Prior to construction, flag the boundaries of red-listed communities within 30 m of the Project footprint. Minimize location of temporary workspaces within red-listed communities
- Reduce the probability of introducing noxious weeds to the sites by cleaning equipment of vegetation debris and soil prior to transport to the sites
- Monitor the radar sites for noxious weeds following construction during vegetation management activities. If noxious weeds are discovered during monitoring, create and implement a management plan to comply with the BC *Weed Control Act*.

5.2 WILDLIFE

Recommended mitigation measures to avoid, limit, restore, or offset potential effects of the Project on wildlife are:

- Reduce potential effects to migratory birds (i.e., incidental take), plan Project activities (i.e., vegetation clearing and construction) to occur outside of the primary nesting period for breeding birds. The Mount Collinson and Seymour Narrows sites are in the A1 Nesting Zone which has a general nesting period of March 31 through August 7 (all habitats) (ECCC 2018). The Denny Island and Safety Mountain sites are in the A2 Nesting Zone, which has a primary nesting period of April 11 to August 8 (all habitats) (ECCC 2018).
- If Project activities overlap with the general nesting period, engage a qualified biologist to carry out a pre-construction survey for nests ('nest sweep'). Nest setbacks will be applied (i.e., flagged exclusion area) following discovery of an active, suspected active, or protected nest. Setback distances will be based on provincial and federal guidelines, and the opinion of a qualified biologist. A qualified biologist will also determine how long a setback will remain in place. Clearing must be started within seven days of the nest sweep being completed, otherwise another nest sweep must be undertaken.



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Recommendations
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- At the Seymour Narrows location where wetted habitat was identified, reduce potential effects to amphibians by avoiding Project activities (i.e., vegetation clearing and construction) in wetlands that contain amphibian egg masses or tadpoles during the amphibian breeding period (mid-April to mid-August) and in habitats where amphibian movement is observed during the post-breeding dispersal period (mid-July to mid-September).
- At the Seymour Narrows location where wetted habitat was identified, if Project activities overlap with the amphibian breeding or post-breeding dispersal periods, engage a qualified biologist to undertake pre-construction amphibian surveys. The surveys will: 1) determine the presence of amphibian eggs, tadpoles, juveniles, or adults; and 2) determine whether salvage or other mitigation measures are required. A British Columbia *Wildlife Act* permit is required to undertake amphibian salvage activities.

5.3 FISH

No mitigation measures or further work is required. None of the proposed radar sites are anticipated to require fisheries-related permits.

5.4 ARCHAEOLOGY

At the Mount Collinson site, one area of low to moderate potential was identified adjacent to the likely CMT-1, near an area of standing water. Additional investigations, which may include coring the tree with an increment borer or examining a cookie of the tree if felled, are recommended to confirm if modifications are cultural, and to determine the scar age. Further, it is recommended that shovel testing of the area occur should the bark-strip be confirmed as cultural. A *Heritage Conservation Act* (HCA) Section 14 Inspection permit will be required to complete this additional study at the Mount Collinson site. Should shovel testing result in the identification of archaeological materials, an HCA Section 12 Alteration permit will be required prior to ground works association with construction at the Mount Collinson site.

No in-field mitigation measures or further work is planned for the Denny Island, Safety Mountain, or Seymour Narrows sites. An archaeological chance find procedure will be in place to support the identification or and response to chance encounters with unanticipated and potential archaeological materials during construction at the Denny Island, Safety Mountain and Seymour Narrows sites.



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Closure

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6.0 CLOSURE

We trust the content of this report is sufficient for your current needs. Should you have any questions or concerns, please contact the undersigned.

Regards,

Stantec Consulting Ltd.

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APPENDIX A
SITE RECONNAISSANCE PHOTOS

**ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF
CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA**

Appendix A Site ReConnaissance Photos
January 23, 2019

Appendix A SITE RECONNAISSANCE PHOTOS

A.1 DENNY ISLAND



Photo A-1 Proposed Denny Island Radar Site—Mature Western Redcedar/Western Hemlock Forest



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Appendix A Site ReConnaissance Photos
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Photo A-2 Example of Larger Limbed Tree at Proposed Denny Island Radar Site



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Appendix A Site ReConnaissance Photos
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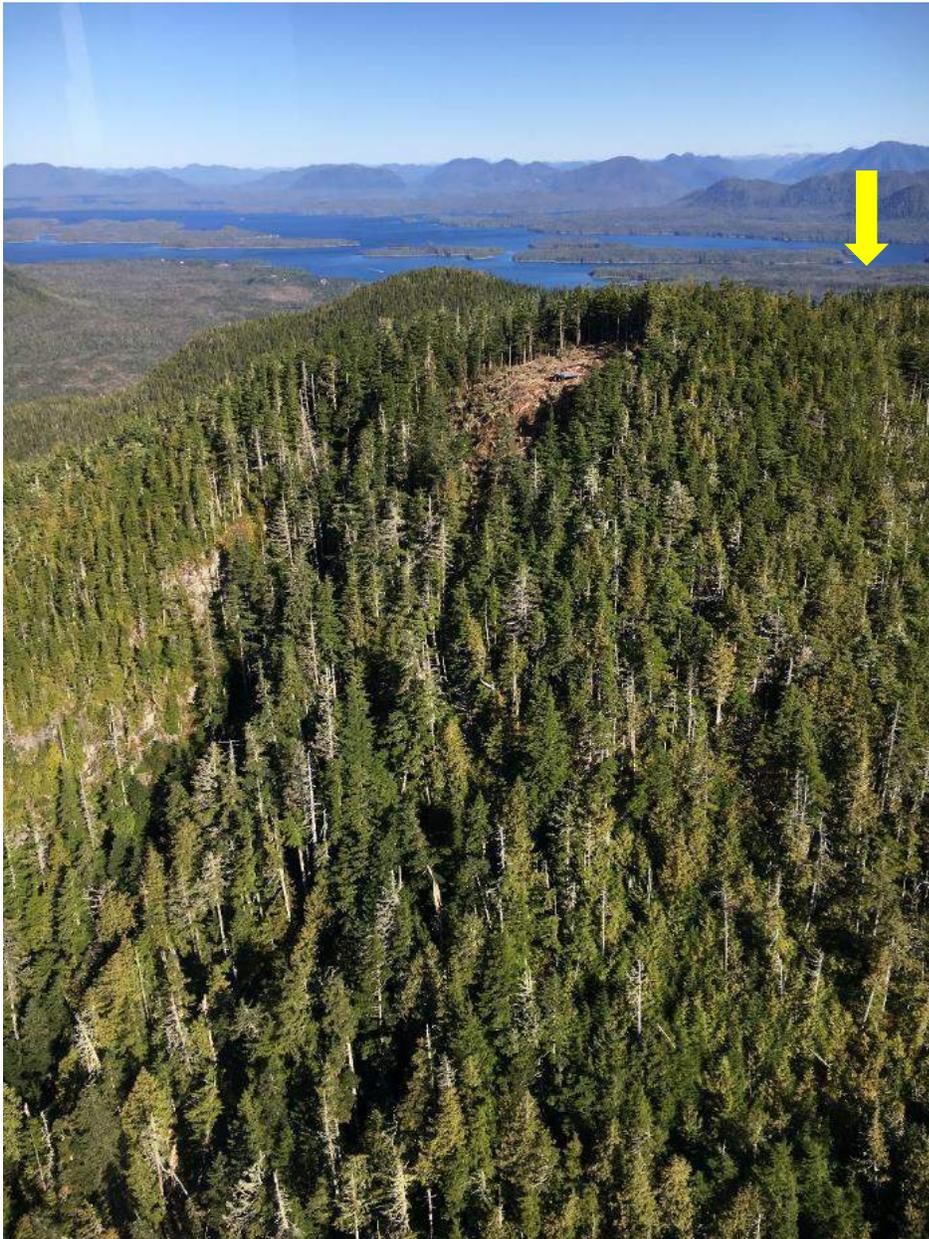


Photo A-3 Aerial View of Proposed Denny Island Radar Site (Indicated by Arrow)



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Appendix A Site ReConnaissance Photos
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A.2 MOUNT COLLINSON



Photo A-4 Proposed Mount Collison Radar Site—Blue-listed Western Hemlock—Western Redcedar/Salal Forested Community



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Appendix A Site ReConnaissance Photos
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Photo A-5 Proposed Mount Collison Radar Site—Open Forest Habitat



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Appendix A Site ReConnaissance Photos
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Photo A-6 Proposed Mount Collison Radar Site—Small Wet Area



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Appendix A Site ReConnaissance Photos
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A.3 SAFETY MOUNTAIN



Photo A-7 Proposed Safety Mountain Radar Site—Krummholz Scrub Forest of Mountain Hemlock and Yellow Cedar



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Appendix A Site ReConnaissance Photos
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Photo A-8 Proposed Safety Mountain Radar Site (Indicated by Arrow)



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Appendix A Site ReConnaissance Photos
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**Photo A-9 Proposed Safety Mountain Radar Site—Small Intermittent Non-Continuous
Drainage**



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Appendix A Site Reconnaissance Photos
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A.4 SEYMOUR NARROWS



Photo A-10 Proposed Seymour Narrows Radar Tower Site—Red-listed Douglas-fir—Lodgepole Pine/Grey Rock-moss Forested Community



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Appendix A Site ReConnaissance Photos
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Photo A-11 Proposed Seymour Narrows Access Road Site—Blue-listed Douglas-fir/Sword Fern Forest



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Appendix A Site ReConnaissance Photos
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Photo A-12 Proposed Seymour Narrows Radar Tower Site—Open, Regenerating Douglas-fir Forest



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Appendix A Site ReConnaissance Photos
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Photo A-13 Proposed Seymour Narrows Access Road Site—Closed Canopy Douglas-fir Forest



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CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA**

Appendix A Site ReConnaissance Photos
January 23, 2019



Photo A-14 Proposed Seymour Narrows Access Road Site—Swampy Area



APPENDIX B

**VEGETATION—POTENTIAL SPECIES AND ECOLOGICAL
COMMUNITIES OF CONSERVATION CONCERN**

**ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES,
BRITISH COLUMBIA**

Appendix B Vegetation—Potential Species and Ecological Communities of Conservation Concern
January 23, 2019

**Appendix B VEGETATION—POTENTIAL SPECIES AND ECOLOGICAL COMMUNITIES
OF CONSERVATION CONCERN**

B.1 DENNY ISLAND

Table B-1 Denny Island Potential Ecological Communities of Conservation Concern

Common Name	Scientific Name	BC List ¹	Site Series	Ecosystem Group ²
Terrestrial Realm				
Sitka spruce/Oregon beaked-moss	<i>Picea sitchensis/Eurhynchium oregonum</i>	Blue	CWHvh2/15	Coniferous—dry
Sitka spruce/Pacific crab apple	<i>Picea sitchensis/Malus fusca</i>	Blue	CWHvh2/19	Coniferous—moist/wet
Sitka spruce/Pacific reedgrass	<i>Picea sitchensis/Calamagrostis nutkaensis</i>	Blue	CWHvh2/16	Coniferous—dry
Sitka spruce/salal	<i>Picea sitchensis/Gaultheria shallon</i>	Blue	CWHvh2/14	Coniferous—dry
Sitka spruce/slough sedge	<i>Picea sitchensis/Carex obnupta</i>	Blue	CWHvh2/18	Coniferous—moist/wet
Sitka spruce/sword fern	<i>Picea sitchensis/Polystichum munitum</i>	Blue	CWHvh2/17	Coniferous—moist/wet
Sitka spruce/tall trisetum	<i>Picea sitchensis/Trisetum canescens</i>	Red	CWHvh2/09	Coniferous—moist/wet
Western hemlock—Sitka spruce/lanky moss	<i>Tsuga heterophylla—Picea sitchensis/Rhytidiadelphus loreus</i>	Blue	CWHvh2/04	Coniferous—mesic
Western redcedar—Sitka spruce/devil's club Very Wet Hypermaritime 2	<i>Thuja plicata—Picea sitchensis/Oplopanax horridus Very Wet Hypermaritime 2</i>	Blue	CWHvh2/07	Coniferous—moist/wet
Western redcedar—Sitka spruce/skunk cabbage	<i>Thuja plicata—Picea sitchensis/Lysichiton americanus</i>	Blue	CWHvh2/13	Coniferous—moist/wet or Swamp Wetland Class (Ws)
Western redcedar—Sitka spruce/sword fern	<i>Thuja plicata—Picea sitchensis/Polystichum munitum</i>	Blue	CWHvh2/05	Coniferous—dry or mesic



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Appendix B Vegetation—Potential Species and Ecological Communities of Conservation Concern
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Table B-1 Denny Island Potential Ecological Communities of Conservation Concern

Common Name	Scientific Name	BC List ¹	Site Series	Ecosystem Group ²
Wetland Realm				
Northern mannagrass Fen	<i>Glyceria borealis</i> Fen	Blue	CWHvh2/ ³	Fen Wetland Class (Wf)
Sitka sedge—Pacific water-parsley	<i>Carex sitchensis</i> — <i>Oenanthe sarmentosa</i>	Blue	CWHvh2/Wm50	Marsh Wetland Class (Wm)
Sitka sedge/peat-mosses	<i>Carex sitchensis</i> / <i>Sphagnum</i> spp.	Red	CWHvh2/Wf51	Fen Wetland Class (Wf)
Sweet gale/Sitka sedge	<i>Myrica gale</i> / <i>Carex sitchensis</i>	Red	CWHvh2/Wf52	Fen Wetland Class (Wf)
NOTES:				
¹ BC List: Red is any indigenous species or subspecies that is extirpated, endangered, or threatened in BC; Blue is any indigenous species or subspecies considered to be of special concern in BC; Yellow is species considered to be secure and not at risk of extinction				
² Excludes flood plain and beach ecosystem groups due to study area conditions				
³ Uncorrelated unit—does not have a site series				

Table B-2 Denny Island Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype ⁴
Alpine anemone	<i>Anemone drummondii</i> var. <i>drummondii</i>	Blue	--	--	Rock/Sparsely Vegetated Rock; Tundra; Meadow
Angled bittercress	<i>Cardamine angulata</i>	Red	--	--	Riparian Forest; Stream/River; Conifer Forest—Moist/wet
California wax-myrtle	<i>Morella californica</i>	Blue	--	--	Shrub—Natural
Dwarf bog bunchberry	<i>Cornus suecica</i>	Red	--	--	Bog; Marsh; Tundra; Meadow; Conifer Forest—Mesic (average); Conifer Forest—Moist/wet
Dwarf red fescue	<i>Festuca rubra</i> ssp. <i>mediana</i>	Blue	--	--	
Estuarine paintbrush	<i>Castilleja ambigua</i> ssp. <i>ambigua</i>	Blue	--	--	Estuary; Vernal Pools/Seasonal Seeps; Garry Oak Maritime Meadow
Fischer's chickweed	<i>Cerastium fischerianum</i>	Blue	--	--	Stream/River; Lake; Meadow; Riparian Herbaceous



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Appendix B Vegetation—Potential Species and Ecological Communities of Conservation Concern
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Table B-2 Denny Island Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype ⁴
Hairy goldfields	<i>Lasthenia maritima</i>	Red	--	--	Cliff; Rock/Sparsely Vegetated Rock; Marine Island
Hibberson's trillium	<i>Trillium hibbersonii</i> comb. ined.	Blue	--	--	
Kamchatka spike-rush	<i>Eleocharis kamtschatica</i>	Blue	--	--	Bog; Marsh; Meadow; Pond/Open Water
Pygmy waterlily	<i>Nymphaea tetragona</i>	Red	--	--	Lake; Pond/Open Water
Queen Charlotte avens	<i>Geum schofieldii</i>	Blue	--	--	Cliff; Rock/Sparsely Vegetated Rock; Talus
Queen Charlotte twinflower violet	<i>Viola biflora</i> var. <i>carlottae</i>	Blue	--	--	Bog; Cliff; Rock/Sparsely Vegetated Rock; Talus; Tundra; Glacier/Icefield; Meadow; Krummholtz; Alpine/Subalpine Meadow; Alpine Grassland; Heath; Fellfield; Nivation; Zoogenic
Redwood sorrel	<i>Oxalis oregana</i>	Blue	--	--	Conifer Forest—Moist/wet
River bulrush	<i>Bolboschoenus fluviatilis</i>	Blue	--	--	Estuary; Marsh; Riparian Shrub
Smith's fairybells	<i>Prosartes smithii</i>	Blue	--	--	Riparian Forest; Deciduous/Broadleaf Forest; Conifer Forest—Moist/wet; Mixed Forest (deciduous/coniferous mix)
Tall woolly-heads	<i>Psilocarphus elatior</i>	Red	Endangered	Endangered	Meadow; Garry Oak Vernal Pool
Tooth-leaved monkey-flower	<i>Erythranthe dentata</i>	Blue	--	--	Riparian Forest; Stream/River
White glacier lily	<i>Erythronium montanum</i>	Blue	--	--	Avalanche Track; Alpine/Subalpine Meadow
White-lip rein orchid	<i>Platanthera ephemerantha</i>	Red	--	--	Conifer Forest—Dry; Garry Oak Woodland



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Appendix B Vegetation—Potential Species and Ecological Communities of Conservation Concern
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Table B-2 Denny Island Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype ⁴
NOTES:					
¹ Provincial Status: Red is any indigenous species or subspecies that is extirpated, endangered, or threatened in BC; Blue is any indigenous species or subspecies considered to be of special concern in BC; Yellow is species considered to be secure and not at risk of extinction					
² COSEWIC: Endangered is a species facing imminent extirpation or extinction; Threatened is a species likely to become endangered; Special Concern is a species that may become threatened or endangered.					
³ SARA: Endangered is a species that is facing extinction or extirpation; Threatened is a species that may become endangered; Special Concern is a species with characteristics that make it sensitive to natural events or human activities.					
⁴ Excludes Habitat Subtypes due to study area conditions: Estuary, Mudflats—Intertidal, Sand Dune, Beach, Marine					

B.2 MOUNT COLLINSON

Table B-3 Mount Collinson Potential Ecological of Conservation Concern

Common Name	Scientific Name	BC List ¹	Site Series	Ecosystem Group ²
Terrestrial Realm				
Amabilis fir—Sitka spruce/devil's club	<i>Abies amabilis</i> — <i>Picea sitchensis</i> / <i>Oplopanax horridus</i>	Blue	CWHvm1/08; CWHvm2/08	Coniferous—moist/wet
Western hemlock—amabilis fir/deer fern	<i>Tsuga heterophylla</i> — <i>Abies amabilis</i> / <i>Blechnum spicant</i>	Blue	CWHvm1/06; CWHvm2/06	Coniferous—moist/wet
Western hemlock—western redcedar/salal Very Wet Maritime	<i>Tsuga heterophylla</i> — <i>Thuja plicata</i> / <i>Gaultheria shallon</i> Very Wet Maritime	Blue	CWHvm1/03; CWHvm2/03	Coniferous—dry
Western redcedar—Sitka spruce/skunk cabbage	<i>Thuja plicata</i> — <i>Picea sitchensis</i> / <i>Lysichiton americanus</i>	Blue	CWHvm1/14	Coniferous—moist/wet or Swamp Wetland Class (Ws)
Western redcedar—western hemlock/sword fern	<i>Thuja plicata</i> — <i>Tsuga heterophylla</i> / <i>Polystichum munitum</i>	Blue	CWHvm1/04; CWHvm2/04	Coniferous—dry



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Appendix B Vegetation—Potential Species and Ecological Communities of Conservation Concern
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Table B-3 Mount Collinson Potential Ecological of Conservation Concern

Common Name	Scientific Name	BC List ¹	Site Series	Ecosystem Group ²
Wetland Realm				
Labrador-tea/western bog-laurel/peat-mosses	<i>Rhododendron groenlandicum/Kalmia microphylla/Sphagnum spp.</i>	Blue	CWHvm1/Wb50	Bog Wetland Class (Wb)
Sitka sedge/peat-mosses	<i>Carex sitchensis/Sphagnum spp.</i>	Red	CWHvm1/Wf51; CWHvm2/Wf51	Fen Wetland Class (Wf)
Sitka willow/Sitka sedge	<i>Salix sitchensis/Carex sitchensis</i>	Blue	CWHvm1/Ws06; CWHvm2/Ws06	Swamp Wetland Class (Ws)
NOTES: ¹ BC List: Red is any indigenous species or subspecies that is extirpated, endangered, or threatened in BC; Blue is any indigenous species or subspecies considered to be of special concern in BC; Yellow is species considered to be secure and not at risk of extinction ² Excludes flood plain and beach ecosystem groups due to study area conditions				

Table B-4 Mount Collinson Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype ⁴
Alaska holly fern	<i>Polystichum setigerum</i>	Blue	--	--	Riparian Forest; Riparian Shrub; Stream/River; Rock/Sparsely Vegetated Rock; Conifer Forest—Moist/wet
Corrupt spleenwort	<i>Asplenium adulterinum</i>	Blue	--	--	NA
Dwarf maiden-hair fern	<i>Adiantum aleuticum var. subpumilum</i>	Blue	--	--	NA
Dwarf red fescue	<i>Festuca rubra ssp. mediana</i>	Blue	--	--	NA
Estuarine paintbrush	<i>Castilleja ambigua ssp. ambigua</i>	Blue	--	--	Estuary; Vernal Pools/Seasonal Seeps; Garry Oak Maritime Meadow
Kamchatka spike-rush	<i>Eleocharis kamtschatica</i>	Blue	--	--	Bog; Marsh; Meadow; Pond/Open Water
Northern adder's-tongue	<i>Ophioglossum pusillum</i>	Blue	--	--	Fen; Pasture/Old Field; Meadow; Riparian Herbaceous; Cold Spring



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Appendix B Vegetation—Potential Species and Ecological Communities of Conservation Concern
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Table B-4 Mount Collinson Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype ⁴
Redwood sorrel	<i>Oxalis oregana</i>	Blue	--	--	Conifer Forest—Moist/wet
Shinleaf wintergreen	<i>Pyrola elliptica</i>	Blue	--	--	Conifer Forest—Mesic (average); Conifer Forest—Dry; Conifer Forest—Moist/wet; Mixed Forest (deciduous/coniferous mix)
Smith's fairybells	<i>Prosartes smithii</i>	Blue	--	--	Riparian Forest; Deciduous/Broadleaf Forest; Conifer Forest—Moist/wet; Mixed Forest (deciduous/coniferous mix)
Tooth-leaved monkey-flower	<i>Erythranthe dentata</i>	Blue	--	--	Riparian Forest; Stream/River
Two-edged water-starwort	<i>Callitriche heterophylla</i> var. <i>heterophylla</i>	Blue	--	--	Pond/Open Water
White glacier lily	<i>Erythronium montanum</i>	Blue	--	--	Avalanche Track; Alpine/Subalpine Meadow
Whitebark pine	<i>Pinus albicaulis</i>	Blue	Endangered	Endangered	Cliff; Rock/Sparsely Vegetated Rock; Talus; Conifer Forest—Mesic (average); Conifer Forest—Dry

NOTES:

¹ Provincial Status: Red is any indigenous species or subspecies that is extirpated, endangered, or threatened in BC; Blue is any indigenous species or subspecies considered to be of special concern in BC; Yellow is species considered to be secure and not at risk of extinction

² COSEWIC: Endangered is a species facing imminent extirpation or extinction; Threatened is a species likely to become endangered; Special Concern is a species that may become threatened or endangered.

³ SARA: Endangered is a species that is facing extinction or extirpation; Threatened is a species that may become endangered; Special Concern is a species with characteristics that make it sensitive to natural events or human activities.

⁴ Excludes Estuary, Sand Dune, Beach Habitat Subtypes due to study area conditions

NA = habitat subtype data not available for some species



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Appendix B Vegetation—Potential Species and Ecological Communities of Conservation Concern
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B.3 SAFETY MOUNTAIN

Table B-5 Safety Mountain Potential Ecological Communities of Conservation Concern

Common Name	Scientific Name	BC List ¹	Site Series	Ecosystem Group
Terrestrial Realm				
Sitka spruce—mountain hemlock/Pacific reedgrass	<i>Picea sitchensis</i> — <i>Tsuga mertensiana</i> / <i>Calamagrostis nutkaensis</i>	Blue	MHwh1/03	Coniferous—mesic
Yellow-cedar—mountain hemlock/rosy twistedstalk	<i>Xanthocyparis nootkatensis</i> — <i>Tsuga mertensiana</i> / <i>Streptopus lanceolatus</i>	Blue	MHwh1/05	Coniferous—moist/wet
NOTES:				
¹ BC List: Red is any indigenous species or subspecies that is extirpated, endangered, or threatened in BC; Blue is any indigenous species or subspecies considered to be of special concern in BC; Yellow is species considered to be secure and not at risk of extinction				



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Table B-6 Safety Mountain Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype
Fischer's chickweed	<i>Cerastium fischerianum</i>	Blue	--	--	Stream/River; Lake; Meadow; Riparian Herbaceous
Queen Charlotte avens	<i>Geum schofieldii</i>	Blue	--	--	Cliff; Rock/Sparsely Vegetated Rock; Talus
Queen Charlotte twinflower violet	<i>Viola biflora var. carlottae</i>	Blue	--	--	Bog; Cliff; Rock/Sparsely Vegetated Rock; Talus; Tundra; Glacier/Icefield; Meadow; Krummholtz; Alpine/Subalpine Meadow; Alpine Grassland; Heath; Fellfield; Nivation; Zoogenic

NOTES:

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B.4 SEYMOUR NARROWS

Table B-7 Seymour Narrows Potential Ecological Communities of Conservation Concern

Common Name	Scientific Name	BC List ¹	Site Series	Ecosystem Group ²
Terrestrial Realm				
Arbutus/hairy manzanita	<i>Arbutus menziesii</i> / <i>Arctostaphylos columbiana</i>	Red	CWHxm1/00	Broadleaf—dry
Douglas-fir—lodgepole pine/grey rock-moss	<i>Pseudotsuga menziesii</i> — <i>Pinus contorta</i> / <i>Racomitrium canescens</i>	Red	CWHxm1/02	Coniferous—dry
Douglas-fir—western hemlock/salal Dry Maritime	<i>Pseudotsuga menziesii</i> — <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> Dry Maritime	Blue	CWHxm1/03	Coniferous—dry
Douglas-fir/sword fern	<i>Pseudotsuga menziesii</i> / <i>Polystichum munitum</i>	Blue	CWHxm1/04	Coniferous—dry
Roemer's fescue—junegrass	<i>Festuca roemerii</i> — <i>Koeleria macrantha</i>	Red	CWHxm1/00	Grassland Class (Gg)
Wallace's selaginella/reindeer lichens	<i>Selaginella wallacei</i> / <i>Cladina</i> spp.	Blue	CWHxm1	Grassland Class (Gg) or Rock Outcrop Class (Ro)
Western hemlock—Douglas-fir/Oregon beaked-moss	<i>Tsuga heterophylla</i> — <i>Pseudotsuga menziesii</i> / <i>Eurhynchium oregonum</i>	Red	CWHxm1/01	Coniferous—mesic
Western hemlock—western redcedar/deer fern	<i>Tsuga heterophylla</i> — <i>Thuja plicata</i> / <i>Blechnum spicant</i>	Red	CWHxm1/06	Coniferous—moist/wet
Western redcedar—Sitka spruce/skunk cabbage	<i>Thuja plicata</i> — <i>Picea sitchensis</i> / <i>Lysichiton americanus</i>	Blue	CWHxm1/12	Coniferous—moist/wet or Swamp Wetland Class (Ws)
Western redcedar/black twinberry	<i>Thuja plicata</i> / <i>Lonicera involucrata</i>	Red	CWHxm1/14	Coniferous—moist/wet
Western redcedar/salmonberry	<i>Thuja plicata</i> / <i>Rubus spectabilis</i>	Red	CWHxm1/13	Coniferous—moist/wet
Western redcedar/slough sedge	<i>Thuja plicata</i> / <i>Carex obnupta</i>	Blue	CWHxm1/15	Coniferous—moist/wet or Swamp Wetland Class (Ws)
Western redcedar/sword fern Very Dry Maritime	<i>Thuja plicata</i> / <i>Polystichum munitum</i> Very Dry Maritime	Blue	CWHxm1/05	Coniferous—mesic
Western redcedar/three-leaved foamflower Very Dry Maritime	<i>Thuja plicata</i> / <i>Tiarella trifoliata</i> Very Dry Maritime	Blue	CWHxm1/07	Coniferous—moist/wet



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Table B-7 Seymour Narrows Potential Ecological Communities of Conservation Concern

Common Name	Scientific Name	BC List ¹	Site Series	Ecosystem Group ²
Wetland Realm				
Common cattail Marsh	<i>Typha latifolia</i> Marsh	Blue	CWHxm1/Wm05	Marsh Wetland Class (Wm)
Hard-stemmed bulrush Deep Marsh	<i>Schoenoplectus acutus</i> Deep Marsh	Blue	CWHxm1/Wm06	Marsh Wetland Class (Wm)
Labrador-tea/western bog-laurel/peat-mosses	<i>Rhododendron groenlandicum</i> / <i>Kalmia microphylla</i> / <i>Sphagnum</i> spp.	Blue	CWHxm1/Wb50	Bog Wetland Class (Wb)
Lodgepole pine/peat-mosses Very Dry Maritime	<i>Pinus contorta</i> / <i>Sphagnum</i> spp. Very Dry Maritime	Blue	CWHxm1/11	Bog Wetland Class (Wb)
Sitka sedge—Pacific water-parsley	<i>Carex sitchensis</i> — <i>Oenanthe sarmentosa</i>	Blue	CWHxm1/Wm50	Marsh Wetland Class (Wm)
Slender sedge—white beak-rush	<i>Carex lasiocarpa</i> — <i>Rhynchospora alba</i>	Red	CWHxm1/Wf53	Fen Wetland Class (Wf)
Sweet gale/Sitka sedge	<i>Myrica gale</i> / <i>Carex sitchensis</i>	Red	CWHxm1/Wf52	Fen Wetland Class (Wf)
Trembling aspen/Pacific crab apple/slough sedge	<i>Populus tremuloides</i> / <i>Malus fusca</i> / <i>Carex obnupta</i>	Red	CWHxm1/ ³	Swamp Wetland Class (Ws)
Western redcedar/sword fern—skunk cabbage	<i>Thuja plicata</i> / <i>Polystichum munitum</i> — <i>Lysichiton americanus</i>	Blue	CWHxm1/Ws53	Coniferous—moist/wet or Swamp Wetland Class (Ws)

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² Excludes flood plain, estuary, and beach ecosystem groups due to study area conditions

³ Uncorrelated unit—does not have a site series



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Appendix B Vegetation—Potential Species and Ecological Communities of Conservation Concern
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Table B-8 Seymour Narrows Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype ⁴
Branching montia	<i>Montia diffusa</i>	Red	--	--	Rock/Sparsely Vegetated Rock
California-tea	<i>Rupertia physodes</i>	Blue	--	--	Deciduous/Broadleaf Forest; Garry Oak Woodland
Chamisso's montia	<i>Montia chamissoi</i>	Blue	--	--	Estuary; Marsh; Stream/River; Beach; Riparian Herbaceous
Common bluecup	<i>Githopsis specularioides</i>	Red	--	--	Vernal Pools/Seasonal Seeps; Rock/Sparsely Vegetated Rock; Grassland; Garry Oak Maritime Meadow
Cup clover	<i>Trifolium cyathiferum</i>	Blue	--	--	Vernal Pools/Seasonal Seeps; Riparian Forest; Riparian Shrub; Garry Oak Maritime Meadow
Deltoid balsamroot	<i>Balsamorhiza deltoidea</i>	Red	Endangered	Endangered	Rock/Sparsely Vegetated Rock; Grassland; Mixed Forest (deciduous/coniferous mix); Sand Dune; Beach; Garry Oak Woodland
Dwarf bramble	<i>Rubus lasiococcus</i>	Blue	--	--	Conifer Forest—Mesic (average); Conifer Forest—Moist/wet
Dwarf red fescue	<i>Festuca rubra</i> ssp. <i>mediana</i>	Blue	--	--	NA
Elegant Jacob's-ladder	<i>Polemonium elegans</i>	Blue	--	--	Cliff; Rock/Sparsely Vegetated Rock; Talus
Estuarine paintbrush	<i>Castilleja ambigua</i> ssp. <i>ambigua</i>	Blue	--	--	Estuary; Vernal Pools/Seasonal Seeps; Garry Oak Maritime Meadow
Giant chain fern	<i>Woodwardia fimbriata</i>	Blue	--	--	Stream/River; Rock/Sparsely Vegetated Rock
Gray's desert-parsley	<i>Lomatium grayi</i> var. <i>grayi</i>	Red	Threatened	Threatened	Cliff; Rock/Sparsely Vegetated Rock; Talus; Conifer Forest—Dry; Garry Oak Woodland
Green-fruited sedge	<i>Carex interrupta</i>	Blue	--	--	Stream/River; Riparian Herbaceous; Gravel Bar
Heterocodon	<i>Heterocodon rariflorus</i>	Blue	--	--	Vernal Pools/Seasonal Seeps; Conifer Forest—Mesic (average); Conifer Forest—Moist/wet; Garry Oak Maritime Meadow
Howell's violet	<i>Viola howellii</i>	Red	--	--	Rock/Sparsely Vegetated Rock; Meadow; Conifer Forest—Moist/wet; Garry Oak Woodland



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Table B-8 Seymour Narrows Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype ⁴
Leafy mitrewort	<i>Mitellastrum caulescens</i>	Blue	--	--	Riparian Forest; Cliff; Rock/Sparsely Vegetated Rock; Talus; Conifer Forest—Mesic (average); Conifer Forest—Moist/wet; Mixed Forest (deciduous/coniferous mix)
Macoun's groundsel	<i>Packera macounii</i>	Blue	--	--	Rock/Sparsely Vegetated Rock; Grassland; Conifer Forest—Dry
Macoun's meadow-foam	<i>Limnanthes macounii</i>	Red	Threatened	Threatened	Meadow; Deciduous/Broadleaf Forest; Garry Oak Vernal Pool; Garry Oak Maritime Meadow
Macrae's clover	<i>Trifolium dichotomum</i>	Red	--	--	Cliff; Rock/Sparsely Vegetated Rock; Talus; Meadow; Garry Oak Coastal Bluffs
Needle-leaved navarretia	<i>Navarretia intertexta</i>	Red	--	--	Vernal Pools/Seasonal Seeps; Meadow; Garry Oak Maritime Meadow
Nevada marsh fern	<i>Thelypteris nevadensis</i>	Red	--	--	Riparian Forest; Stream/River; Rock/Sparsely Vegetated Rock; Mixed Forest (deciduous/coniferous mix)
Northern adder's-tongue	<i>Ophioglossum pusillum</i>	Blue	--	--	Fen; Pasture/Old Field; Meadow; Riparian Herbaceous; Cold Spring
Nuttall's quillwort	<i>Isoetes nuttallii</i>	Blue	--	--	Vernal Pools/Seasonal Seeps; Stream/River; Rock/Sparsely Vegetated Rock; Meadow; Conifer Forest—Dry; Garry Oak Woodland; Garry Oak Vernal Pool; Garry Oak Maritime Meadow
Oregon ash	<i>Fraxinus latifolia</i>	Red	--	--	Estuary; Swamp; Stream/River
Phantom orchid	<i>Cephalanthera austiniiae</i>	Red	Endangered	Threatened	Conifer Forest—Mesic (average); Mixed Forest (deciduous/coniferous mix)
Pine broomrape	<i>Orobancha pinorum</i>	Red	--	--	Conifer Forest—Mesic (average); Conifer Forest—Moist/wet
Poverty clover	<i>Trifolium depauperatum</i> var. <i>depauperatum</i>	Blue	--	--	Vernal Pools/Seasonal Seeps; Rock/Sparsely Vegetated Rock; Meadow; Grassland; Garry Oak Vernal Pool



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Appendix B Vegetation—Potential Species and Ecological Communities of Conservation Concern
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Table B-8 Seymour Narrows Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype ⁴
Prairie lupine	<i>Lupinus lepidus</i>	Red	Endangered	Endangered	Rock/Sparsely Vegetated Rock; Meadow; Garry Oak Maritime Meadow
Purple sanicle	<i>Sanicula bipinnatifida</i>	Red	Threatened	Threatened	Rock/Sparsely Vegetated Rock; Deciduous/Broadleaf Forest; Garry Oak Woodland; Garry Oak Maritime Meadow
Rough-leaved aster	<i>Eurybia radulina</i>	Red	--	--	Rock/Sparsely Vegetated Rock; Conifer Forest—Dry; Garry Oak Woodland
Salt marsh Philadelphia daisy	<i>Erigeron philadelphicus</i> var. <i>glaber</i>	Red	--	--	NA
Short-seeded waterwort	<i>Elatine brachysperma</i>	Red	--	--	Bog; Fen; Swamp; Marsh
Slender-spiked mannagrass	<i>Glyceria leptostachya</i>	Blue	--	--	Bog; Fen; Swamp; Marsh; Lake; Pond/Open Water; Mudflats—Intertidal
Slimleaf onion	<i>Allium amplexans</i>	Blue	--	--	Vernal Pools/Seasonal Seeps; Rock/Sparsely Vegetated Rock; Meadow; Garry Oak Woodland; Garry Oak Coastal Bluffs
Smith's fairybells	<i>Prosartes smithii</i>	Blue	--	--	Riparian Forest; Deciduous/Broadleaf Forest; Conifer Forest—Moist/wet; Mixed Forest (deciduous/coniferous mix)
Streambank lupine	<i>Lupinus rivularis</i>	Red	Endangered	Endangered	Stream/River; Meadow; Urban/Suburban; Mudflats—Intertidal; Garry Oak Woodland
Texas toadflax	<i>Nuttallanthus texanus</i>	Red	--	--	Vernal Pools/Seasonal Seeps; Cliff; Rock/Sparsely Vegetated Rock; Grassland; Sand Dune; Garry Oak Coastal Bluffs
Two-edged water-starwort	<i>Callitriche heterophylla</i> var. <i>heterophylla</i>	Blue	--	--	Pond/Open Water
Washington springbeauty	<i>Claytonia washingtoniana</i>	Red	--	--	Cliff; Talus; Conifer Forest—Dry; Mixed Forest (deciduous/coniferous mix)
Western wahoo	<i>Euonymus occidentalis</i> var. <i>occidentalis</i>	Red	--	--	Riparian Forest; Conifer Forest—Moist/wet; Mixed Forest (deciduous/coniferous mix); Garry Oak Woodland



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Table B-8 Seymour Narrows Potential Vascular Plant Species of Conservation Concern

Common Name	Scientific Name	BC List ¹	COSEWIC ²	SARA ³	Habitat Subtype ⁴
White meconella	<i>Meconella oregana</i>	Red	Endangered	Endangered	Rock/Sparsely Vegetated Rock; Deciduous/Broadleaf Forest; Garry Oak Coastal Bluffs
White-top aster	<i>Sericocarpus rigidus</i>	Blue	Special Concern	Special Concern	Rock/Sparsely Vegetated Rock; Meadow; Mixed Forest (deciduous/coniferous mix); Garry Oak Woodland
Wine-cup clarkia	<i>Clarkia purpurea</i> ssp. <i>quadrivulnera</i>	Red	--	--	Meadow; Garry Oak Maritime Meadow
Yellow montane violet	<i>Viola praemorsa</i> var. <i>praemorsa</i>	Red	Endangered	Endangered	Pasture/Old Field; Meadow; Garry Oak Woodland
Yellow sand-verbena	<i>Abronia latifolia</i>	Blue	--	--	NA

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⁴ Excludes Estuary, Mudflats—Intertidal, Sand Dune, Beach, Marine Habitat Subtypes due to study area conditions

NA = habitat subtype data not available for some species



APPENDIX C

**WILDLIFE SPECIES OF CONSERVATION CONCERN WHICH
MAY OCCUR IN THE FOUR WILDLIFE STUDY AREAS**

**ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES,
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Appendix C Wildlife Species of Conservation Concern which may Occur in the Four Wildlife Study Areas
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**Appendix C WILDLIFE SPECIES OF CONSERVATION CONCERN WHICH MAY OCCUR
IN THE FOUR WILDLIFE STUDY AREAS**

Species	Scientific Name	Provincial Status ¹	COSEWIC Status ²	SARA Schedule 1 Status ³	Study Area			
					Denny Island	Mount Collinson	Safety Mountain	Seymour Narrows
Birds								
Bald eagle ⁴	<i>Haliaeetus leucocephalus</i>	Yellow	-	-	X	X	X	X
Band-tailed pigeon	<i>Patagioenas fasciata</i>	Blue	Special Concern	Special Concern	X	X	X	X
Barn swallow ⁵	<i>Hirundo rustica</i>	Blue	Threatened	Threatened	X	X	X	X
Black swift	<i>Cypseloides niger</i>	Blue	Endangered	-	X	X	X	X
Common nighthawk	<i>Chordeiles minor</i>	Yellow	Special Concern	Threatened		X		X
Evening grosbeak	<i>Coccothraustes vespertinus</i>	Yellow	Special Concern	-	X	X	X	X
Great blue heron, <i>fannini</i> subspecies ⁴	<i>Ardea herodias fannini</i>	Blue	Special Concern	Special Concern	X	X	X	X
Marbled murrelet	<i>Brachyramphus marmoratus</i>	Blue	Threatened	Threatened	X	X	X	X
Northern goshawk, <i>laingi</i> subspecies	<i>Accipiter gentilis laingi</i>	Red	Threatened	Threatened	X	X	X	X
Northern pygmy-owl, <i>swarhi</i> subspecies	<i>Glaucidium gnoma swarhi</i>	Blue	-	-		X		X
Olive-sided flycatcher	<i>Contopus cooperi</i>	Blue	Special Concern	Threatened	X	X	X	X
Osprey ⁴	<i>Pandion haliaetus</i>	Yellow	-	-	X	X	X	X



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Appendix C Wildlife Species of Conservation Concern which may Occur in the Four Wildlife Study Areas

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Species	Scientific Name	Provincial Status ¹	COSEWIC Status ²	SARA Schedule 1 Status ³	Study Area			
					Denny Island	Mount Collinson	Safety Mountain	Seymour Narrows
Peregrine falcon, <i>pealei</i> subspecies ⁴	<i>Falco peregrinus pealei</i>	Blue	Special Concern	Special Concern	X	X	X	X
Western screech-owl, <i>kennicottii</i> subspecies	<i>Megascops kennicottii kennicottii</i>	Blue	Threatened	Threatened	X	X	X	X
Mammals								
American water shrew, <i>brooksi</i> subspecies	<i>Sorex navigator brooksi</i>	Blue	-	-		X		X
Ermine, <i>anguinae</i> subspecies	<i>Mustela erminea anguinae</i>	Blue	-	-		X		X
Keen's myotis	<i>Myotis keenii</i>	Blue	-	-	X	X	X	X
Little brown myotis	<i>Myotis lucifugus</i>	Yellow	Endangered	Endangered	X	X	X	X
Roosevelt elk	<i>Cervus elaphus roosevelti</i>	Blue	-	-		X		X
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	Blue	-	-				X
Townsend's vole, <i>cowani</i> subspecies	<i>Microtus townsendii cowani</i>	Red	-	-		X		X
Wolverine, <i>vancouverensis</i> subspecies ⁶	<i>Gulo gulo vancouverensis</i>	Red	Special Concern	Special Concern		X		X
Amphibians								
Northern red-legged frog	<i>Rana aurora</i>	Blue	Special Concern	Special Concern		X		X
Wandering salamander	<i>Aneides vagrans</i>	Blue	Special Concern	Special Concern	X	X	X	X
Western toad	<i>Anaxyrus boreas</i>	Yellow	Special Concern	Special Concern	X	X	X	X



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Appendix C Wildlife Species of Conservation Concern which may Occur in the Four Wildlife Study Areas
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Species	Scientific Name	Provincial Status ¹	COSEWIC Status ²	SARA Schedule 1 Status ³	Study Area			
					Denny Island	Mount Collinson	Safety Mountain	Seymour Narrows
<p>Notes:</p> <p>¹ Provincial Status: Red is any indigenous species or subspecies that is extirpated, endangered, or threatened in BC; Blue is any indigenous species or subspecies considered to be of special concern in BC; Yellow is species considered to be secure and not at risk of extinction</p> <p>² COSEWIC Status: Endangered is a species facing imminent extirpation or extinction; Threatened is a species likely to become endangered; Special Concern is a species that may become threatened or endangered</p> <p>³ SARA Status: Endangered is a species that is facing extinction or extirpation; Threatened is a species that may become endangered; Special Concern is a species with characteristics that make it sensitive to natural events or human activities</p> <p>⁴ Nests protected year-round under the BC <i>Wildlife Act</i></p> <p>⁵ Nests protected year-round under <i>Species at Risk Act</i></p> <p>⁶ Last verified sighting on Vancouver Island was in 1991 (COSEWIC 2014)</p> <p>SOURCES: Nagorsen and Brigham 1993; Nagorsen 1996, 2005; Hatler et al. 2008; Davidson et al. 2015; Rodewald 2015; BC CDC 2018; BSC 2018; e-Fauna BC 2018; GOC 2018</p>								



ENVIRONMENTAL OVERVIEW ASSESSMENT IN SUPPORT OF THE DEVELOPMENT OF CANADIAN COAST GUARD RADAR SITES, BRITISH COLUMBIA

Appendix C Wildlife Species of Conservation Concern which may Occur in the Four Wildlife Study Areas
January 23, 2019

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APPENDIX H

ENVIRONMENTAL MANAGEMENT PLAN



**Canadian Coast Guard Radar
Stations, British Columbia**

Environmental Management Plan

January 22, 2019

Prepared for:

Canadian Coast Guard—Marine & Civil
Infrastructure
Fisheries & Oceans Canada

Prepared by:

Stantec Consulting Ltd.

Issued for Tender

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Abbreviations

BC	British Columbia
BMP	best management practices
CCG	Canadian Coast Guard
CMT	culturally modified tree
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
EM	environmental monitor
EMP	Environmental Management Plan
HCA	<i>Heritage Conservation Act</i>
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
QEP	qualified environmental professional
WCA	<i>Weed Control Act</i>



Introduction
January 22, 2019

1.0 INTRODUCTION

This Environmental Management Plan (EMP) was compiled for the Canadian Coast Guard (CCG) Radar Stations Project (the Project), and describes roles and responsibilities (Section 1.3), regulatory and legislative requirements (Section 2.0), planned construction activities (Section 3.0), the existing environment at the project location (Section 4.0) and environmental protection measures developed to avoid or mitigate effects to the environment during construction (Section 5.0). This EMP also provides recommendations for environmental monitoring, and reporting requirements related to environmental monitoring and non-compliance incidents (Section 6.0).

1.1 PROJECT BACKGROUND

The CCG arm of Fisheries and Oceans Canada (DFO), is planning to construct four new radar stations at Denny Island, Mount Collinson, Safety Mountain, and Seymour Narrows (the Project) as part of the Oceans Protection Program aimed at enhancing navigational safety in Canadian waters. These sites are located along the west coast of British Columbia (BC) near Campbell River (Seymour Narrows), Telegraph Cove (Mount Collinson), Bella Bella (Denny Island) and Calvert Island (Safety Mountain). All locations are situated on the top of hills or are at high elevations to enhance the range of radar signals (Figure 1).

1.2 PURPOSE OF THE ENVIRONMENTAL MANAGEMENT PLAN

This EMP is intended to mitigate adverse environmental effects and reduce the risk of unforeseen environmental incidents from the Project. Contractor(s) working on the Project must complete this Project in accordance with applicable legislation and comply with this EMP and/or provide suitable alternative approaches pre-approved by the CCG project manager and/or the environmental monitor (EM) (if applicable¹). This document outlines the following:

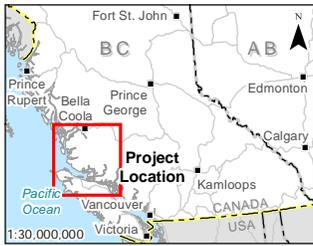
- Roles and responsibilities for the CCG project manager, the contractor(s), and the EM
- Regulatory requirements and permits for the Project
- Key construction activities and schedule
- Existing environmental conditions and resources
- Potential project effects and mitigation measures
- Management measures to mitigate potential project effects
- Environmental monitoring, reporting, and compliance requirements

The EMP is a living document that will be reviewed and updated as needed prior to and during construction of the Project. The mitigation measures and monitoring protocols outlined in this EMP may be re-evaluated to identify and update deficiencies and improve overall environmental management and protection.

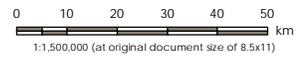
¹ CCG will determine whether a dedicated EM will be onsite. If a dedicated EM (CCG staff or external) is not required for the Project site or specific activities, the contractor will assign an individual to act as the onsite EM and fulfil the duties and responsibilities outlined in Table 1.



\\Cd1183_603\Workgroup\1232\193\Projects\123221193\Figures\reports\Environmental\Conditions_from\Desktop_Review_and_Site_Reconnaissance\Fig_123221193_andrdrsr_01_Overview_Map.mxd Revised: 2019-01-08 By: lludfsl



- City, Town, or Village
- CCG Radar Tower Location
- Highway
- Road
- +— Railway



Project Location: Westcoast of British Columbia
 Project Number: 123221193
 Prepared by: LTRUDEL on 20180913
 Discipline Review by: SNABESS on 20190107
 GIS Review by: SPARKER on 20190107

Client/Project/Report: Canadian Coast Guard Radar Stations, British Columbia; Environmental Management Plan
 Figure No.: 1
 Title: Overview Map

Notes
 1. Coordinate System: NAD 1983 BC Environment Albers
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 3. Imagery Source: ESRI World Ocean Base

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Introduction
January 22, 2019

1.3 ROLES AND RESPONSIBILITIES

Table 1 describes the roles and responsibilities of the project team.

Table 1 Roles and Responsibilities of the Project Team

Role	Responsibilities
CCG project manager	<ul style="list-style-type: none"> • Project owner with overall responsibility for delivery of the works associated with this Project; provides direction and general oversight for the Project • Responsible for overall environmental management and performance of the Project • Administers contracts and assesses the Contractor(s)'s ability to comply with this EMP as part of the tender evaluation • Attends health and safety meetings and Contractor tailgate meetings where appropriate, to communicate potential environmental concerns/requirements • Provides the contractor(s) and EM with project-specific details, such as background information, permits and this EMP • Authorizes stop work authority to project personnel (e.g., EM) for non-compliance with this EMP and contravention of regulatory permits and allow them to suspend project activities that are at risk of causing or potentially causing serious harm to fish, wildlife or the environment (e.g., water quality, drinking water quality, terrestrial, air quality) • Notifies regulatory agencies or authorizes notification of environmental non-compliance or environmental incidences, where applicable • Oversee compliance of the EMP • Advises EM(s) as required • Liaise with regulatory agencies, as necessary • Reviews and provides comment to the EM reports • Has the authority to issue a Stop Work order where activities are affecting or will affect the environment (e.g., water quality, drinking water quality, terrestrial, air quality), fish and wildlife.
Contractor(s)	<ul style="list-style-type: none"> • Understands details of the Project by reviewing relevant documentation and regulatory approvals supplied by CCG (e.g., EMP, environmental permits) • Constructs works according to approved designs and standards, regulatory requirements/approvals, this EMP and if required, contractor-specific management plans • Verifies that personnel are appropriately trained and competent in the use of environmental protection and mitigation measures, such as sediment, waste, spill and noise control measures • Notifies project manager and/or EM(s) of any observed or potential non-compliances with this EMP • Immediately reports incidents to the project manager or EM(s) and initiates an appropriate response • Acts as the EM, or assigns a designated person to be EM, at all times when a dedicated EM is not on site. During these times the contractor will provide environmental monitoring updates to the CCG project manager weekly or whenever site activities change. • Corrects deficiencies and any non-compliance upon direction from the project manager, EM(s) and/or regulators



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Regulatory and Legislative Requirements

January 22, 2019

Table 1 Roles and Responsibilities of the Project Team

Role	Responsibilities
Environmental monitor	<ul style="list-style-type: none"> • Will be a qualified environmental professional (QEP)² • Liaises/reports back to the project owner on status of work and of any emerging environmental issues and assists in addressing them • Completes and records environmental pre-job meetings with the contractor(s) • Attends health and safety meetings and contractor tailgate meetings where appropriate, to communicate potential environmental concerns/requirements • Maintains a current version of the EMP and is familiar with all aspects of the document • Communicates requirements of this EMP to the project manager and contractor(s) • Evaluates and reports on the effectiveness of the environmental mitigation measures and on the contractor's work procedures through regular site visits during construction. Frequency of site visits will be determined prior to construction start-up and will be based on regulatory (e.g., <i>Wildlife Act</i>) requirements and higher risk activities. • Advises the contractor of non-compliance and of any emerging environmental issues and assists in addressing them • Provides corrective advice to the contractor where appropriate; such as when non-compliances are observed or imminent • Has the authority to issue a stop work order where activities are affecting, or will affect the environment (e.g., water quality, drinking water quality, terrestrial, air quality), fish and wildlife • Maintains records of site visits and regularly updates the CCG project manager • Writes environmental monitoring and permit-required reports to be submitted to the CCG project manager and appropriate regulatory authorities • Addresses and closely monitors non-compliance issues immediately • Provides guidance and direction as needed during clean-up and restoration activities (e.g., after a spill or hydraulic leak) according to the requirements in this EMP

2.0 REGULATORY AND LEGISLATIVE REQUIREMENTS

A summary of the key federal and provincial environmental legislation relevant to the Project, including required permits, notifications and approvals to regulatory agencies to facilitate the proposed project works are provided in Table 2.

Table 2 Construction Environmental Permits and Notifications

Legislation	Environmental Permits for Construction	Regulatory Agency	Description
<i>Migratory Birds Convention Act, 1994</i>	None applicable	Environment and Climate Change Canada (ECCC)	Most migratory birds and their nests and eggs are protected everywhere in Canada under the <i>Migratory Birds Convention Act</i> . If vegetation clearing or other activities that may result in incidental take must occur during the primary migratory bird nesting period, a bird nest mitigation plan should be implemented.

² A qualified environmental professional (QEP) is an applied scientist or technologist who is registered and in good standing with an appropriate BC professional organization constituted under an Act.



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Construction Activities

January 22, 2019

Table 2 Construction Environmental Permits and Notifications

Legislation	Environmental Permits for Construction	Regulatory Agency	Description
<i>Wildlife Act</i>	General wildlife permit; amphibian salvage permit (may be required at the Seymour Narrows Site)	Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD)	A permit under the <i>Wildlife Act</i> is required to salvage and relocate amphibians and to remove and relocated unoccupied protected nests of certain species (e.g., bald eagle, osprey, and great blue heron). A permit may be required for wildlife disturbance caused by blasting.
<i>Heritage Conservation Act (HCA)</i>	An HCA inspection permit is required to date the age of the tree modification and determine the heritage status of trees at the Mount Collinson Site.	MFLNRORD	Heritage objects and archaeological sites, on provincial Crown land and private land in British Columbia, that predate 1846 are protected by the HCA. These objects and sites are protected through designation as “provincial heritage sites” (section 9) or through automatic protection by virtue of being of particular historic or archaeological value (section 13). Protected archaeological sites may not be altered without permit issued by MFLNRORD.
<i>Forest Act</i>	Occupant licence to cut	MFLNRORD	An occupant licence to cut is required for any cutting or removal of Crown timber from Crown land or private land.

3.0 CONSTRUCTION ACTIVITIES

Each site will include a radar tower, a prefabricated aluminum building (5 m by 10 m), solar panels and or fuel tank, and a helicopter landing pad. Construction at each site will require clearing of a temporary helicopter landing area (23 m by 23 m); general site clearing to support the tower, building and helicopter pads; radar tower construction; building installation; and helipad installation. Some tree clearing will be completed for tower site lines. The radar towers range from 46 m (Seymour Narrows and Mount Collinson) to 24.4 m (Safety Mountain and Denny Island). In addition to the facilities described above, the Seymour Narrows site will also have a 1 km powerline to Brown’s bay, and a 300 m access road, both of which will require vegetation and tree clearing. The road clearing for Seymour Narrows and radar site construction at Mount Collinson will require rock blasting.

4.0 EXISTING CONDITIONS

The following section describes the existing biophysical conditions and key environmental components for each of the four proposed radar station sites compiled from an environmental overview assessment and site reconnaissance completed in 2018 (Stantec 2018). None of the four sites overlap with any wildlife habitat areas, ungulate winter range, important bird areas, parks, ecological reserves, or grizzly bear population units.



Existing Conditions

January 22, 2019

4.1 DENNY ISLAND

Denny Island is an island on the central coast of British Columbia, located east of the community of Bella Bella (Figure 1). The proposed radar site location is on a high point of land, dropping off steeply on all sides, and likely subject to strong winds, particularly in the winter. The site is located in a mature western redcedar/western hemlock forested community with an understory composed primarily of blueberry and a forest floor covered by feather mosses (Photo 1). The key environmental components and existing conditions for this site are summarized in Table 3.



Photo 1 Proposed Denny Island Radar Site—Mature Western Redcedar/Western Hemlock Forest



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Existing Conditions
January 22, 2019

Table 3 Denny Island—Key Environmental Components and Conditions

Key Environmental Component	Description
Vegetation	<ul style="list-style-type: none"> 15 ecological communities of conservation concern and 20 vascular plant species of conservation concern may occur in the project area
Wildlife	<ul style="list-style-type: none"> Project tenure area overlaps 4.0 ha of marbled murrelet critical habitat; however, the tower and related facilities do not overlap with this critical habitat Field ranking identified very low suitability as nesting habitat (trees with dead tops, snags, and likely usable cavities, one larger hemlock tree downslope from site may be suitable nesting tree) No amphibians, species of conservation concern or wildlife habitat features were detected during the site reconnaissance
Fish	<ul style="list-style-type: none"> No fish resources present at site; nearest waterbody located 175 to the west
Archaeology	<ul style="list-style-type: none"> No above-ground archaeological resources or locations with high potential for buried archaeological resources were identified at the proposed tower, building, and helipad location Small patches of Indian Hellebore (traditional use plant) on slopes around site
SOURCE: Stantec 2018	

4.2 MOUNT COLLINSON

Mount Collinson is located near the community of Telegraph Cove on Vancouver Island, British Columbia (Figure 1). The proposed radar site is located at the top of a peak above Johnstone Strait along the shoreline with steep slopes on all sides, dominated by old coniferous forest (Photo 2). The key environmental components and existing conditions for this site are summarized in Table 4.



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Existing Conditions

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Photo 2 Proposed Mount Collison Radar Site—Blue-listed Western Hemlock—Western Redcedar/Salal Forested Community

Table 4 Mount Collinson—Key Environmental Components and Conditions

Key Environmental Component	Description
Vegetation	<ul style="list-style-type: none"> • Site is in a sparsely treed forest of mountain hemlock, western hemlock, and yellow cedar; shrub layer (primarily salal, blueberry, and crowberry); ground layer (feathermosses and lichen) • Project area does not overlap with any mapped wetlands, riparian areas, known occurrences of plant species or ecological communities of conservation concern, invasive plants, or critical habitat for plant species at risk
Wildlife	<ul style="list-style-type: none"> • Proposed development area overlaps 1.5 ha of marbled murrelet critical habitat; however, site is not considered suitable for marbled murrelet nesting • Small wet area within site may serve as amphibian breeding habitat • No amphibians, species of conservation concern, or wildlife habitat features were detected during the site reconnaissance
Fish	<ul style="list-style-type: none"> • No fish resources near site (e.g., within 350 m) the
Archaeology	<ul style="list-style-type: none"> • Two likely CMTs were recorded within the proposed development area, both large diameter yellow cedar bark-stripped trees • Six species of traditional use plants (kwak'wala names in brackets): <ul style="list-style-type: none"> – Indian Hellebore (axwsuli) – Oval leaf blueberry (nuxwa) – Alaska blueberry – Salal (naku!l) – Red huckleberry (gwadam)



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Existing Conditions
January 22, 2019

Key Environmental Component	Description
	– Bog cranberry (<u>kikalis</u>)
NOTE: CMT = culturally modified tree	
SOURCE: Stantec 2018	

4.3 SAFETY MOUNTAIN

Safety Mountain is located on top of a ridge, just east of the peak on Calvert Island, east of the Queen Charlotte Sound (Figure 1). The proposed radar site is on a high point of land, dropping off steeply on all sides, and likely subject to strong winds, particularly in the winter. The site is a parkland community with patches of stunted trees and openings dominated by heather and low-growing berry-producing shrubs (Photo 3). The key environmental components and existing conditions for this site are summarized in Table 5.



Photo 3 Proposed Safety Mountain Radar Site—Krummholz Scrub Forest of Mountain Hemlock and Yellow Cedar



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Existing Conditions

January 22, 2019

Table 5 Safety Mountain—Key Environmental Components and Conditions

Key Environmental Component	Description
Vegetation	<ul style="list-style-type: none"> • Stunted scrub forest of mountain hemlock and yellow cedar trees, with a herb layer dominated by pink mountain heather crowberry, and blueberries, and ground lichen cover • Project area does not overlap with any know occurrences of plant species or ecological communities of conservation concern, invasive plants, or critical habitat for plant species at risk
Wildlife	<ul style="list-style-type: none"> • Small non-continuous drainage in a low area between two knolls which may have flowing water under very wet conditions, however with low to nil suitability for amphibian breeding • No amphibians or species of conservation concern were detected during the site reconnaissance
Fish	<ul style="list-style-type: none"> • No fish resources present at site; closest waterbody is 135 m to the north
Archaeology	<ul style="list-style-type: none"> • No above-ground archaeological resources or locations with high potential for buried archaeological resources were identified at the proposed tower, building, helipad location, and access road
SOURCE: Stantec 2018	

4.4 SEYMOUR NARROWS

Seymour Narrows is located near Campbell River on Vancouver Island (Figure 1). The prosed radar site is located near the top of a hill and is dominated by mature forest, with occasional cliffs and rock outcrops (Photo 4). The key environmental components and existing conditions for this site are summarized in Table 6.



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Existing Conditions
January 22, 2019



Photo 4 Proposed Seymour Narrows Radar Tower Site—Red-listed Douglas-fir—Lodgepole Pine/Grey Rock-moss Forested Community

Table 6 Seymour Narrows—Key Environmental Components and Conditions

Key Environmental Component	Description
Vegetation	<ul style="list-style-type: none"> • Forest is composed of Douglas fir and shore pine, with an understory dominated by salal, grasses, mosses and ground lichen on the numerous rock outcrops • 23 ecological communities of conservation concern and 44 vascular plant species of conservation concern may occur in the project area
Wildlife	<ul style="list-style-type: none"> • Two bald eagle nests within 1 km of the tenure area along the shoreline of Seymour Narrows (WTSP 2018)
Fish	<ul style="list-style-type: none"> • No fish resources near site; closest waterbody is approximately 400 m to the southwest
Archaeology	<ul style="list-style-type: none"> • No above-ground archaeological resources or locations with high potential for buried archaeological resources were identified at the proposed tower, building, helipad location, and access road
SOURCE: Stantec 2018	



5.0 ENVIRONMENTAL PROTECTION MEASURES

Construction activities associated with the Project have the potential to affect environmental resources, however with the implementation of the mitigation measures outlined below, potential effects associated with the Project can be limited.

5.1 GENERAL BEST MANAGEMENT PRACTICES

Mitigation and management measures that avoid and/or mitigate adverse environmental effects associated with the Project are based on best management practices (BMPs) and standard industry procedures. These documents are from various government agencies, industry BMPs and recommendations by qualified professionals. The mitigation and management measures included in these documents have been created, modified and enhanced as needed for the purposes of this EMP. Examples of BMPs used to develop this EMP include, but are not limited to:

- Field Guide to Fuel Handling, Transportation and Storage (MWLAP 2002)
- Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1993)
- Environment and Climate Change Canada’s General Nesting Periods of Migratory Birds in Canada (ECCC 2018b)
- Guidelines for Raptor Conservation During Urban and Rural Land Development in British Columbia (MOE 2013)

5.2 GENERAL CONSTRUCTION PRACTICES

Many environmental mitigation measures are common to many construction components and activities. Table 7 provides general environmental mitigation measures applicable to all project activities.

Table 7 General Mitigation Measures

Category	Mitigation Measure
EMP and permits	1. A copy of the EMP and any applicable permits will be onsite and readily available.
Project start up	2. At the start of project construction, onsite personnel should review and discuss the measures in this EMP to promote an understanding of the Project, environmentally sensitive areas, reporting responsibilities and emergency response plans.
Training	3. Personnel involved with construction activities will be adequately trained and will utilize appropriate personal protective equipment.
Stop work	4. The contractor will stop work and contact the EM for assistance prior to commencing or continuing any activities that may pose any environmental risk not addressed in this document.
	5. The EM will have authority to issue a stop work order where activities are adversely affecting or are likely to adversely affect environmental conditions presented in Section 4.0. The EM will also make recommendations in the field for avoiding and mitigating effects, where measures in this EMP are not effective.



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Environmental Protection Measures

January 22, 2019

Table 7 General Mitigation Measures

Category	Mitigation Measure
Construction footprint	6. Construction footprint will be limited to the extent feasible to safely construct the Project.
	7. Construction limits will be flagged to identify work areas, sensitive habitats (e.g., old forest/sensitive habitat/nest buffer zones).
Site cleanliness	8. Sites (staging areas, construction sites) will be kept tidy during construction and left in a good condition at the end of the Project.
Stock piles/ laydown areas	9. Stockpiling of material and laydown area shall be in accordance with BMPs (e.g., erosion and sediment control measures) and limited to approved areas.
	10. Blast rock will not be stockpiled within 30 m of a watercourse or wetland, or placed on sensitive vegetation
Deleterious substance	11. To the extent practical, construction materials will be free of deleterious substances that may be harmful to fish, fish habitat or drinking water quality (e.g., fine sediments, hydrocarbons, contaminants) downstream of the project sites.
	12. Machinery will be in good working condition (free of leaks) and cleaned prior to arriving on site; machinery will be inspected/maintained for the duration of the Project to limit leaks/spills.
Hydrocarbons	13. Hydrocarbons (e.g., hydraulic fluids and fuel, detectable by sight or smell) will not be released to the environment).
Flora and fauna	14. Activities should be completed in such a way as to limit stress and disturbance to flora and fauna.
Air and noise quality	15. Limit equipment and machine idling.
	16. Turn off heavy equipment when inactive for more than 30 minutes.
	17. Verify that equipment and machinery are in good operating condition prior to work.
	18. Carry out regular maintenance on equipment and machinery.
	19. Equipment and machinery will have noise abatement equipment (e.g., mufflers) in good working order.
	20. Drills will be equipped with dust collectors.
	21. Burning of slash material will follow Provincially accepted guidelines to increase burning efficiency.
Wildfire Prevention	22. Smoking will only be permitted in designated areas.
	23. Smoking will not be permitted on site when the fire danger ranking is high or extreme.
	24. Fire suppressing equipment must be present at the work site and at designated smoking areas.
	25. Burning of slash material will be scheduled to avoid high fire hazard periods.



5.3 SPILL PREVENTION, RESPONSE AND REPORTING

Substances that are deleterious to the environment and may pose a spill risk for this Project could include:

- Gasoline
- Diesel
- Hydraulic fluid
- Transmission fluid
- Engine oil
- Lubricants (grease, etc.)
- Drilling fluids
- Sediment

Table 8 outlines procedures for prevention and control of spills including responsibilities, storage, and equipment.

Table 8 Spill Prevention, Mitigation Measures, Response and Reporting

Category	Mitigation Measure
Training	1. The contractor will provide on-site staff with training in the use of hazardous materials and the location and use of spill kits and containment booms.
Fuel handling guide	2. Fuel handling, storage and labelling procedures shall be consistent with <i>A Field Guide to Fuel Handling, Transportation and Storage</i> (MWLAP 2002). If there are discrepancies between this EMP and the Fuel Handling Guide (MWLAP 2002), the Project will err on the side of more stringent unless otherwise approved by CCG
Fuel	3. Where possible, fuel storage, equipment or machinery refueling, and servicing will occur a minimum of 30 m from any waterbody. Where operational constraints require fuel storage, equipment or machinery re-fueling and servicing within 30 m of a waterbody (e.g., on the trestle above the creek), measures to prevent the release or spill of hazardous materials must be discussed and approved by CCG and the EM.
	4. Storage of fuels and petroleum products will comply with safe operating procedures, including containment facilities in case of a spill.
	5. An inventory of all hazardous materials on site will be maintained.
	6. Portable fuel tanks (e.g., jerry cans) will be stored within leak-proof secondary containment with absorbent pads with a capacity of 110% of its volume. Accumulated water in the containment shall be removed regularly as not to diminish the capacity of the containment.
	7. Vehicles and equipment must be shut off while refueling.
Equipment	8. Equipment (e.g., containers, hoses and machinery) will be maintained in proper running order to prevent leaking or spilling of potentially hazardous or toxic products. This includes hydraulic fluid, diesel, gasoline and other petroleum products.
	9. At the discretion of the EM, drip trays, poly sheet or sorbent pads will be placed beneath machinery and equipment that are within 30 m of the high-water mark of water bodies.
	10. Small machinery (e.g., generators) should be placed in secondary containment, such as within drip trays with sorbent pads.
	11. Containers not in use will be sealed with a proper fitting cap or lid.



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Table 8 Spill Prevention, Mitigation Measures, Response and Reporting

Category	Mitigation Measure
Equipment maintenance/ servicing	12. Impervious materials, such as tarps, drip pans or spill trays must be placed underneath equipment and machinery during servicing when there is a potential for accidental drips or spills.
Spills	13. In the event of a leak, all fueling/filling operations will be stopped until the cause of the leak has been identified and it has been repaired.
	14. Spills must be reported to the EM immediately, regardless of volume.

In the event of a spill, the measures presented in Table 9 should be implemented.

Table 9 Spill Response and Reporting Mitigation Measures

Category	Mitigation Measure
Spill kits	1. The contractor will provide an appropriate number of spill kits on site based on the type and amount of equipment on site.
	2. Spill kits will be inspected by the contractor on a regular basis and will be re-filled immediately after use.
	3. Spill response materials contained in spill kits are required to be readily available when working at the project site. These materials include, but are not limited to: <ol style="list-style-type: none"> a. Spill kits b. Sorbent pads and booms c. Dry oil sorbent d. Personal protective equipment (e.g., nitrile gloves, safety glasses, suits) e. Heavy duty plastic garbage bags f. Fire extinguishers g. Shovels
Response	4. The initial response to the spill may include: <ol style="list-style-type: none"> a. Stop work b. Ensure your own safety and the safety of others c. On-site personnel wear personal protective equipment, such as nitrile gloves and safety glasses d. Identify the spilled materials and refer to the appropriate Safety Data Sheet to determine if human health or ignition hazards exist e. If possible and safe to do so, contain the spill by any safe means possible (e.g., plug leak, close/isolate leaking valve, etc.) f. Obtain assistance of others g. Begin containment of the spill and stop it from spreading h. Cleanup the spilled substance using available supplies from the on-site spill kits i. If the spill is to water, use measures such as installing sorbent rolls as floating booms to contain the spill and sorbent pads to soak up the material j. Report the spill to the EM, where the EM will notify the CCG project manager k. The CCG project manager and/or the EM will determine if notification to regulatory agencies is required



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Table 9 Spill Response and Reporting Mitigation Measures

Category	Mitigation Measure
Clean-up	5. Final clean-up and reclamation will be conducted following an assessment (by QEP) of soil and/or water conditions. Conduct in situ remediation only if approved by CCG and appropriate regulatory agencies. Specific clean-up measures will be determined in consultation with CCG, regulatory agencies, and the appropriately qualified professionals.
Reporting	6. CCG is responsible for notifying regulatory agencies or authorizing notification on their behalf (e.g., environmental representative) to regulatory agencies of all hazardous spills and to verify that the spill reporting meets provincial and federal requirements. CCG should report all spills to water to the Provincial Emergency Program (1-800-663-3456).
	7. The Spill Reporting Regulation under the British Columbia <i>Environmental Management Act</i> identifies externally reportable quantities for certain substances (Appendix A).
Environmental incident/non-compliance report	8. The CCG project manager will prepare an Environmental Incident/Non-Compliance Report in the event of a spill. Information required to be included in this report is provided in Section 6.2.



5.4 SEDIMENT AND EROSION CONTROL

Construction mitigation measures designed to limit the loss of soil and sediment mobilization to watercourses and vegetation adjacent to project areas are provided in Table 10. Sediment inputs to the aquatic environment can increase turbidity levels, directly affecting the quality of fish habitat. Sedimentation of vegetation can reduce the health of plants.

Table 10 Sediment and Erosion Control Mitigation Measures

Category	Mitigation Measure
Work	1. Activities should be completed in such a way as to limit the amount of fines and organic debris that may enter nearby aquatic and terrestrial environments.
Rain events	2. The contractor shall be prepared for rain events and have sediment and erosion control measures readily available and of sufficient amount.
	3. During high rainfall (e.g., 100 mm in 24-hour period) or when there is a risk of sediment and runoff entering waterbodies, work may be stopped at the discretion of the EM.
Vegetation	4. Limit disturbance to existing vegetation as part of sediment and erosion control measures in order to prevent sediment release.
	5. Avoid clearing vegetation on steep slopes during periods with high rainfall forecasted.
Erosion and sediment control measures	6. The contractor shall have a precautionary approach to erosion and sediment control. Put sediment control measures into place before starting any works that may result in sediment mobilization or cause erosion. Construction is not to start until sediment and erosion control measures are in place and deemed functional by the EM.
	7. When project activities have the potential to release sediment, erosion and sediment control measures (e.g., erosion control fabric, plastic sheeting, silt fences, gravel check dams, etc.) will be installed by the contractor.
	8. Stockpiled erodible materials shall be covered (e.g., straw, mulch, geotextile) to limit exposed erosion potential.
	9. Blast rock stockpiles will be contoured to limit erosion and covered and/or revegetated following construction as needed to limit erosion potential.
	10. Where necessary, exposed soils and ditches may require seeding with a native mix, as a form of sediment and erosion control.
11. Erosion and sediment control measures will remain in place and be maintained throughout all construction activities and weather conditions, and will only be removed once construction is complete, ground conditions have stabilized.	



5.5 VEGETATION MANAGEMENT

The proposed radar sites are located in areas where ecological communities of conservation concern and vascular plant species of conservation concern may occur as described in Section 4.0. Since the presence of plant species of conservation concern could not be confirmed because of the timing of the site reconnaissance, a pre-disturbance survey by a QEP is recommended before construction activities commence if work continues into the spring/summer. Table 11 outlines mitigation measures that should be implemented to reduce the disturbance of sensitive ecological communities and protect existing vegetation.

Table 11 Vegetation Mitigation Measures

Category	Mitigation Measure
Access	1. Limit the area that will be disturbed to extent possible. Where possible use pre-existing trails, roads or cut lines as access routes.
Laydown	2. Construction materials will not be stored on vegetated areas, unless approved by the EM.
Clearing	3. Consider reducing tree clearing by locating project infrastructure in areas previously cleared for the temporary helipads.
	4. Cleared material will not be placed within 30 m of a watercourse or wetland, or placed on sensitive vegetation such as rock outcrops.
	5. Large diameter slash material will either be burned/chipped on site, or removed from site and disposed of at an acceptable disposal location (e.g., landfill).
Rare plants	6. If a previously unidentified rare plant is found prior to or during construction, those areas will be flagged and avoided where possible. If not possible, then a QEP will determine appropriate mitigation.
Revegetation	7. Areas cleared in support of project construction (i.e., access areas) will be restored to original condition, or enhanced.
Denny Island	8. Avoid effects to old forest by planning project activities (i.e., vegetation clearing and construction of project infrastructure) outside of the limits of old forest on Denny Island.



5.6 INVASIVE PLANT AND WEED MANAGEMENT

The Project has the potential to introduce and spread invasive terrestrial species. Mitigation and management measures to reduce, prevent and control invasive species and weeds during the Project are described in Table 12. Throughout this section the term “invasive plants” also refers to the general term “weeds”, whereas “noxious weeds” refers specifically to invasive plants that fall under the BC *Weed Control Act* (WCA). For the purposes of this section invasive plants and noxious weeds will be referred to collectively as “Invasive Plants”.

Table 12 Invasive Species and Weed Control Management Measures

Category	Management Measure
Equipment	1. Equipment, vehicles and machines will arrive to site clean, paying special attention to undercarriages, tracks, tires and blades prior to arrival at the project site. Reduce the probability of introducing noxious weeds to the sites by cleaning equipment of vegetation debris and soil prior to transport to the sites
	2. Equipment and machines used to remove invasive species will be washed.
Clearing	3. Removal of invasive species, if present in areas requiring clearing, will require special attention to contain the vegetation and prevent its spread.
Material	4. Imported fill material must be free of invasive species.
	5. Imported fill material must meet the Canadian Council of Ministers of the Environment Canadian Soil Quality Guidelines for Commercial/Industrial Land Use and sample analysis should be documented from an independent Canadian Association of Laboratory Accreditation Inc. accredited laboratory
Disposal	6. Removed invasive species must be transported to an appropriate disposal facility approved by CCG.
Revegetation	7. Use only high-quality seed-lots for revegetation
Inspection	8. Inspect work areas during construction for establishment of invasive species and remove or chemically control as necessary to prevent establishment and spread.
Monitoring	9. Monitor the radar sites for noxious weeds following construction. If noxious weeds are discovered during monitoring, create and implement a management plan to comply with the BC <i>Weed Control Act</i> .



5.7 WILDLIFE PROTECTION

Activities associated with this Project, such as vegetation clearing and equipment operation, have the potential to directly or indirectly affect wildlife. Table 13 presents the mitigation measures that should be implemented to avoid or limit adverse effects on wildlife.

Table 13 Wildlife Mitigation Measures

Category	Mitigation Measure
Pre-disturbance survey	1. Prior to construction, areas to be cleared will be inspected by a QEP for wildlife features. The most likely wildlife features to be encountered are related to birds (e.g., bald eagle nests, nest cavities, stick nests in trees, marbled murrelet nests). Mitigation measures to address birds and bird nests are detailed in this table. In the unlikely event other wildlife features (e.g., mineral lick, den) are identified during this survey, the QEP will consult with the EM on appropriate mitigation measures (e.g., setbacks).
Birds and bird nests	2. The contractor is not permitted to fall trees without approval from the EM and the applicable regulatory agency.
	3. Nests of eagles, peregrine falcons, gyrfalcons, ospreys, and herons are protected year-round under the BC <i>Wildlife Act</i> , even when unoccupied. If such a nest is identified during the pre-construction survey, the QEP will consult with the EM on appropriate mitigation measures (e.g., avoidance).
	4. Reduce potential effects to migratory birds (i.e., incidental take), plan project activities (i.e., vegetation clearing and construction) to occur outside of the primary nesting period for breeding birds. <ul style="list-style-type: none"> a. The Mount Collinson and Seymour Narrows sites are in the A1 Nesting Zone which has a general nesting period of March 31 through August 7 (all habitats) (ECCC 2018b). b. The Denny Island and Safety Mountain sites are in the A2 Nesting Zone, which has a primary nesting period of April 11 to August 8 (all habitats) (ECCC 2018b). Migratory bird nests are protected under the federal <i>Migratory Birds Convention Act</i> while they are being used for breeding, nesting, roosting or rearing young. If vegetation clearing and/or timber removal/repair must occur during the primary migratory bird nesting period as identified above, then a “nest sweep” will be completed. The construction site and a 30-m zone around the construction site (where practical) will be inspected by a QEP for active bird nests no more than seven days before disturbance is to begin, otherwise another nest sweep must be undertaken. Where active bird nests are identified, a buffer zone will be established (see Buffer Zones category).
5. Once construction has begun, if a nest is encountered within the construction site or adjacent to the construction site (even after the end of the primary migratory bird nesting period), the nest will be evaluated by a QEP to determine species and/or if it is active. After the evaluation, the QEP will consult with the EM on appropriate mitigation measures (e.g., establishment of a buffer zone).	
Buffer zones	6. Where active bird nests are identified, a circular ‘buffer zone’ will be established around the nests and marked (e.g., with flagging tape). The required buffer distance varies by species, habitat type, and setting, and will be developed with input from the QEP based on provincial and federal guidelines, and the QEP’s opinion. Buffers will be at least 5 m (radius) and will remain in place while the nest is active. The QEP will also determine how long a setback will remain in place.
	7. Construction activities will be limited within buffer zones and must be approved by the EM and regulators (if necessary).



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Table 13 Wildlife Mitigation Measures

Category	Mitigation Measure
Feeding, attractants, and hazards	8. Feeding of wildlife will not be permitted.
	9. Meals, food waste, garbage, and other attractants (e.g., oil containers) will be securely stored in vehicles or bear-resistant containers to prevent attraction of wildlife.
	10. Construction materials (e.g., cables, wires, fencing) will be properly stored to avoid potential hazards for wildlife.
Dead, sick, injured animals	11. If dead, sick or injured animals are observed, report to the EM directly (verbally or by radio, as soon as possible).
Potentially hazardous wildlife	12. In the unlikely event elk, cougar or black bear are observed at the construction site do not approach the animal. Contact the EM directly (verbally or by radio), as soon as possible, for additional direction. If elk, cougar or black bear presence becomes an ongoing concern for construction personnel, the EM will consult with the British Columbia Conservation Officer Service (1-877-952-7277 [Report all poachers and polluters, RAPP, 24-hour hotline]) .
Seymour narrows	13. At the Seymour Narrows location where wetted habitat was identified, reduce potential effects to amphibians by avoiding project activities (i.e., vegetation clearing and construction) in wetlands that contain amphibian egg masses or tadpoles during the amphibian breeding period (mid-April to mid-August) and in habitats where amphibian movement is observed during the post-breeding dispersal period (mid-July to mid-September).
Seymour narrows pre-construction amphibian surveys	14. At the Seymour Narrows location where wetted habitat was identified, if project activities overlap with the amphibian breeding or post-breeding dispersal periods, engage a QEP to undertake pre-construction amphibian surveys. The surveys will: 1) determine the presence of amphibian eggs, tadpoles, juveniles, or adults; and 2) determine whether salvage or other mitigation measures are required.



5.8 ARCHAEOLOGICAL AND HERITAGE RESOURCE PROTECTION

In the event that an archaeological or heritage site is encountered during construction, the archaeological standards and practices (including implementation of a chance find protocol) in place for private and Crown lands should be followed.

Evidence of what is thought to be an archaeological or heritage resource may include the following:

- Artefacts of stone or other material
- Shell deposits
- Rock paintings
- Old-looking pits in the ground (large or small, circular or rectangular)
- Cabins and other old-looking structures
- Old industrial, ranching, and other remains of possible heritage significance
- Mature western red cedar with well-defined bark scars
- Human remains

If an archaeological or heritage resource is encountered during construction, the work must be stopped in the vicinity of the find and the EM will notify the CCG project manager. From there, the CCG project manager or their delegate will contact the BC Archaeological Branch and/or a professional archaeologist immediately.

At the Mount Collinson site, one area of low to moderate potential was identified adjacent to the likely CMT 1, near an area of standing water. Additional investigations, which may include coring the tree with an increment borer or examining a cookie of the tree if felled, is recommended to confirm if modifications are cultural, and to determine the scar age. Further, it is recommended that shovel testing of the area occur should the bark-strip be confirmed as cultural. No mitigation measures or further work beyond the chance find protocol is required for the Denny Island, Safety Mountain, or Seymour Narrows sites.

5.9 WASTE CONTROL

Waste from project activities has the potential to adversely affect the aquatic and terrestrial environments; therefore, the mitigation measures outline in Table 14 will be implemented:

Table 14 Waste Control Mitigation Measures

Category	Mitigation Measure
Waste	1. Waste or any miscellaneous unused materials will be recovered for disposal in a designated facility. Under no circumstances will materials be deliberately thrown into the aquatic or terrestrial environment.
	2. Meals, food waste, garbage, and other attractants (e.g., oil containers) will be securely stored in vehicles or bear-resistant containers to prevent attraction of wildlife.
	3. All On-site personnel will make best efforts to prevent debris from entering the environment.
	4. Litter in the form of coffee cups, lunch wrappers, cigarette butts, and other such items will be stored and secured in such a way as to prevent attracting wildlife and starting wildfires.



Table 14 Waste Control Mitigation Measures

Category	Mitigation Measure
	5. Construction debris/waste will be collected, transported and disposed of off-site and in accordance with applicable legislation, guidelines and best management practices.
Portable Toilets	6. Portable toilets, if required, will be located a minimum of 30 m from any waterbody or plant species of concern. Sewage from portable toilets will be disposed of in an approved sewage disposal facility on an as-needed basis.
Hazardous Waste	7. Although hazardous waste is not anticipated for this Project, it should be noted that sorbent materials or soils saturated with hydrocarbons (greater than or equal to 3% by weight) are classified as hazardous waste under the British Columbia <i>Environmental Management Act</i> and must be managed accordingly.
	8. Used petroleum products, including their empty containers, will be collected and transported to a licensed recycling facility in approved storage containers following applicable regulations.

6.0 ENVIRONMENTAL MONITORING AND REPORTING

6.1 GENERAL ENVIRONMENTAL MONITORING

The EM will verify that all ongoing project components are monitored against this EMP, any additional construction-specific plans and applicable regulatory and legal requirements. The EM will be responsible for environmental monitoring related to any subcontractor activities as well as the prime contractor’s activities. In addition, the EM will confirm with the contractor(s) that any new on-site personnel understand their environmental responsibility and requirements of the EMP. If this EMP is followed, the potential for environmental effects and adverse environmental effects are low.

The appropriate frequency of site visits by a dedicated CCG EM will be determined prior to construction start-up and will be based on any regulatory requirements and higher-risk activities. When a CCG EM is not on site the contractor will be responsible for environmental monitoring.

The CCG project manager and EM will have authority to alter work methodology and/or issue stop work orders to prevent environmental effects and/or adverse environmental effects, whether probable, imminent, or occurring. Once corrective actions have been implemented and deemed appropriate by the EM, suspended project activity will be allowed to resume under the EM’s guidance.

6.2 REPORTING

The EM is responsible for keeping notes of site activities for each site visit and will prepare one monitoring report at the end of construction. This report will be submitted as a draft to the CCG project manager for review and comment. Once the EM has addressed the project manager’s comments, the EM will finalize the report.



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Environmental Monitoring and Reporting

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The monitoring report should include, at minimum:

- Construction activities
- Monitoring period
- Mitigation measures and activities that have been implemented or recommended
- Non-compliances and environmental incidents
- Presence of wildlife observed in the work area
- Photographs
- Overall compliance or non-compliance with the EMP and/or regulatory permits/authorizations

Non-compliances and incidents will be reported to the CCG project manager (and regulators where required) as soon as possible and within 24 hours of occurrence.

In the event of non-compliance or an incident, the event must be reported to CCG project manager. Non-compliances include non-compliance with this EMP, project-specific mitigation plans or project permits/authorizations/legislation (e.g., spills).

The non-compliance and incident reports should include:

- Reporting person's name and telephone number
- Date and time of the non-compliance or incident, including major steps (such as when the incident occurred, when did response occur)
- Location of non-compliance or incident (coordinates if available)
- Description and cause of the non-compliance or incident (if a spill—including type, source and quantity of material)
- Receiving environment description
- Names of other persons or government agencies notified
- Description of the response and when it occurred
- If a spill, percent of material recovered
- Details of further action required
- Recommendations for preventative/mitigation measures

Non-compliances and incidents must be resolved immediately by the CCG project manager, the EM and the contractor(s), with the CCG project manager as the top authority. When a non-compliance or incident occurs, remedial actions must be taken as soon as possible (i.e., as soon as the site is safe).



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6.3 EMERGENCY CONTACTS

Emergency contacts for the Project are provided in Table 15. Updated phone numbers for project personnel should be obtained prior to construction.

Table 15 Emergency Contact List for Project

Contact	Phone Number
The CCG project manager: Clint Hoffman	Office: (250) 413-2834 Mobile: (250) 686-0016
Contractor contact: TBD	Office: Mobile:
CCG environmental monitor: Robin Connelly	Office: (250) 363-8727 Mobile: (250) 580-8382
Provincial emergency program, 24 hours spill reporting	1-800-663-3456
DFO, violations and reporting, Report All Poachers and Polluters (RAPP), 24 hours hotline	1-877-952-RAPP (7277)
Medical emergency	Use 911
WorkSafeBC	1-866-621-7233

7.0 CLOSURE

We trust that this information meets with your present requirements. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Regards,

Stantec Consulting Ltd.

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APPENDIX A

Recordable Levels for Spills of Certain Substances

Appendix A RECORDABLE LEVELS FOR SPILLS OF CERTAIN SUBSTANCES

Item	Substance spilled	Specified amount
1	Class 1, Explosives as defined in section 2.9 of the Federal Regulations	Any quantity that could pose a danger to public safety or 50 kg
2	Class 2.1, Flammable Gases, other than natural gas, as defined in section 2.14 (a) of the Federal Regulations	10 kg
3	Class 2.2 Non-Flammable and Non-Toxic Gases as defined in section 2.14 (b) of the Federal Regulations	10 kg
4	Class 2.3, Toxic Gases as defined in section 2.14 (c) of the Federal Regulations	5 kg
5	Class 3, Flammable Liquids as defined in section 2.18 of the Federal Regulations	100 L
6	Class 4, Flammable Solids as defined in section 2.20 of the Federal Regulations	25 kg
7	Class 5.1, Oxidizing Substances as defined in section 2.24 (a) of the Federal Regulations	50 kg or 50 L
8	Class 5.2, Organic Peroxides as defined in section 2.24 (b) of the Federal Regulations	1 kg or 1 L
9	Class 6.1, Toxic Substances as defined in section 2.27 (a) of the Federal Regulations	5 kg or 5 L
10	Class 6.2, Infectious Substances as defined in section 2.27 (b) of the Federal Regulations	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
11	Class 7, Radioactive Materials as defined in section 2.37 of the Federal Regulations	Any quantity that could pose a danger to public safety and an emission level greater than the emission level established in section 20 of the "Packaging and Transport of Nuclear Substances Regulations"
12	Class 8, Corrosives as defined in section 2.40 of the Federal Regulations	5 kg or 5 L
13	Class 9, Miscellaneous Products, Substances or Organisms as defined in section 2.43 of the Federal Regulations	25 kg or 25 L
14	waste containing dioxin as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
15	leachable toxic waste as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
16	waste containing polycyclic aromatic hydrocarbons as defined in section 1 of the hazardous Waste Regulation	5 kg or 5 L
17	waste asbestos as defined in section 1 of the Hazardous Waste Regulation	50 kg
18	waste oil as defined in section 1 of the Hazardous Waste Regulation	100 L



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Appendix A Recordable Levels For Spills of Certain Substances
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Item	Substance spilled	Specified amount
19	waste containing a pest control product as defined in section 1 of the Hazardous Waste Regulation	5 kg or 5 L
20	PCB Wastes as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
21	waste containing tetrachloroethylene as defined in section 1 of the Hazardous Waste Regulation	50 kg or 50 L
22	biomedical waste as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
23	A hazardous waste as defined in section 1 of the Hazardous Waste Regulation and not covered under items 1 – 22	25 kg or 25 L
24	A substance, not covered by items 1 to 23, that can cause pollution	200 kg or 200 L
25	Natural gas	10 kg, if there is a breakage in a pipeline or fitting operated above 100 psi that results in a sudden and uncontrolled release of natural gas

SOURCE: British Columbia *Environmental Management Act*. Spill Reporting Regulation. 2008. Available at: http://www.bclaws.ca/civix/document/id/loco96/loco96/46_263_90





APPENDIX J

Radar Antenna Specifications

1. TERMA – 21 FEET HIGH GAIN ANTENNA SYSTEM
2. TERMA – DRAWING 259460-ZD

COMPANY UNCLASSIFIED

Class: PSP
Doc. no: 304786-DP
Rev: F
Date: 2018-08-13
Approved by: JCP

TERMA[®]
CAGE code: R0567

21 Feet High Gain Antenna System



Template no: 199997-FA, Rev. G

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CM:
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**Record of Changes**

ECR/ECO	Description	Rev	Date
	Released	A	2005-03-31
	General update - Specification updated	B	2006-04-27
40601	General update - Specification updated	C	2012-08-14
48406/68420	General update - Specification updated	D	2016-08-02
	Wind specifications clarified, lightning protection and grounding improved, preventive maintenance updated.		
53158/72841	VP variant and associated comments taken out of the document, as VP is not a managed product Added CP, HP variants and corresponding information regarding allowed motor power (2.2kW or 4.0kW)	E	2018-03-06
54345/73834	Added one antenna variant HP-F-38 with 4.0 kw nominal motor power in section 6.1 Reference changed to the valid manual in section 9 (from 972059-DN to 255548-HT)	F	See header

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Notice:

This document describes the product and may serve as reference in quotations and contracts.

Within the basic product configuration, a number of features and options are available to fulfill the customer application. These are specifically mentioned where relevant.

Note that illustrations are for visualization only. Please refer to detailed drawings which can be handed over upon request for specific details,

Terma A/S aims to improve the product family continuously, and consequently reserves the right to revise product characteristics without notice.



1 Abbreviations

Term	Definition
AC	Alternate Current
ACP	Azimuth Count Pulse output
AQAP	Allied Quality Assurance Publications
ARP	Azimuth Reference Pulse
C / Cosec ²	Cosecant squared (beam shape)
CP	Circular Polarization
CSS	Coastal Surveillance Service
DC	Direct Current
EIA	Electronic Industries Association
EN	European Norm
F	Fan (beam shape)
FD	Frequency Diversity
HG	High Gain antenna family
HP	Horizontal Polarization
I	Inverse Cosecant Squared (beam shape)
IEC	International Electro-technical Commission
ISO	International Organization for Standardization
MDR	Minimum Detection Range
NATO	North Atlantic Treaty Organisation
RF	Radio Frequency
RPM	Rotations Per Minute
Rx	Receive
SMR	Surface Movement Radar
TD	Time Diversity
TMS	Terma Management System
Tx	Transmit
VSWR	Voltage Standing-Wave Ratio
VTS	Vessel Traffic Service

2 Introduction

2.1 Executive summary

The Terma SCANTER High Gain X-band radar antennas are tailored specifically to meet the requirements for professional customers requiring durable high performance and high operational reliability.

For use in security and safety applications such as: Coastal Surveillance Service (CSS), Vessel Traffic Service (VTS) and Surface Movement Radar (SMR)

The antennas are of the linear array type, with fan beam, Cosec^2 (Cosecant squared) beam or inverse Cosec^2 beam elevation shape and are available with horizontal or circular polarization.

The antennas are designed to have narrow horizontal beam width, low side lobes, and no back lobes.



Figure 2.1 Typical antenna installation

Table 2-1: List of models

P/N 259460-xxx

- **21' HG-HP-F-38**
- **21' HG-HP-C-37**
- **21' HG-HP-I-37**
- **21' HG-CP-F-38**
- **21' HG-CP-C-37**
- **21' HG-CP-I-37**

<p>21' length in feet HG ~ High Gain CP ~ Circular Polarization HP ~ Horizontal Polarization F ~ Fan beam shape C ~ Cosec^2 beam shape I ~ Inverse Cosec^2 beam shape</p>

2.2 Polarization

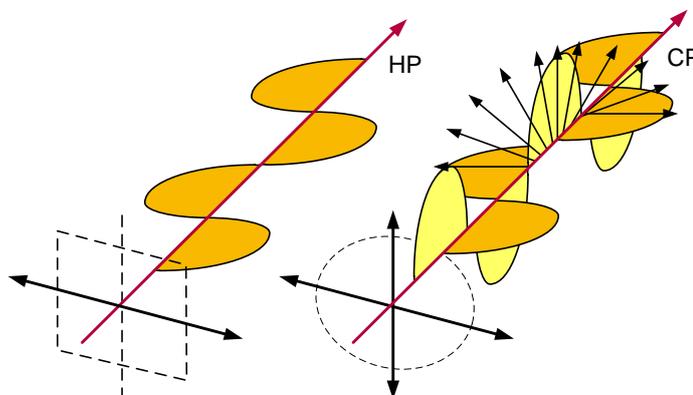


Figure 2.2 Electrical field of horizontally and circularly polarized antennas

Horizontally Polarized (HP) antennas have their electrical field parallel to the Earth's surface, and the magnetic field perpendicular to the Earth's surface. HP antennas are efficient for detection of very small targets, but have higher backscatter from rain than Circularly Polarized (CP) antennas. However, influence from rain can often be accepted in systems aimed for detection of small targets.

Circularly polarized (CP) antennas have both fields rotating in a corkscrew pattern, making one complete revolution during each wavelength. CP antennas provide low susceptibility to rain: as the shape of individual raindrops approach perfect spheres, the backscatter from the rain drops will rotate with opposite sense, thus suppressing rain. Typically, CP antennas reduce rain backscatter with 10-20 dB compared to HP antennas. However, target returns are typically 3-5 dB lower compared to HP antennas. Small non-metallic targets may be suppressed completely. CP antennas are typically preferred for SMR applications.

2.3 Frequency and time diversity

If a linear array antenna is connected to a transceiver, which transmits several different frequencies, these frequencies are transmitted in different angles. This can be utilized for Frequency Diversity (FD) functionality.

Together with a rotating antenna, this gives Time Diversity (TD), which means that the clutter and the target are hit by different frequencies at different time.

By using this phenomenon and combining and comparing the received signals, better performance is achieved, target fluctuations will be reduced, and clutter will be suppressed, enhancing target relative to clutter and rain. For small targets in rough clutter environment, this enhancement is typically 6 dB.

3 Performance

3.1 Coverage

Coverage calculations are depending on the actual scenario, such as transceiver specification, the installation, the propagation and the target, etc. The coverage diagram in this section shows the relative difference of the 3 various antenna beam shapes, not a specific scenario.

Multipath effects, sea and land clutter are disregarded. *Multipath* ~ the beam of the antenna reflects at the land or sea surface with interference and phase shifting of the signal.

Inverse Cosec² beam shape - is often used in Surface Movement Radar (SMR) applications with near range coverage of ground targets if close proximity is desired.

Fan beam shape - is often used in VTS and CS applications for longer range use.

Cosec² beam shape – is recommended in all applications where airborne targets are of interest. Additional gain on the Cosec² beam shape at shorter ranges will enhance detection and tracking of airborne targets in the surface clutter range.

Note: The following diagrams are for illustration purposes only, and shows coverage as a function of range of the 3 different beam shapes. The vertical and horizontal scales are not identical formatted.

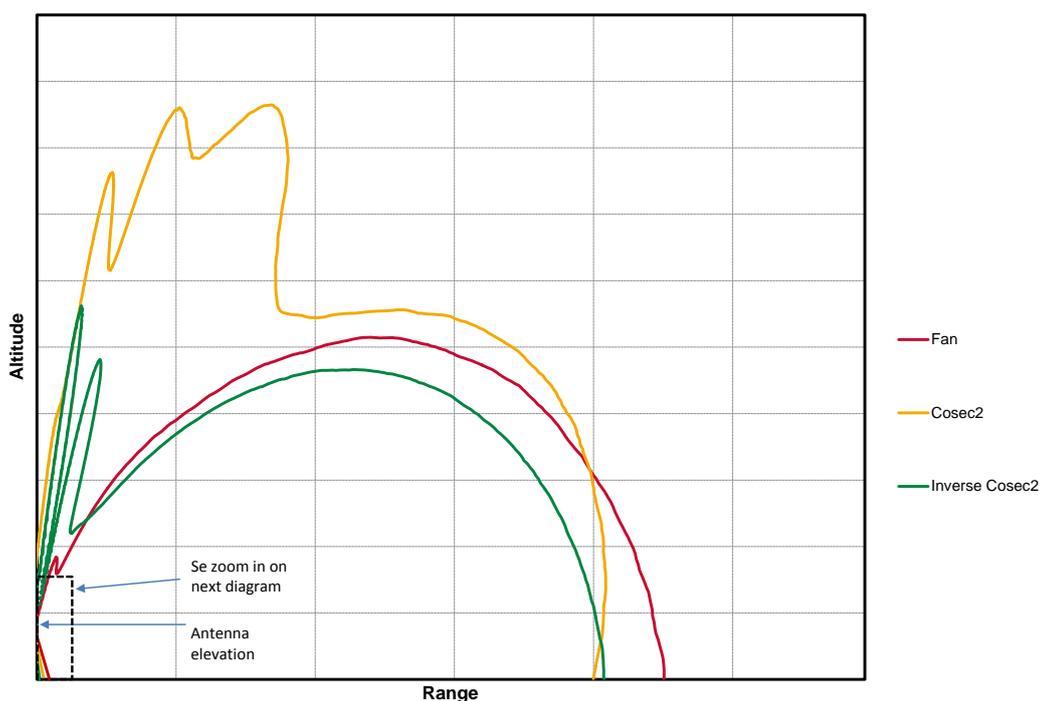


Figure 3.1 Long-range coverage diagram

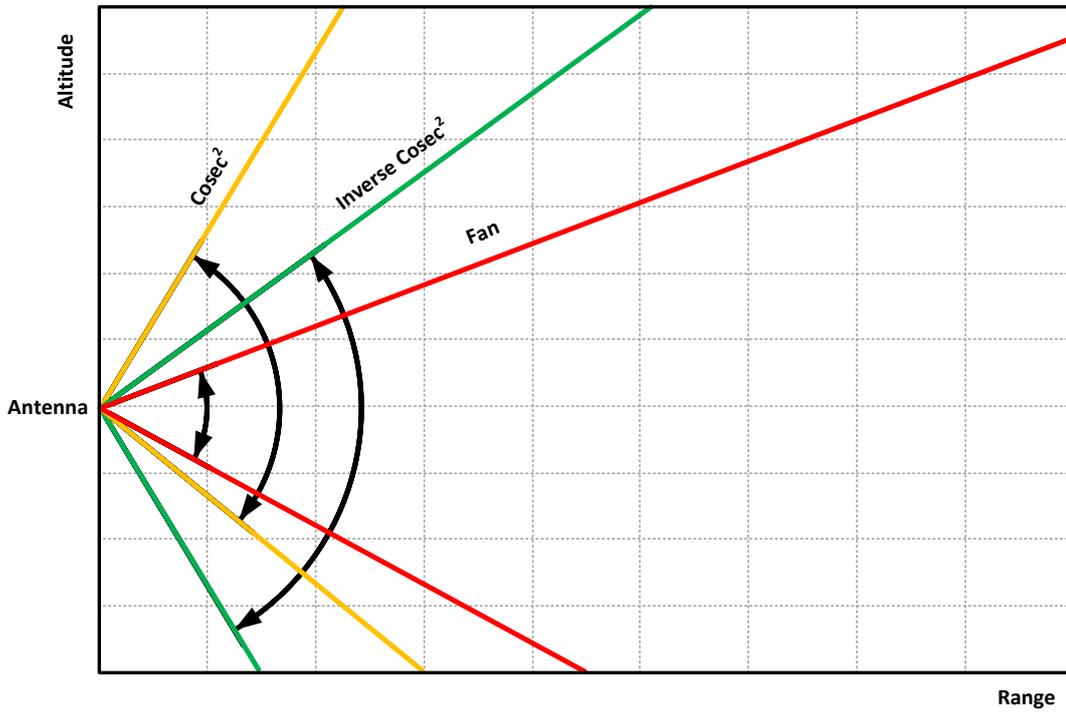


Figure 3.2 Close-range coverage diagram

3.2 Minimum detection range

The antenna beam shape and the antenna height above the surface determine the Minimum Detection Range (MDR) of a target.

Example: a Fan beam shaped antenna 100 m above the surface has a MDR of ~ 400 m.

However, the length of the waveguide between antenna and transceiver must be taken into account. For example if an installation has a 25 m waveguide, then the first $2 \times 25 \text{ m} = 50 \text{ m}$ from the radar center is a blind zone.

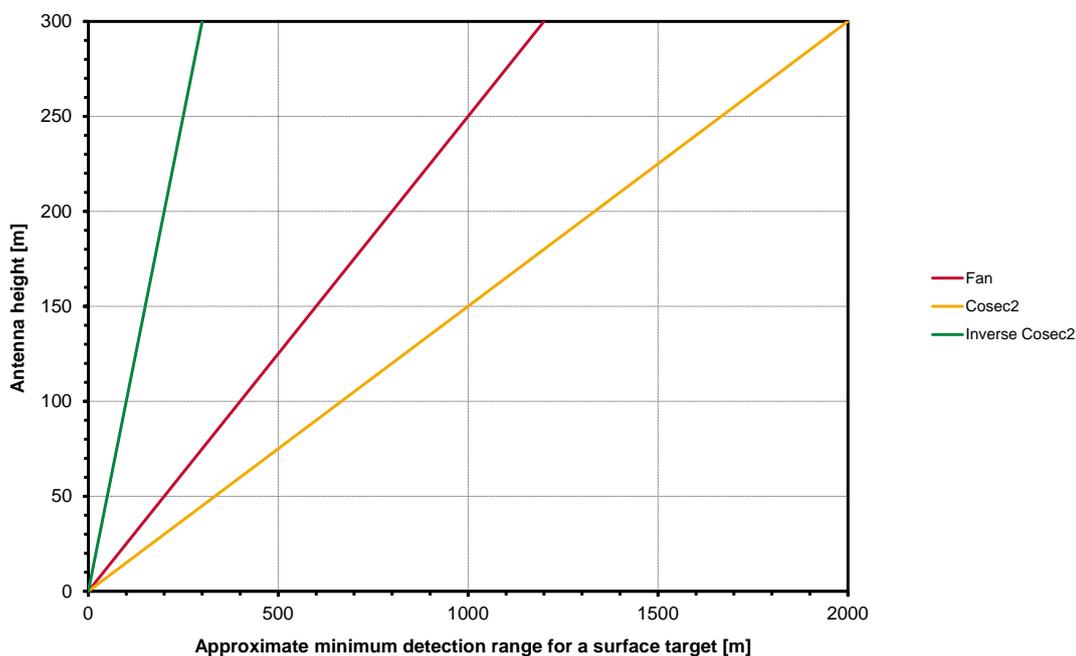


Figure 3.3 Minimum detection range

4 Product characteristics

4.1 Physical appearance

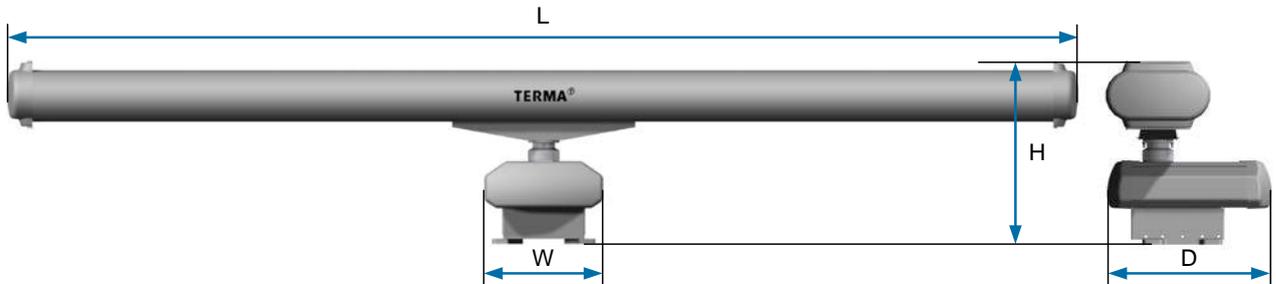


Figure 4.1 Mechanical dimensions

Table 4.1 Mechanical specifications

Mechanical construction	
Color	Silver grey RAL 7001 / White RAL 9010 (opt.) / Orange RAL 2009 (opt.)
Weight	Approx 400 kg
H x L x W x D (Height x Length x Width x Depth)	1110 x 6560 x 712 x 1000 mm
Swing radius	3300 mm
Packed for transport	
Weight incl. wooden crate	Approx 850 kg
H x L x D (Height x Length x Depth)	Approx 1560 x 6820 x 880 mm



Figure 4.2 Wooden transport crate

4.2 Color scheme

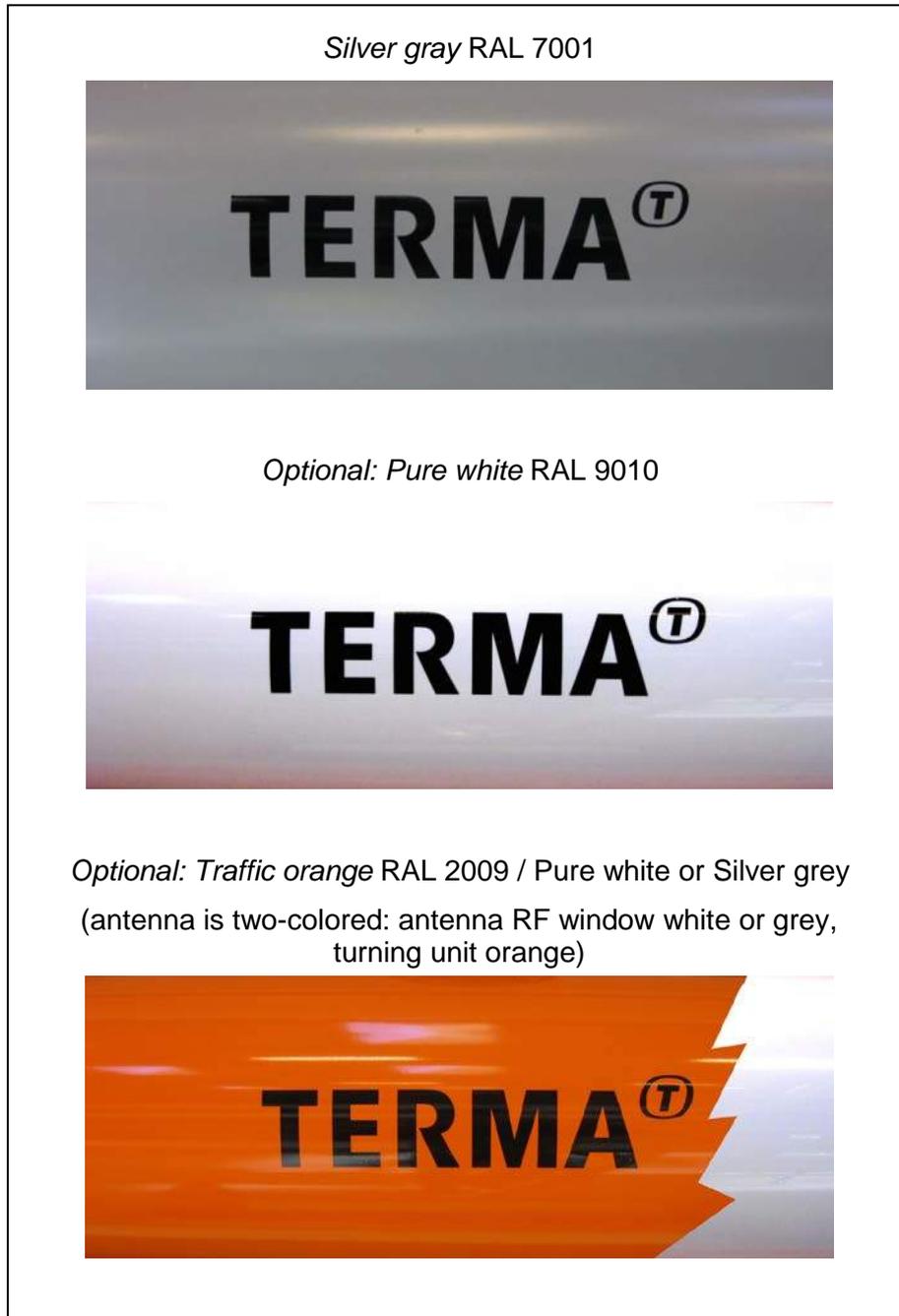


Figure 4.3 Color scheme

4.3 Main assemblies

The *Antenna system* consists of two main assemblies:

- The *Antenna* radiating the RF-power and subsequently receiving radar echoes.
- The *Turning unit* including: gearbox, asynchronous motor, terminal box, waveguide rotary joint and azimuth encoder(s).

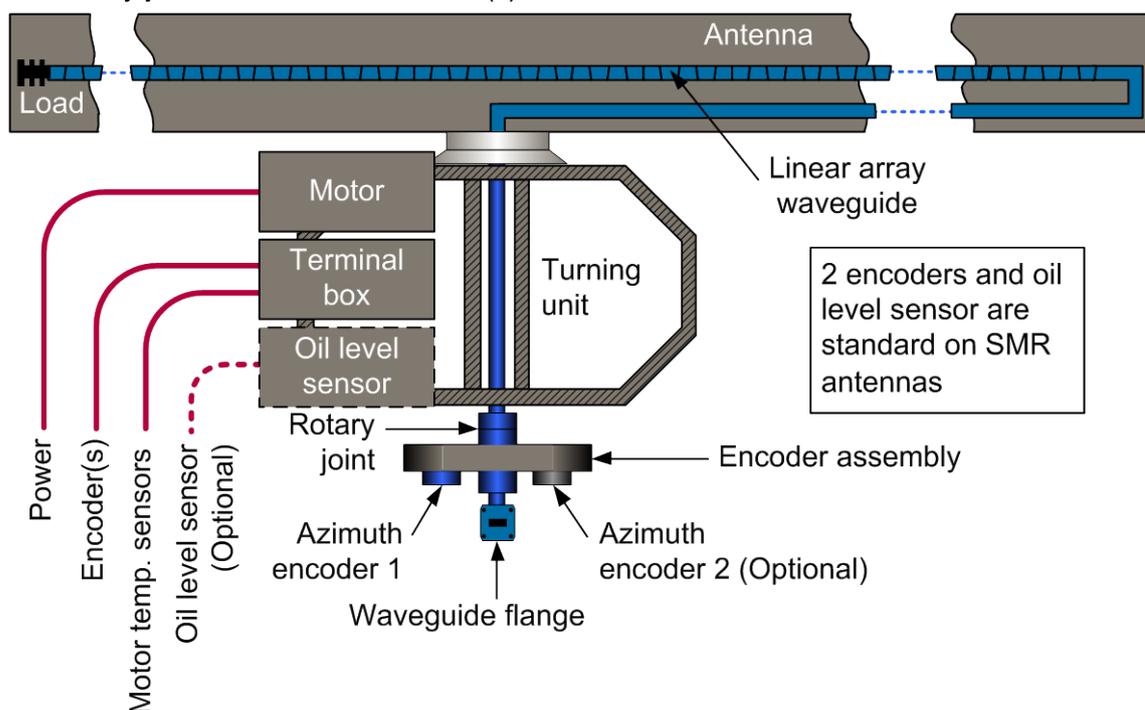


Figure 4.4 Antenna system schematic

4.4 Antenna

The *Antenna* consists of a linear array waveguide with inclined narrow wall slots, mounted in a flared horn, and a low loss RF-transparent radome.

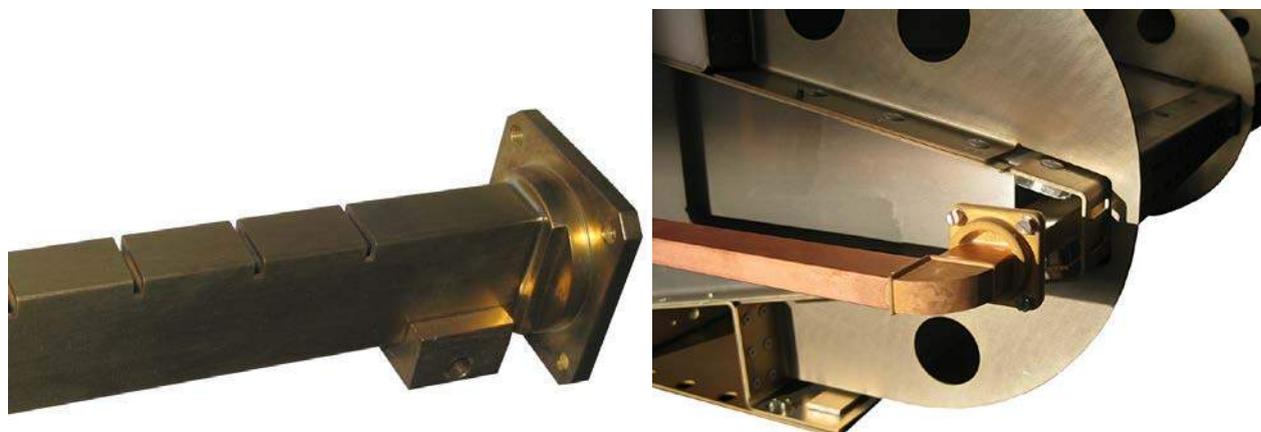


Figure 4.5 Linear array waveguide and mechanics without radome

4.5 Turning Unit

The *Turning unit* includes the asynchronous motor, the gearbox, the encoder assembly and the terminal box. The encoder assembly consists of a rotary joint and up to two azimuth encoders (2nd redundant encoder is optional). Two encoders are standard on SMR antennas.



Figure 4.6 Turning unit

5 Interfaces

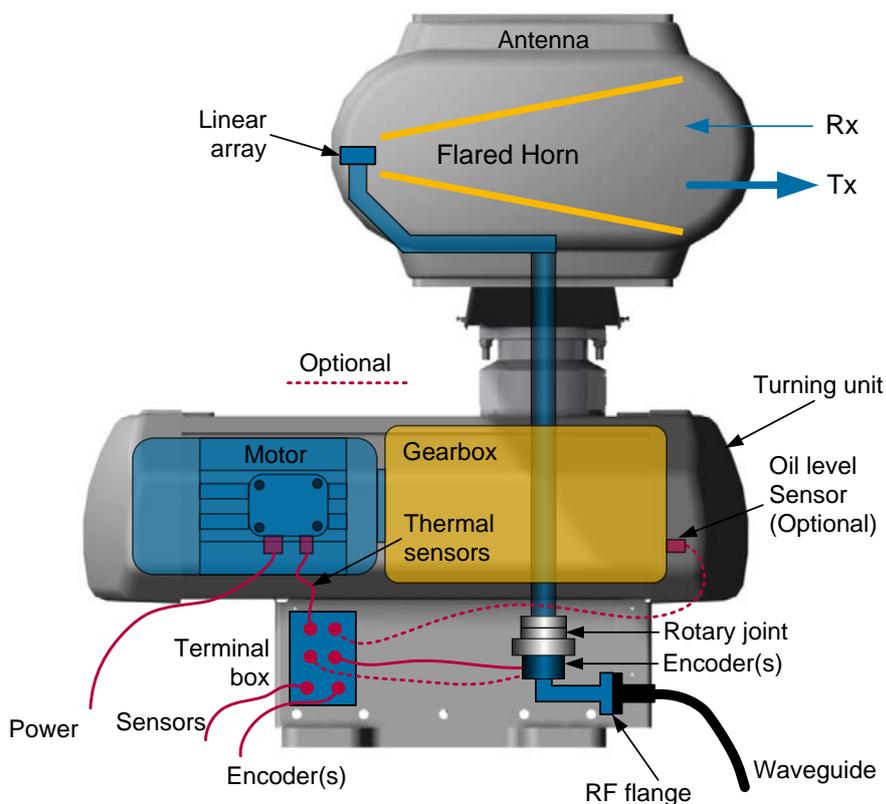


Figure 5.1 Schematic Interfaces

5.1 RF interface

The RF interface used is an UBR 100 RF flange, according to IEC154 for R100 Waveguide. According to EIA standard (USA) for WR90 Waveguide, the RF flange Cover Square UG39/U is used.

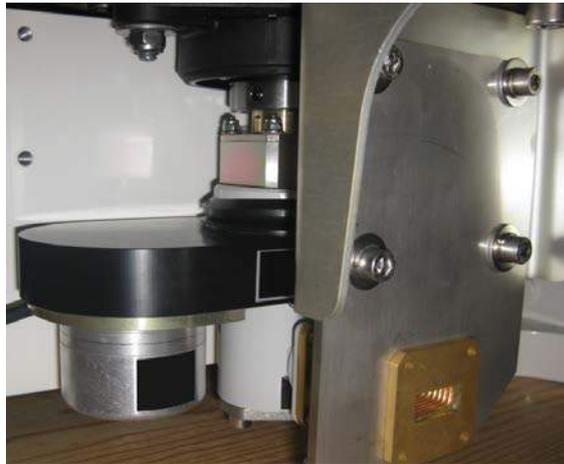


Figure 5.2 Encoder, rotary joint and RF flange

5.2 Electrical interfaces

All low voltage signals are connected through the terminal box located inside the Turning Unit.

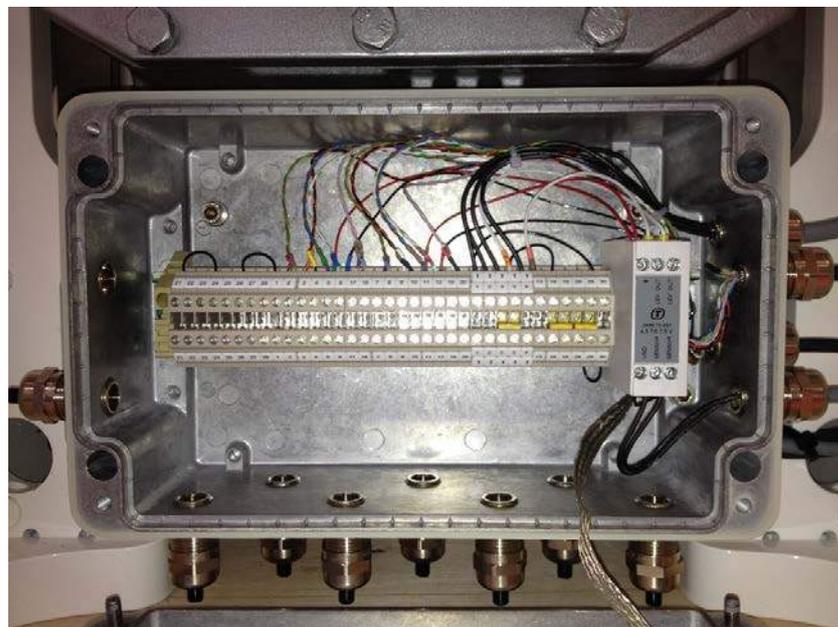


Figure 5.3 Open terminal box - ready for installation (example)

The power supply for the motor is connected directly. The motor has two integrated thermal switches, which monitor the motor temperature and when activated, reports either a warning or a shutdown.



6 Specifications

T 8-1.2, # T 8-1.3, # T 8-1.4, # T 8-1.5, # T 8-1.7, # T 8-1.8,
T 8-1.9, # T 8-1.10, # T 8-1.11, # T 8-1.12, # T 8-1.14,
T 8-1.15, # T 8-1.16, # T 8-1.22, # T 8-1.23

6.1 Main

Table 6-1: Main specifications

		Electrical					
Type	Linear array						
Operating frequency band	X-band 9.14 - 9.50 GHz (Optional low freq. 9.0 - 9.2 GHz)						
Gain at antenna flange		HP-F	HP-C	HP-I	CP-F	CP-C	CP-I
		≥ 38 dBi	≥ 37 dBi	≥ 37 dBi	≥ 38 dBi	≥ 37 dBi	≥ 37 dBi
-3 dB horizontal beam width (Azimuth)	≤ 0.36 °						
-3 dB vertical beam width (Elevation)	≤ 11 °						
Integrated Cancellation Ratio (ICR)	≥ 15 dB (only for CP antennas)						
Voltage Standing Wave Ratio (VSWR)	≤ 1.2:1 (-20.8 dB) at antenna flange						
Squint angle	~ 1 ° per 100 MHz frequency difference						
Fixed beam peak angle (Tilt)	Fan	- 1.5 °					
	Cosec ²	0.6 °					
	Inverse Cosec ²	-0.6 °					
Azimuth sidelobe levels (Symmetrical)	1.5 - 5.0 ° ≤ - 28 dB / 5 - 10° ≤ - 30 dB / ≥ 10° ≤ - 35 dB						
RF power handling - Peak / average	≤ 50 kW / ≤ 75 W (Optional high power variant with average ≤ 600 W)						
Motor supply	3 phases via frequency inverter						
RF waveguide interface	UBR100 flange for R100 / WG16 / WR90 waveguide						
Turning unit loss	≤ 0.3 dB						
Motor temperature sensor contacts	120° warning and 150° shutdown - normally closed						
Optional oil level sensor	Low oil level war. contact - normally closed						

Turning unit, 2.2 kW nominal motor power

Variants	HP-F-38	HP-C-37	HP-I-37	CP-F-38	CP-C-37	CP-I-37
Rotation speed range	10-40 RPM					
Maximum wind speed * Note	≤ 20 RPM	≤ 51 m/s ~ 100 knots				
	≤ 30 RPM	≤ 40 m/s ~ 78 knots				
	≤ 40 RPM	≤ 35 m/s ~ 68 knots				
Survival wind speed	≤ 75 m/s - motor power off and free rotating					

Turning unit, 4.0 kW nominal motor power

Variants	HP-F-38	CP-F-38	CP-C-37	CP-I-37
Rotation speed range	10-60 RPM			
Maximum wind speed * Note	≤ 20 RPM	≤ 55 m/s ~ 107 knots		
	≤ 40 RPM	≤ 55 m/s ~ 107 knots		
	≤ 60 RPM	≤ 41 m/s ~ 80 knots		
Survival wind speed	≤ 75 m/s - motor power off and free rotating			

Azimuth encoder

Azimuth count pulses	8K ~ 8192 (redundant encoders as option)
Supply voltage	5 VDC ± 10% (Optional variant with 15 VDC supply)
Current	< 100 mA
Azimuth Count Pulse output (ACP)	2 x 90° phased shifted EIA-422 square waves
Azimuth Reference Pulse output (ARP)	1 x EIA-422 square wave pulse and its inverted

* Note: Motor **must** be stopped when winds speed exceeds limits.

6.2 Radiation patterns

All graphs are measured examples

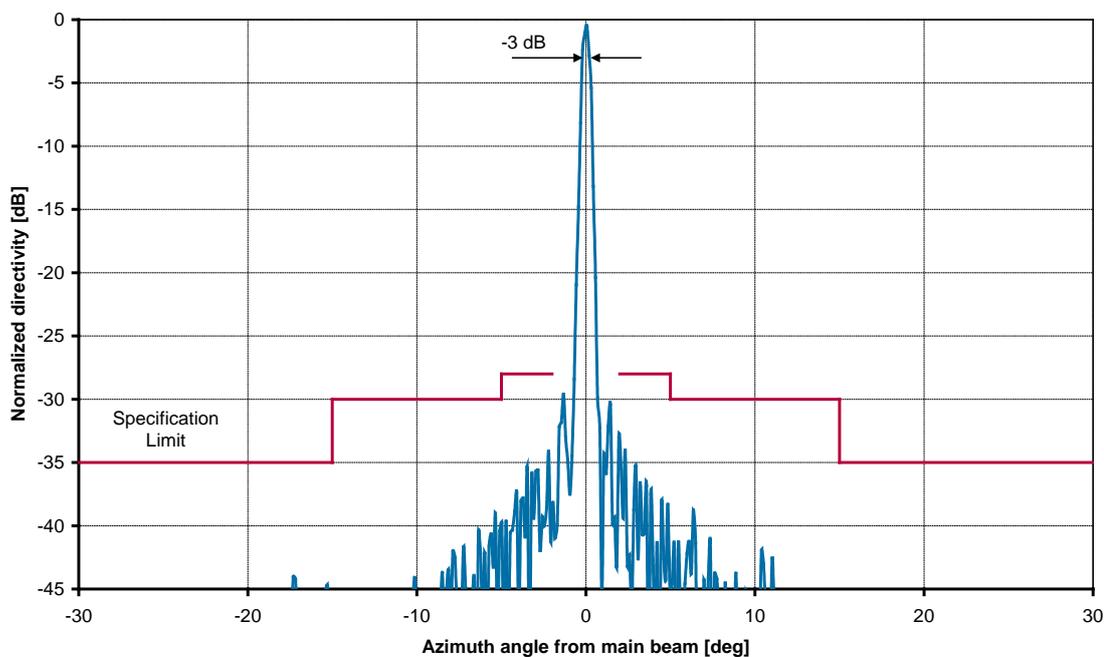


Figure 0.1 Horizontal radiation pattern with sidelobe specification limits for all models

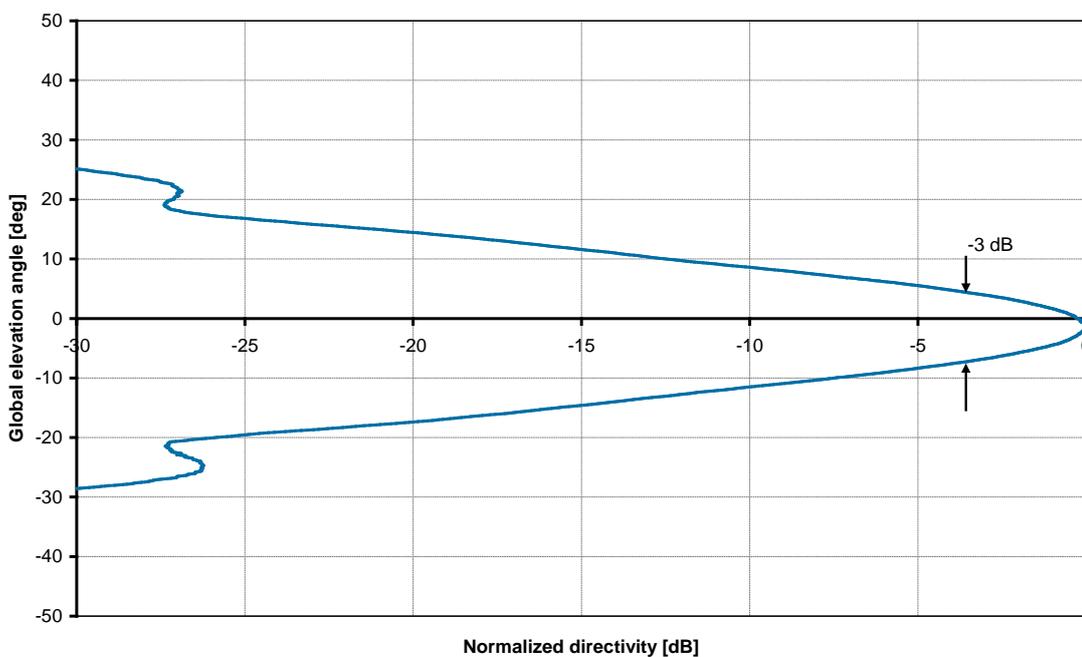


Figure 0.2 Fan beam shape - vertical radiation pattern

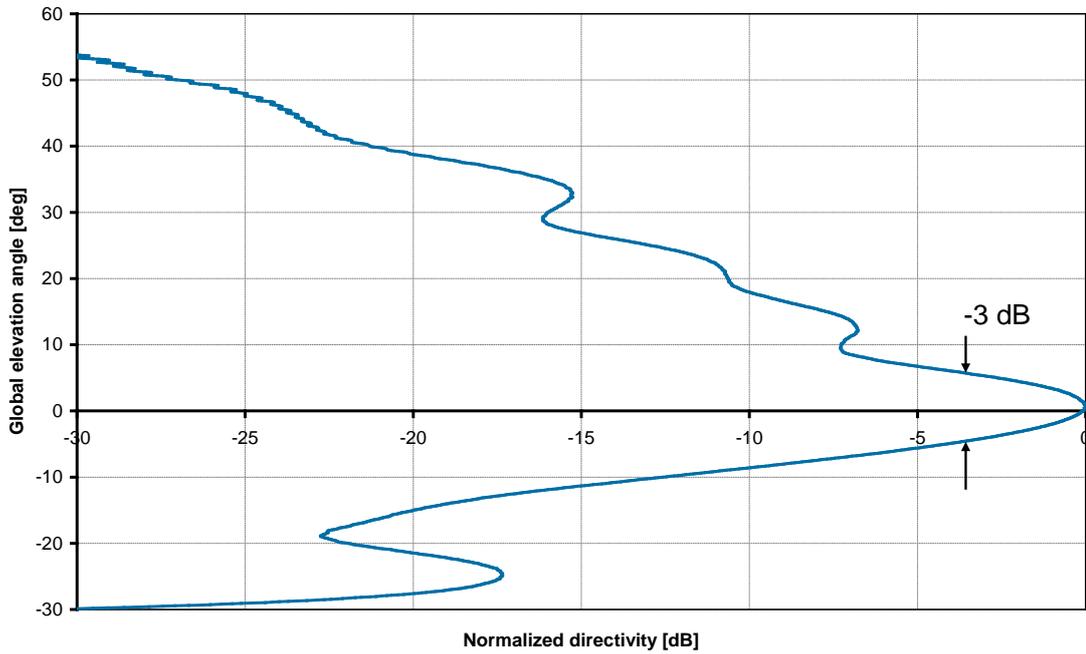


Figure 0.3 Cossec² beam shape - vertical radiation pattern

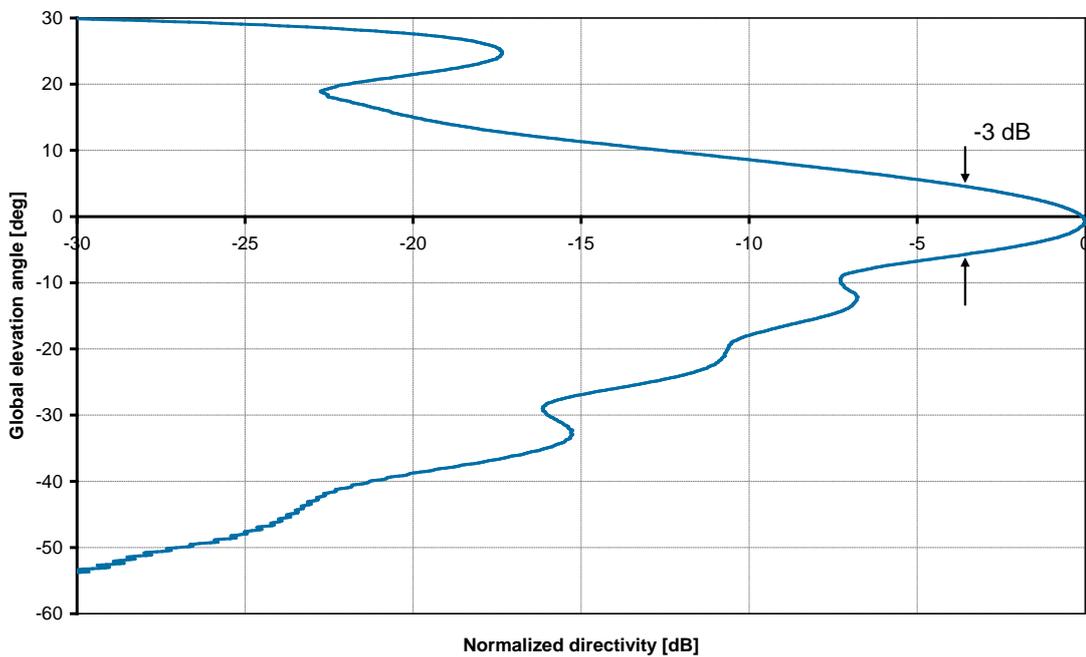


Figure 0.4 Inverse Cossec² beam shape - vertical radiation pattern

6.3 Wind load and tower forces

The antenna system is designed to withstand the horizontal wind loads specified in section 6.1.

The turning unit is matched to the aero dynamical behavior of the antenna and the antenna rotational speed.

It is recommended to situate the antenna in a free wind field to reduce turbulence and avoid irregular wind loads such as asymmetrical winds caused by buildings or terrain. Further wind scenarios should be taken into account:

- Gust factor and gradient wind effect
- Wind speed statistics (modal, median and average speed)
- Hot and cold air and density of air effect
- The Venturi effect in hilly surroundings
- Turbulence effect when the wind is interrupted
- Asymmetrical or irregular wind loads on installations on slopes and structures
- Special meteorological wind phenomena's such as the Bora, Sirocco, Mistral, etc.

For further guidance on wind considerations and recommendations for installation, refer to doc. no. 804487-DN.

6.4 Environmental specifications

T 8-1.20

Table 0-1: Environmental specifications

T 8-1.21

Packed for transportation and storage environment requirements

Temperature	-40 °C to 70 °C	IEC 60068-2-1/-2-2
Humidity	80 %RH to 96 %RH @ -10 °C to +60 °C	IEC 60068-2-38
IP protection class	IP 54 (Dust and watersplash)	IEC 60529
Bumps	10 g, 16 ms, 1000 bumps	IEC 60068-2-27
Shock	16 g, 6 ms, 3 shocks	IEC 60068-2-27

Operational environment requirements

Temperature	-40 °C to 55 °C *	IEC 60068-2-2, Bb
Humidity	80 %RH to 96 %RH @ -10 °C to +65 °C	IEC 60068-2-38
Corrosion category	C4 (High atmospheric-corrosivity)	EN/ISO 12944
IP protection class	IP 54 (dust and watersplash)	IEC 60529
Salt mist	Severity (1) - Salt 5% by weight	IEC 60068-2-52
Solar radiation	≤ 1120 W/m ²	IEC 60068-2-9
Hail	≤ 10 mm hail @ 18 m/s wind	-
Ice load	≤ 20 kg/m ²	-
Max wind speeds	See table 6.1 for operational and survival wind speeds	
Design life	15 years	-

Operational emissions

Turning unit acoustic noise	Lower than typical natural background noise
Radiation safety distance	10 m (horizontal plane)
	1 m (vertical plane)

*) Cold startup: Down to - 25 °C

The upper operational temperature limit of 55 °C refers to the ambient air temperature, the effective temperature including solar heating may be higher.

7 System considerations

7.1 Supporting structures

The tower requirements depend on the desired accuracy of the radar performance.

The load/forces from the antenna system can be found in doc. no. 259460-ZD.

Bending

Bending of the tower is normally insignificant to affect radar performance.

Azimuth torsion

In the azimuth direction, torsion will result in azimuth errors.

The azimuth error is calculated as follows:

$$\text{Azimuth error [m]} = \frac{2\pi}{360} R\phi$$

Where R is the target distance in meters, and ϕ is the torsion angle in degrees.

Example: With a torsion angle of 0.2° , a target at a distance of 40 km gives an azimuth error of 140 m.

As a rule of thumb, the torsion must be below $\frac{1}{4}$ of the horizontal antenna beam width, in normal operational weather conditions. Most trackers will accept this.

Accuracy requirements may call for less tolerance.

Tilting

In stationary radar systems, the tilt of the platform on which the antenna is mounted, should be below 0.5° .

The picture shows a self-supporting conically shaped three-leg steel lattice tubular tower, which is excellent for radar antennas.

The antenna base plate may be mounted on a steel pedestal or directly on the tower construction.



Figure 7.1 Three-legged lattice tower

7.2 Lightning protection and grounding

The antenna system must be properly protected against lightning. 99% of all damage caused by lightning occurs due to overvoltage induced in the power supply and distributed to other parts of the system. To accommodate this problem, it is recommended to add surge arrestors to power supplies and galvanic connections penetrating the equipment cabins. The optimum solution is that the power supply is the only galvanic connection from the exterior and using fiber optic cables for all signal connections.

Figure 7.2 shows the recommended solution for lightning protection and grounding. If a lightning strikes the radar antenna mast, experience shows that it is extremely difficult to secure the high-energy power flow. If the lightning attractor rod(s) is isolated, it is imperative that the impedance for earth is smaller than for other paths; that is, there may be >100 kV potential at the top of the lightning conductor(s) and 0 V immediately next to it via the signal cables. In this situation, the energy is able to “jump”, causing serious problems.

In summary, the idea is to connect the system as effectively as possible to ensure that all components have the same potential in the event that lightning strikes and a Faraday’s cage must be established around the equipment cabin.

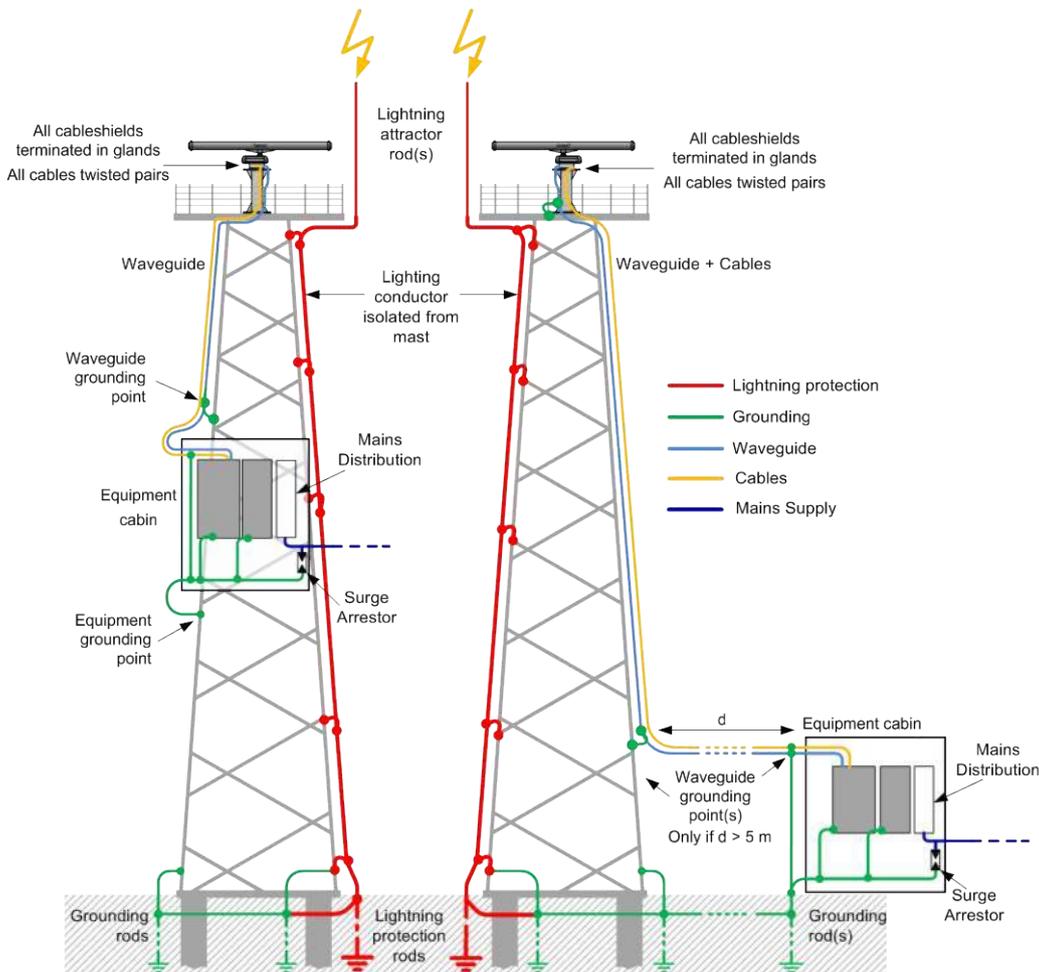


Figure 7.2 Lightning protection and grounding solution

8 Waveguide drying

Waveguide drying or dehydrating pressurizing are recommended in all installations. The actual recommendation depends on climate conditions and waveguide length.

Simple Silica gel based static desiccators are recommended for installations in which day to night temperature variation is low, relative humidity in equipment rooms is never high and waveguides are short (< 20-25 meters).



Figure 8.1 Static desiccator and waveguide pressurizer

Waveguide pressurizing is recommended in all other cases, especially if equipment buildings are occupied regularly or located in tropical areas or other areas with considerable day-night temperature variations.



9 Preventive Maintenance

Preventive maintenance should be performed with fixed intervals.
The procedures and recommended intervals are based on long-term experience.
Refer to doc. no. 255548-HT for maintenance intervals.



Figure 0.1 Turning unit maintenance access

10 Quality assurance certification

AQAP-2110

For more than 25 years, Terma A/S has been certified to the NATO Quality standard AQAP-1, later AQAP-110 and AQAP-150, and since 2006, Terma has been assessed and certified to AQAP-2110 by Bureau Veritas Certification.

ISO 9001

Since 2003, Terma has been assessed and certified to ISO 9001 by Bureau Veritas Certification.



Terma Quality Management System

Terma Quality Management System is an inherent part of the Terma Management System (TMS), which is an on-line process orientated information system on Terma's intranet. TMS is formed as a front-end to the Quality Handbook and other business procedures for each business area giving an easy way to gain relevant information to the individual employee based on the actual job and stage in the process.

Other certifications

Contact Terma A/S for a complete list of various second party approvals and certificates.

4

3

2

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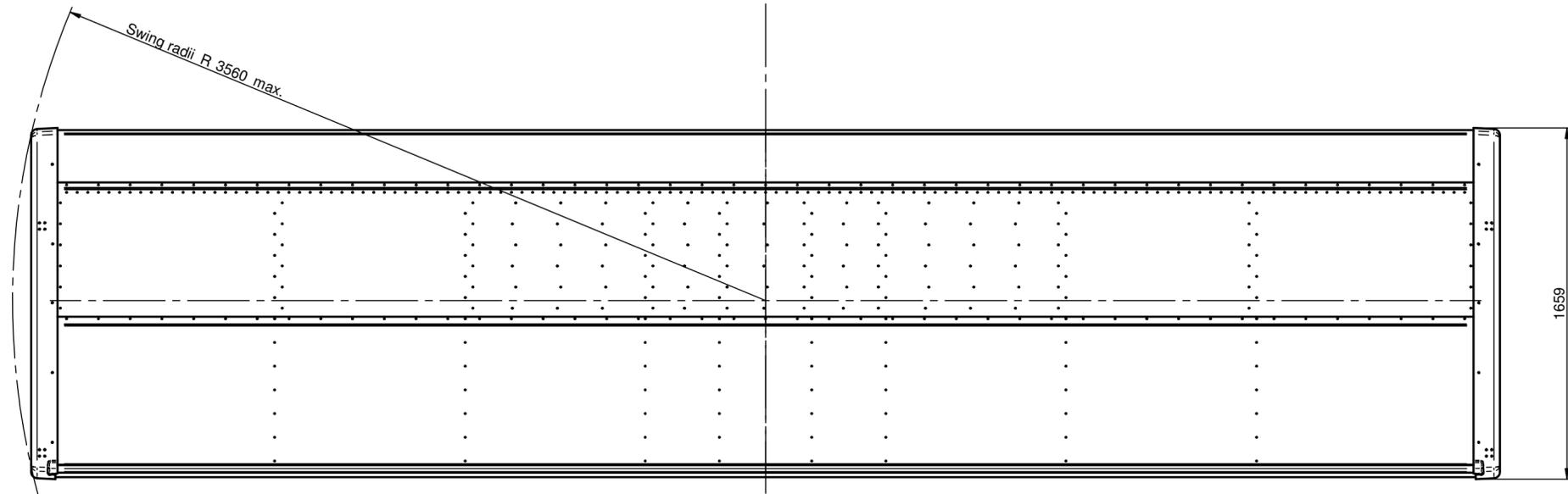
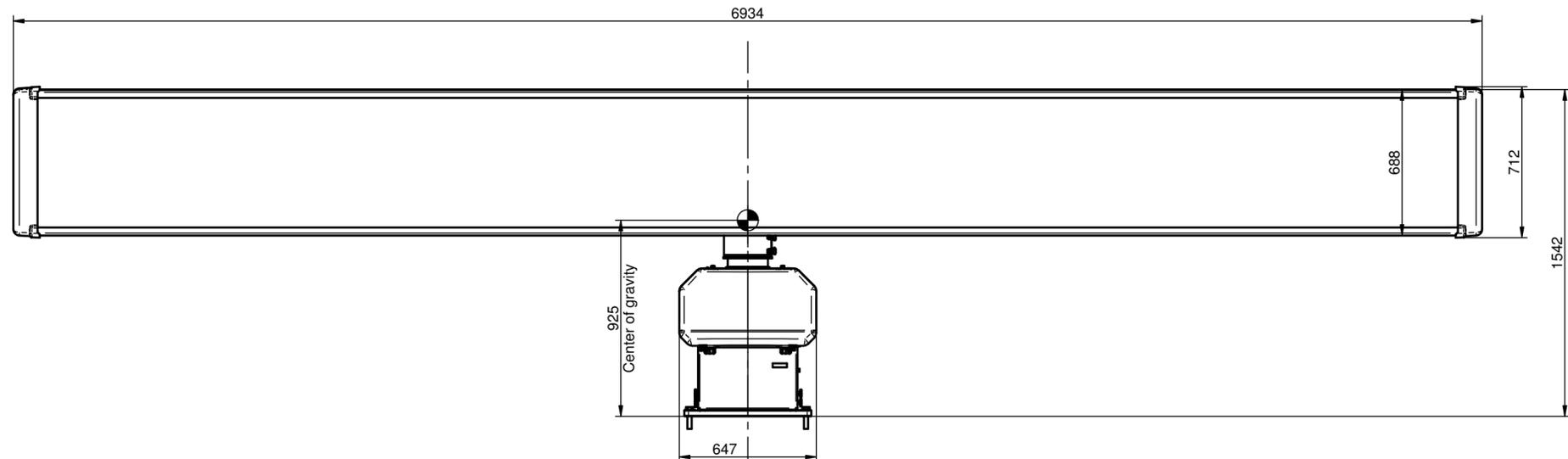
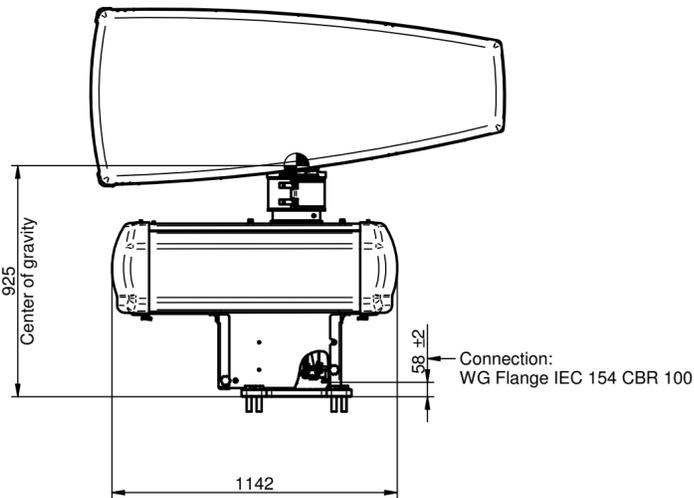
- 1 ⊕ Denotes center of gravity
- 2 All dimensions are typical and in mm
- 3 Lifting method, see page 4

D

C

B

A



LA 21'				
Start torque [Nm]	Min	Max	Frequency [Hz]	Wind [m/s]
Cyclic torque 15 RPM [Nm]	82	1274	0,5	30 m/s
Cyclic torque 10 RPM [Nm]	37	1274	0,33	45 m/s
Cyclic torque 4 RPM [Nm]	6	567	0,133	50 m/s
	Min	Max	Frequency [Hz]	Wind [m/s]
Lateral force 15 RPM [N]	1386	6368	0,5	30 m/s
Lateral force 10 RPM [N]	3119	14328	0,33	45 m/s
Lateral force 4 RPM [N]	3850	17689	0,133	50 m/s
Lateral force non operating [N]	7547	34670	-	70 m/s
	Min	Max	Frequency [Hz]	Wind [m/s]
Overturning moment 15 RPM [Nm]	609	7576	0,5	30 m/s
Overturning moment 10 RPM [Nm]	1370	17046	0,33	45 m/s
Overturning moment 4 RPM [Nm]	1691	21045	0,133	50 m/s
Overturning moment non operating [Nm]	3315	41248	-	70 m/s
Motor output power : 4,0 kW				
Rated Current (In) : 9,0 A @ 400V				
Locked Rotor Current (Is) : 42,3 A				
Is/In = 4,7				

Variant Table									
Part no.	Color	Type	Azimuth Output [ACP]	Max Speed RPM	Mains [V]	Weight approx. Kg	Oil Sensor	Encoder Supply	Motor Output Power kW
304262-002	Grey	21' LAHP-F-42	1*8192	15	3x230/400	1000	Optional	± 10%, max. 120mA	4,0
304262-022	Grey	21' LAHP-C-40	1*8192	15	3x230/400	1000	Optional	± 10%, max. 120mA	4,0
304262-031	Grey	21' LACP-F-42	1*8192	15	3x230/400	1000	Optional	± 10%, max. 120mA	4,0

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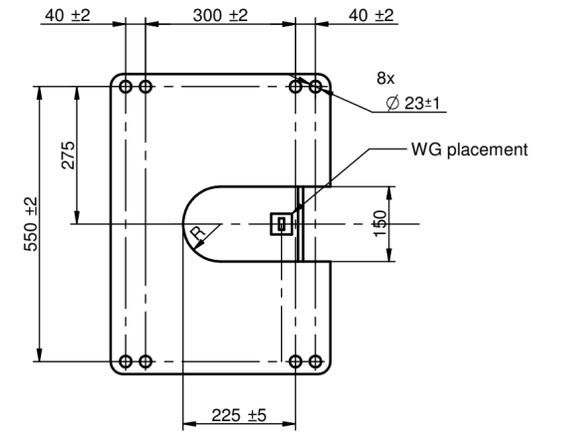
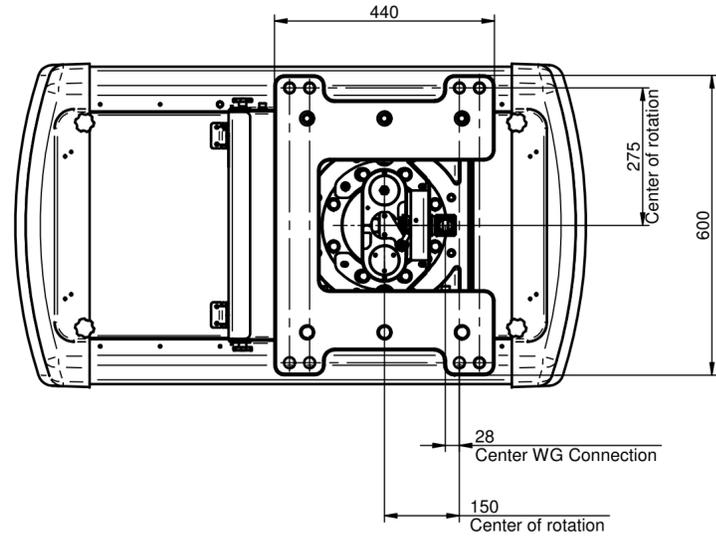
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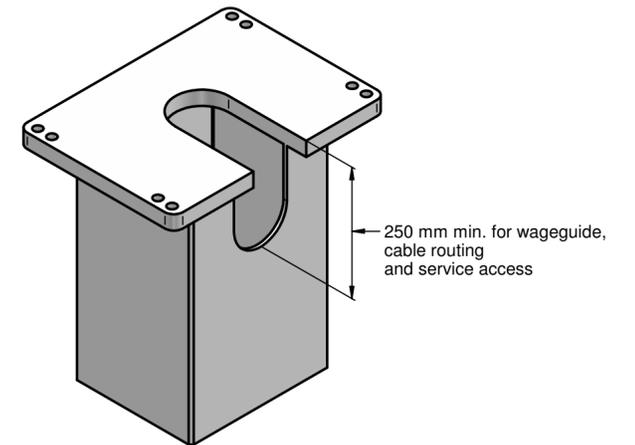
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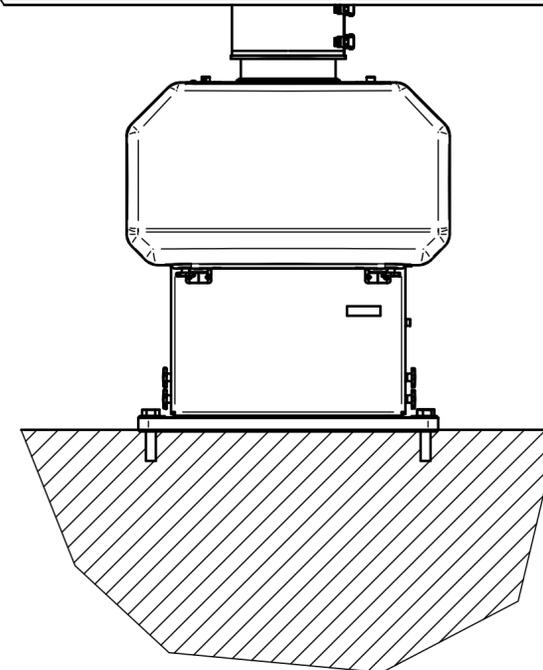
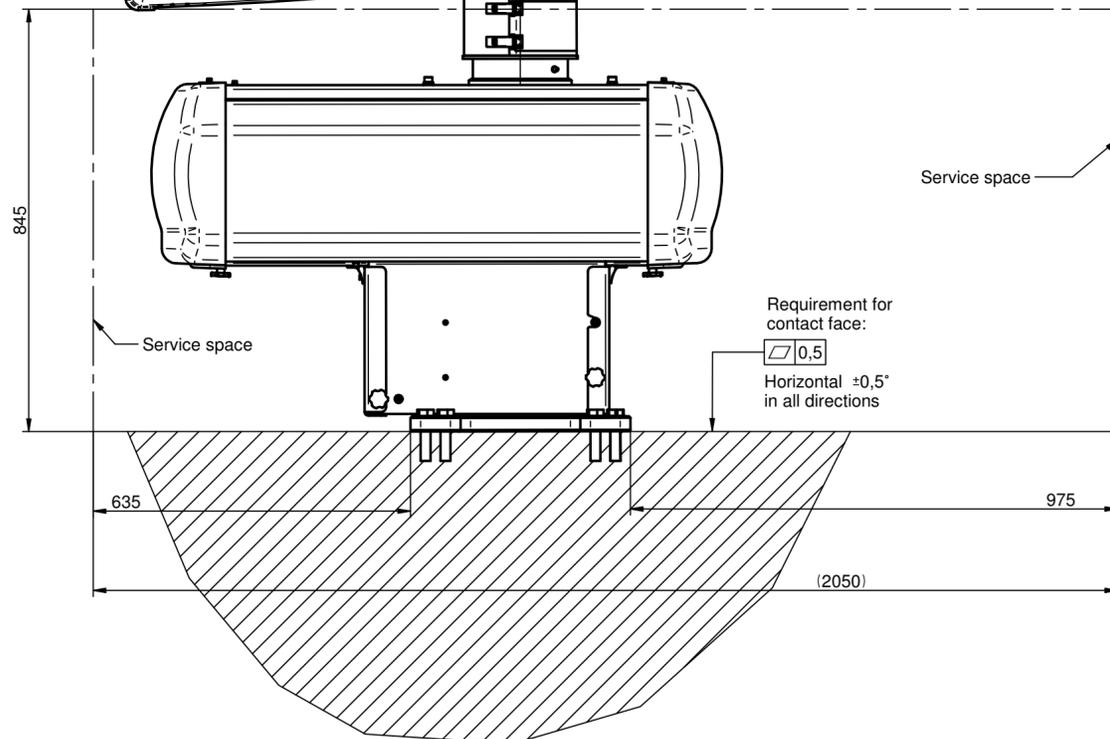
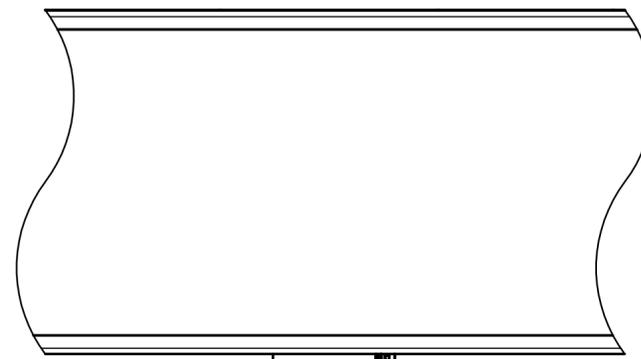
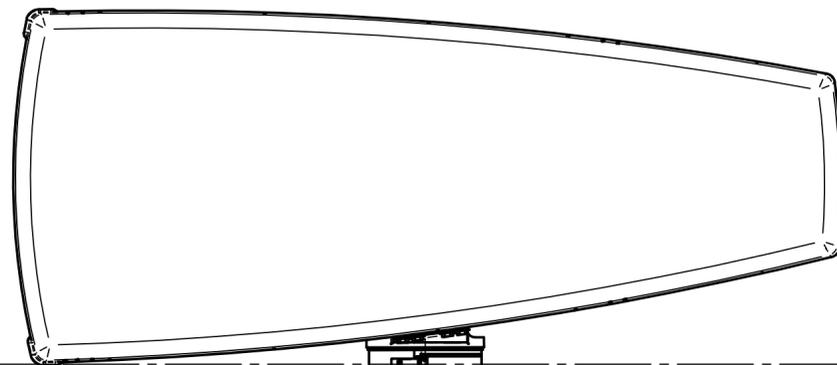
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Required Pedestal interface



Typical installation



For installation use:

- 8 bolts DIN933, M20x90, A4, CL. 70
- 16 washers, flat DIN 125A, A4
- 8 washers, lock DIN 127B, A4
- 8 nut DIN 934, M20, A4

Tightening torque

- Lubricated thread: 225 Nm
- Dry thread: 324 Nm

Mounting interface materials and fasteners shall be, galvanic, compatible with AISI 316 (recommended potential diff. < 0,25V).
 If this is not possible, proper isolation and coating/surface treatment of critical areas must be performed.
 Stainless steel fasteners are acceptable.

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TITLE	DOCUMENT NO.	REV	PAGE
LA Antenna System, 21'	304262-ZD	C	2 OF 4

4

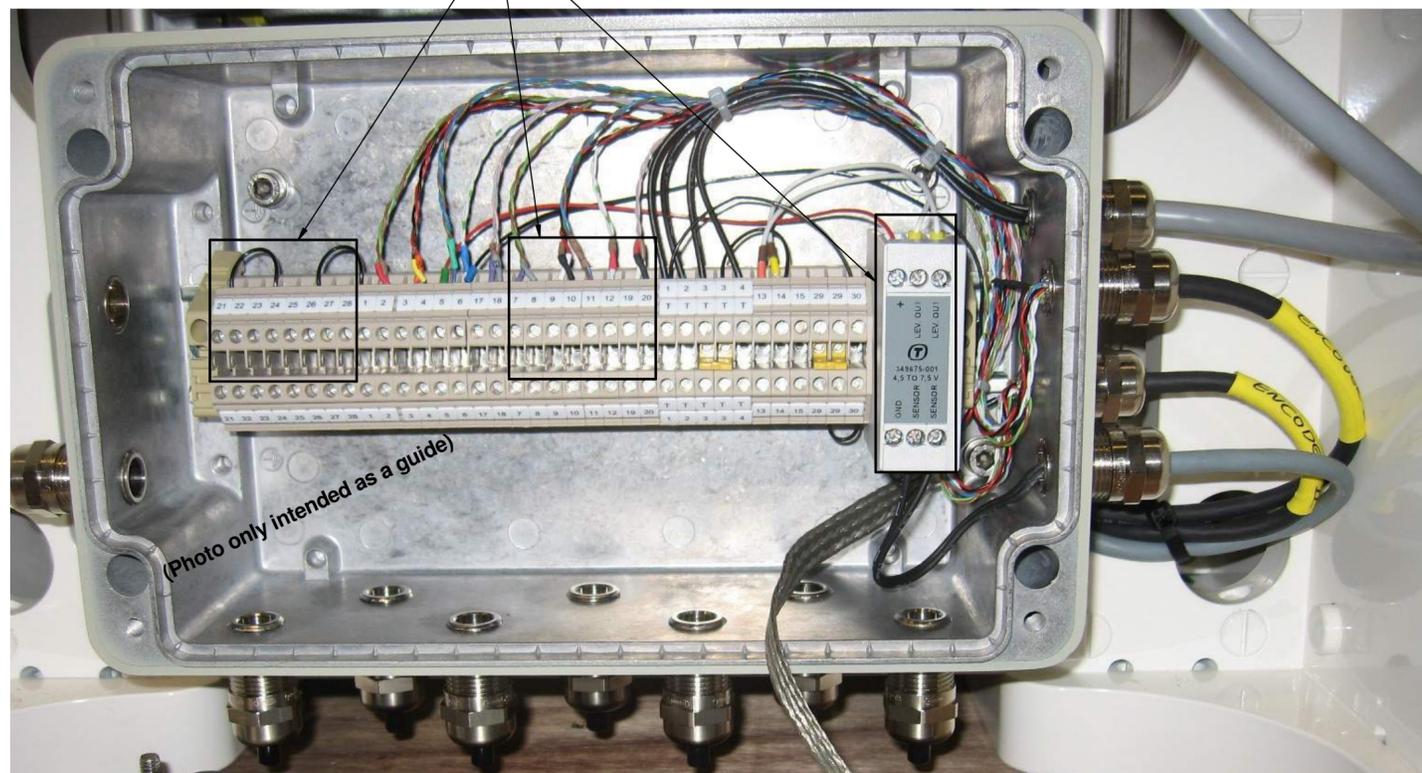
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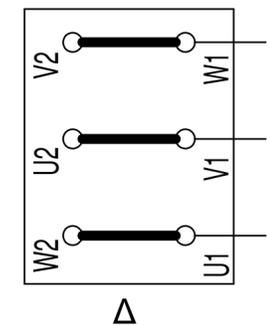
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TB1 ENSURE THAT UNUSED CABLE INLETS ARE CLOSED WITH BLIND PLATES

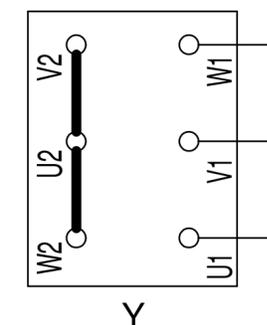
OPTION



TB2 SCHEMATIC



3 x 230V/50Hz



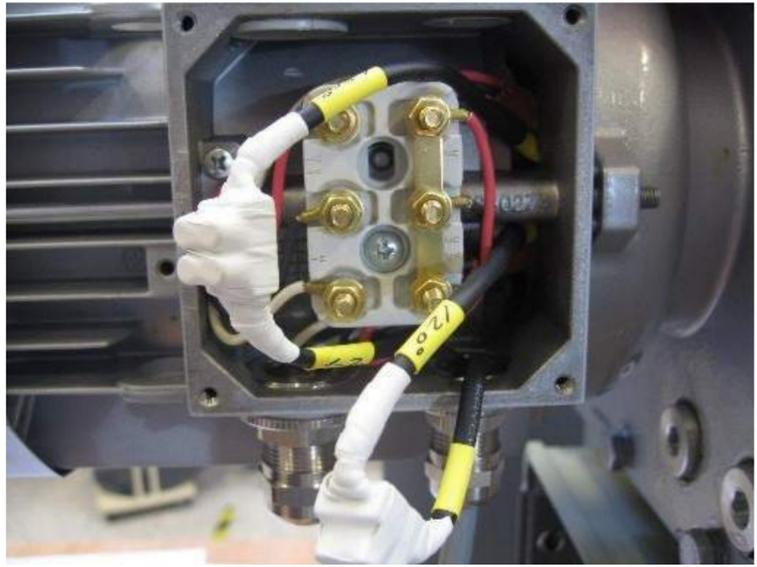
3 x 400V/50Hz

OR

TABLE 3 : TERMINATION

CABLE INLET	FUNCTION	REF DES	TERMINAL	WIRE FUNCTION	SPECIFICATION
M16 x 1,5 E2	Encoder azimuth	TB1	1	ACP2+	BAL 8192 PULSES/REV, RS422, PHASE 2
		TB1	2	ACP2-	
		TB1	3	ARP+	BAL 1 PULS/REV, RS422
		TB1	4	ARP-	
		TB1	5	+5V/+15V	+5V ± 10%, max.120mA, approx. 35mA, 10-30V, max. 100mA, approx. 20mA at 15 V
		TB1	6	GND	
		TB1	17	ACP1+	BAL 8192 PULSES/REV, RS422, PHASE 1
		TB1	18	ACP1-	
M16 x 1,5 E4	2nd Encoder Azimuth (259222-001 OPTION)	TB1	7	ACP2+	BAL 8192 PULSES/REV, RS422, PHASE 2
		TB1	8	ACP2-	
		TB1	9	ARP+	BAL 1 PULS/REV, RS422
		TB1	10	ARP-	
		TB1	11	+5V	+5V ± 10%, max.120mA, approx. 35mA 10-30V, max. 100mA, approx. 20mA at 15 V
		TB1	12	GND	
		TB1	19	ACP1+	BAL 8192 PULSES/REV, RS422, PHASE 1
		TB1	20	ACP1-	
M16 x 1,5 E3		TB1	T1	Normally	MOTOR PROTECTION 155 ± 10°C AUTOMATIC RESET. MAX 2,5A - 250VAC
		TB1	T2	Closed	
		TB1	T3	Normally	MOTOR OVERHEAT ALARM 120 ± 10°C AUTOMATIC RESET. MAX 2,5A - 250VAC
		TB1	T4	Closed	
M20 x 1,5		TB2	U1	MOTOR SUPPLY	PHASE 1
		TB2	V1		PHASE 2
		TB2	W1		PHASE 3
		TB2	GND	SHIELD	
M16 x 1,5 E5	Oil Sensor (304139-001 Option)	TB1	13	Normally closed	Current max.0,5A - 300VAC/DC (breakdown min. 600VDC) Switching Power 50VA
		TB1	T3		

TB2



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Template: DwgA2srf2-K/Ref doc: 200000-AS

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SERVICE

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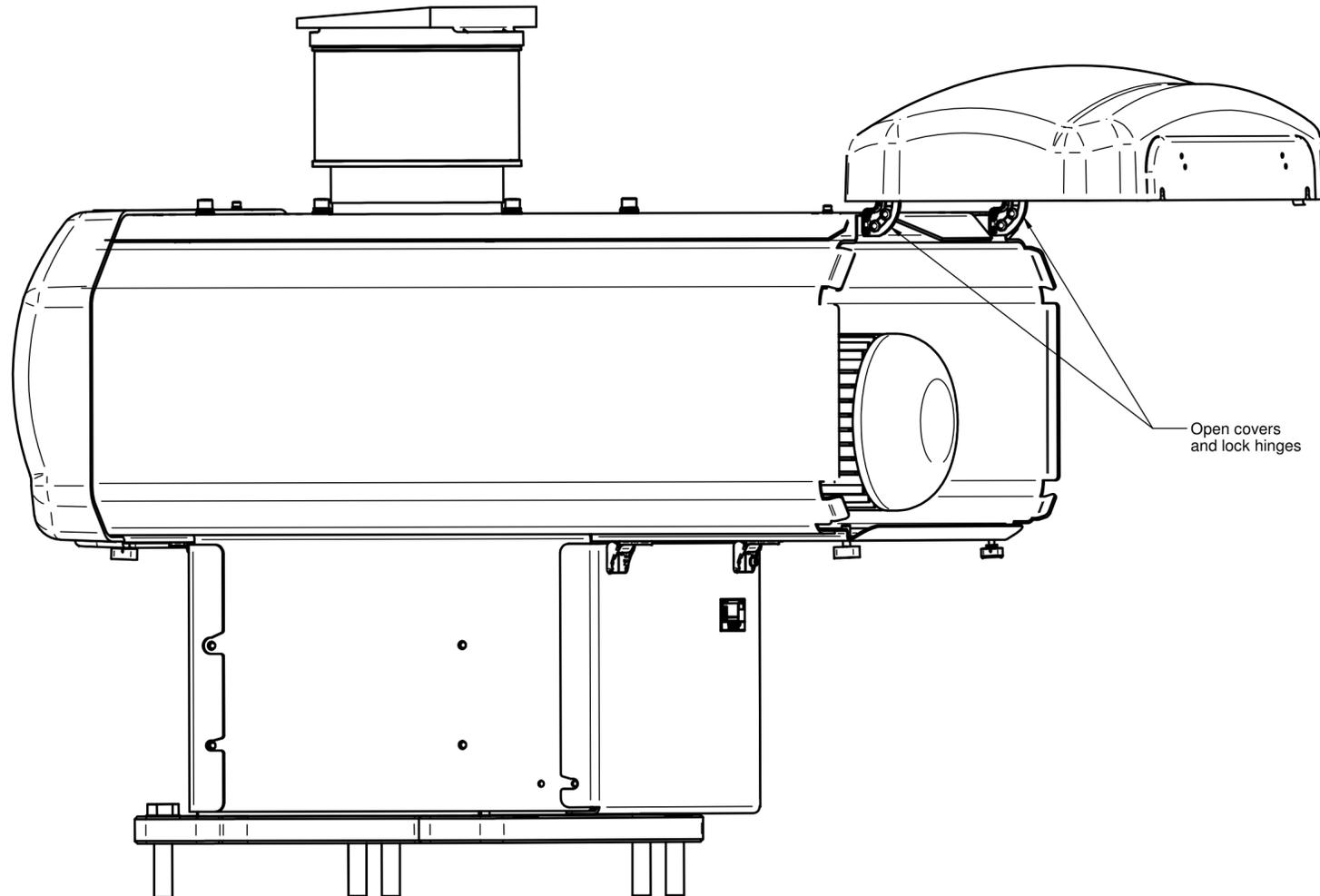
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LIFTING INSTRUCTION	
<ul style="list-style-type: none"> • Use Lifting Yokes TERMA part no.: 306535-001 • Mount Lifting Yokes as shown, and fasten with screws • Minimum sling length: 3,5m • Remove Lifting Yokes after mounting Antenna • Handbook doc. 306535-HC 	<p>306535-001 2 x</p> <p>Fasten with screws 2 x 4 places</p> <p>min. 3,5m</p>

First mount the bracket with the 4 screws, then
the profile can be mounted onto the bracket.
Remember to tighten the screws

After the antenna has been installed remember
remove the brackets

The straps must not touch the antenna surface



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TITLE LA Antenna System, 21'	DOCUMENT NO. 304262-ZD	REV C	PAGE 4 OF 4

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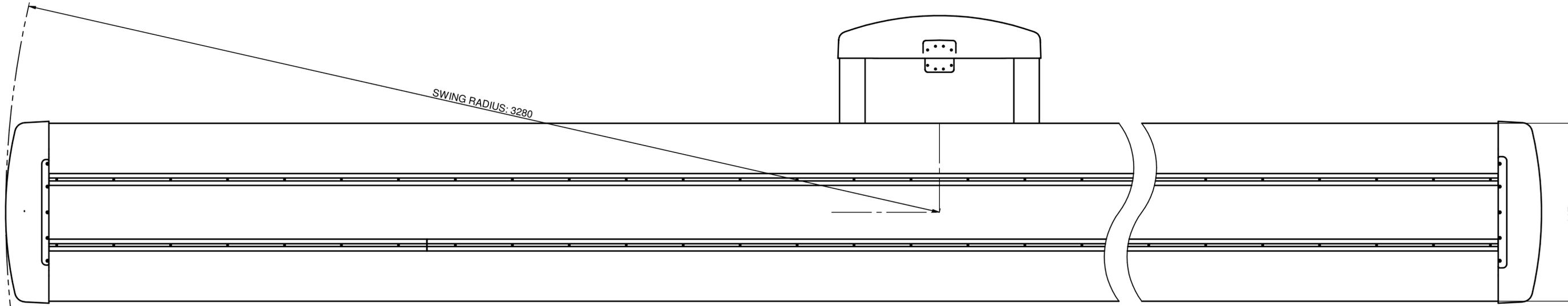
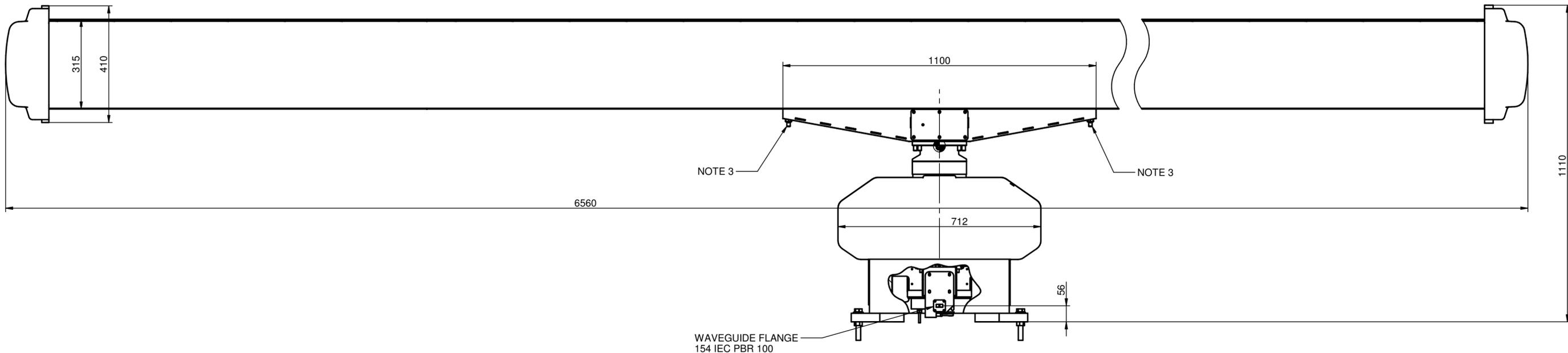
- 1. All dimensions are typical
- 2.  denotes centre of gravity
- 3. Lifting method, see page 5
- 4. Varianttable, see page 2

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A2 FORM 200000 FE Rev H

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MATERIAL	CHANGE ORDER/REVISION					PREP	MSI	CHKD	KHA	Terma A/S Hovmarken 4 DK-8520 Lystrup Denmark		
GENERAL TOLERANCE	REVISION	J	J1	H	H1	H2	APVD	CAK	CM	Cage Code R0567		
PROJECTION	CO NO.	73984	74125	67324	69179	72733	DATE OF INITIAL RELEASE	040526	DATE OF THIS RELEASE	2018-10-05	DOCUMENT NO.	
	APVD	MDN	MDN	JGN	JONP	JONP	TITLE	Antenna System, 21', HG		259460-ZD	REV	
	CM	REVISION STATUS OF PAGES (OTHER THAN)									J1	PAGE
	PAGE NO.										1	OF 7
	REVISION											



TABLE 1

Part No.	Color	Type	Azimuth Output [ACP]	MAX SPEED	MAINS [V]	WEIGHT	Oil Sensor	Encoder Supply	Motor Output Power kW
259460-001	White	HP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-002	Grey	HP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-003	White	HP-F	1 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-011	White	HP-I	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-012	Grey	HP-I	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-013	White	HP-I	1 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-021	White	HP-C	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-022	Grey	HP-C	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-030	White	CP-F	1 * 8192	60	3x230/400	400	Optional	+5V ± 10%, max. 120mA	4.0
259460-031	White	CP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-032	Grey	CP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-040	White	CP-I	1 * 8192	60	3x230/400	400	Optional	+5V ± 10%, max. 120mA	4.0
259460-041	White	CP-I	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-042	Grey	CP-I	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-051	White	CP-C	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-052	Grey	CP-C	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-141	White	CP-I	2 * 8192	40	3x230/400	400	Yes	10-30V, max. 100mA	2.2
259460-142	Grey	CP-I	2 * 8192	40	3x230/400	400	Yes	10-30V, max. 100mA	2.2
259460-431	White	CP-F	2 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-432	Grey	CP-F	2 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-441	White	CP-I	2 * 8196	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-442	Grey	CP-I	2 * 8196	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-443	Orange	CP-I	2 * 8196	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-502	Grey	HP-F, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-512	Grey	HP-I, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-522	Grey	HP-C, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-532	Grey	CP-F, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-542	Grey	CP-I, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-552	Grey	CP-C, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-632	Grey	CP-F	1 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-702	Grey	HP-F	2 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-712	Grey	HP-I	2 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-803	Grey	CP-F	2 * 8192	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-832	Grey	CP-F	2 * 8192	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-842	Grey	CP-I	2 * 8196	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-843	Orange	CP-I	2 * 8196	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-844	Grey	CP-C	2 * 8196	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-931	White	CP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2

TABLE 2							
Loads 21' HG antenna							
Motor	Variant	Load	Reference	Condition	Unit	Value	Frequency (Hz) of load (between 20 to 60 RPM)
2.2kW and 4.0 kW	21'HG	Starting torque	Axis of rotation	Max	Nm	1930	-
		Cyclic torque	Axis of rotation	Max, operational	Nm	1645	0.66 to 2
		Cyclic horizontal force	Bottom surface of pedestal	Max, operational	N	4890	0.66 to 2
		Cyclic vertical force	Bottom surface of pedestal	Max / min operational	N	+9867 / -15363	0.66 to 2
		Cyclic overturning moment	Bottom surface of pedestal	Max, operational	Nm	5390	0.66 to 2
		Horizontal force	Bottom surface of pedestal	Survival, Free rotating	N	14130	-
		Overturning moment	Bottom surface of pedestal	Survival, Free rotating	Nm	10865	-
		Vertical force	Bottom surface of pedestal	Max +/-	N	+20846 / -23320	-

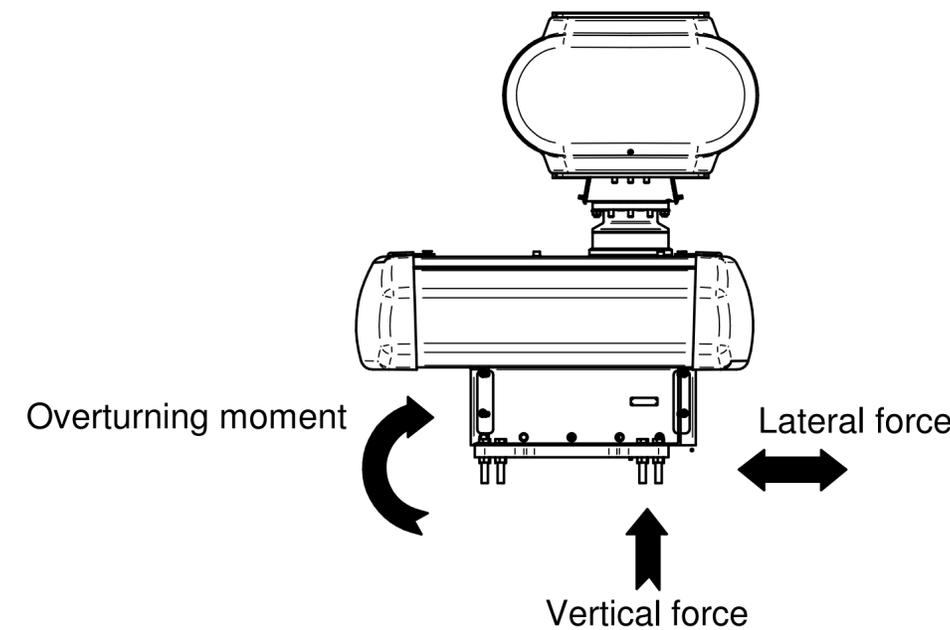
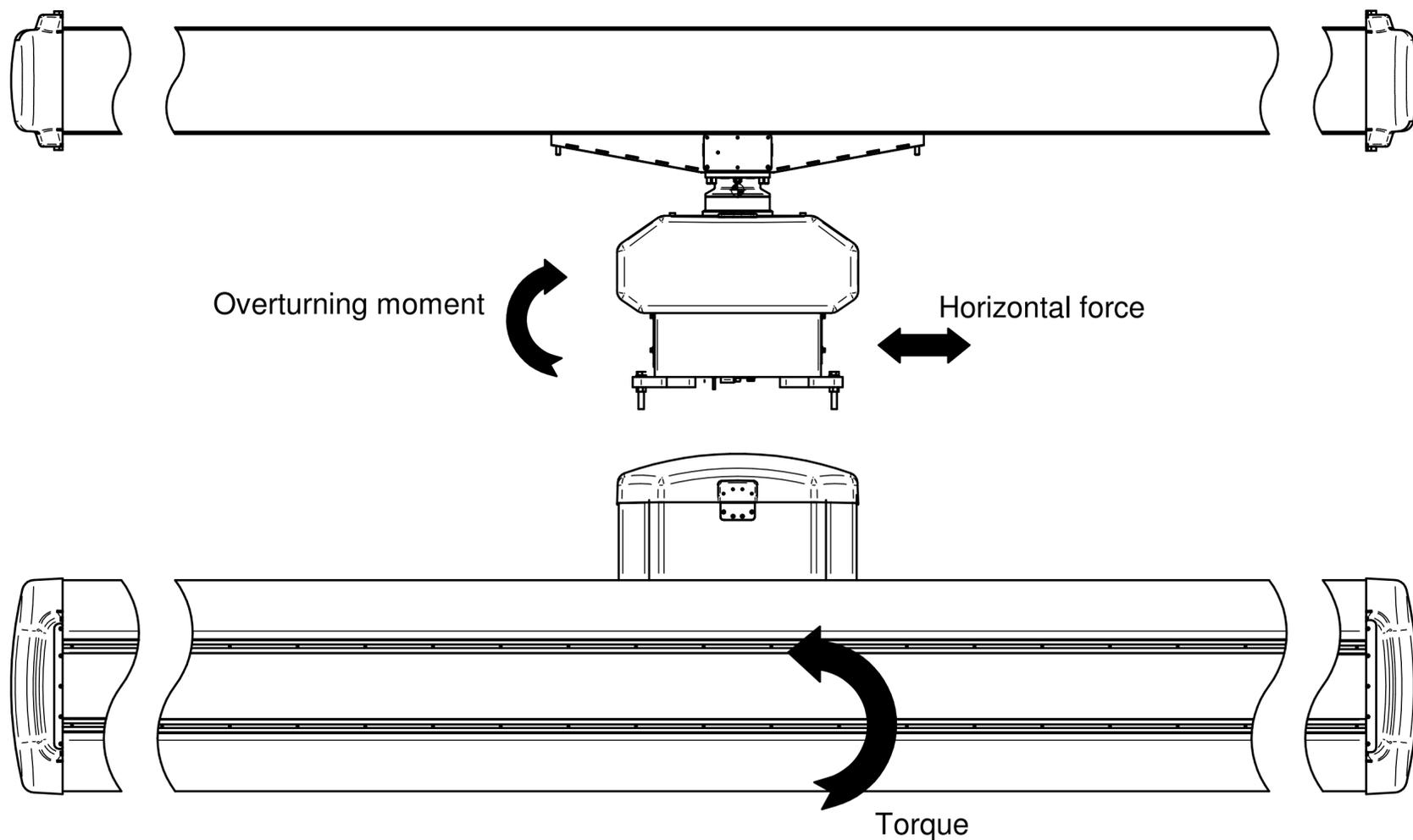
Operational values are max values
 Survival values at wind speed of 75m/s and antenna stopped
 All loads are at bottom surface
 Weight of antenna included
 Load safety factor of 1.5 included (Naturally occurring loads - Eurocode)

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FOR INSTALLATION USE:
 8 BOLTS DIN 933 , M16x100, A4, CL. 70
 16 WASHERS, FLAT DIN 125A, A4
 8 WASHERS, LOCK DIN 127B, A4
 8 NUT DIN 934, M16, A4
 TIGHTENING TORQUE
 LUBRICATED THREAD: 103 Nm
 DRY THREAD: 186 Nm

Corrosion protective measures shall be taken to the two grounding spots

$\varnothing 19^{+0,5}_{-0,1}$

$40 \pm 0,3$ $355 \pm 0,3$ $40 \pm 0,3$

$570 \pm 0,6$

70 ± 1

CENTER OF ROTATION

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SERVICE SPACE

APP. 600

150

APP. 600

290

42

620

REQUIREMENTS FOR CONTACT FACE :

$\square 1,0$

HORIZONTAL $\pm 0,5^\circ$
IN ALL DIRECTIONS

SERVICE SPACE

Mounting interface materials and fasteners shall be, galvanically, compatible with aluminium (recommended potential diff. < 0,25V).
 If this is not possible, proper isolation and coating/surface treatment of critical areas must be performed.
 Stainless steel fasteners are acceptable.

1000

310

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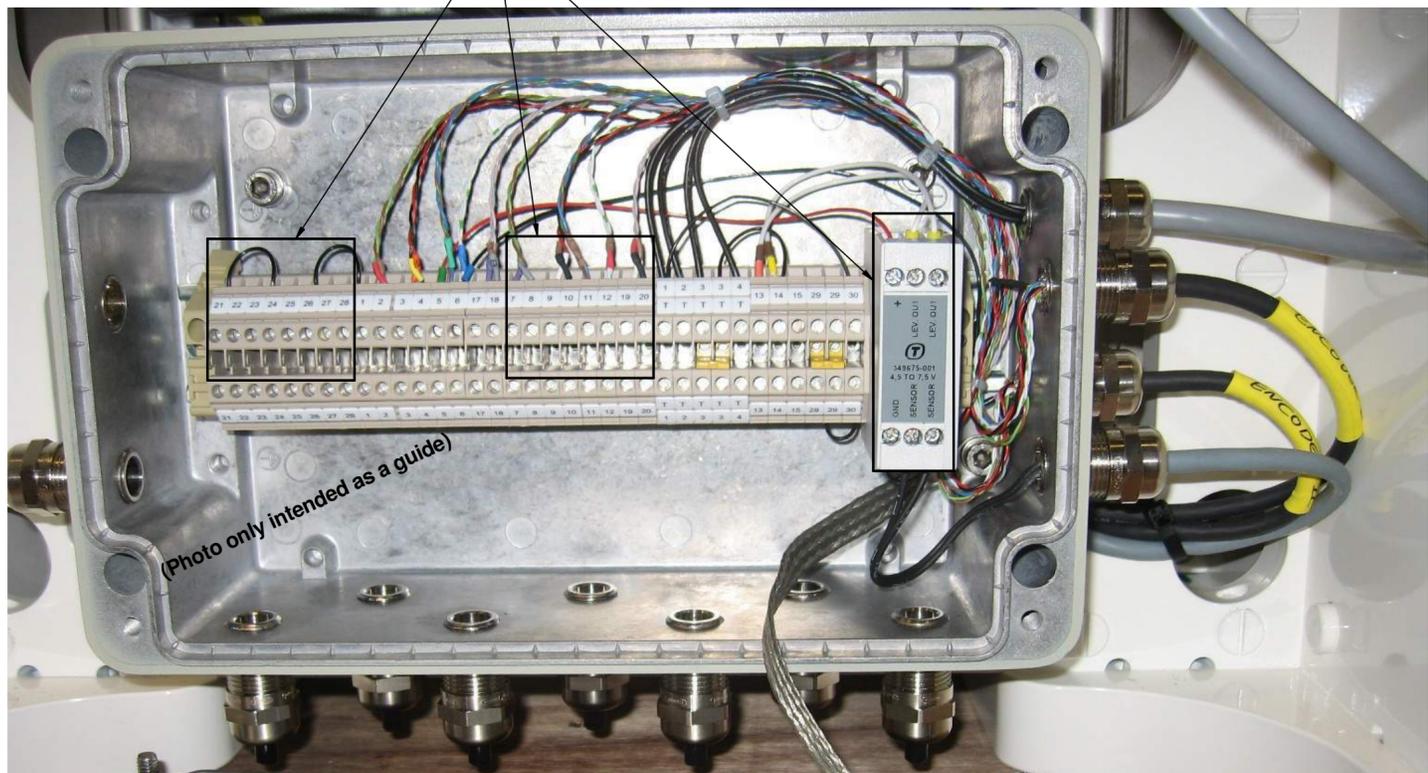
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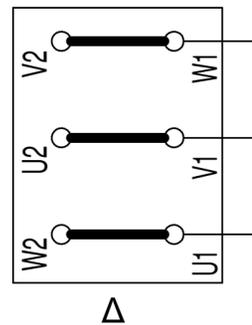
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TB1 ENSURE THAT UNUSED CABLE INLETS ARE CLOSED WITH BLIND PLATES

OPTION

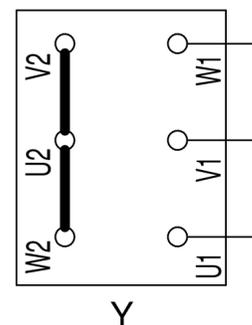


TB2 SCHEMATIC



3 x 230V/50Hz

OR

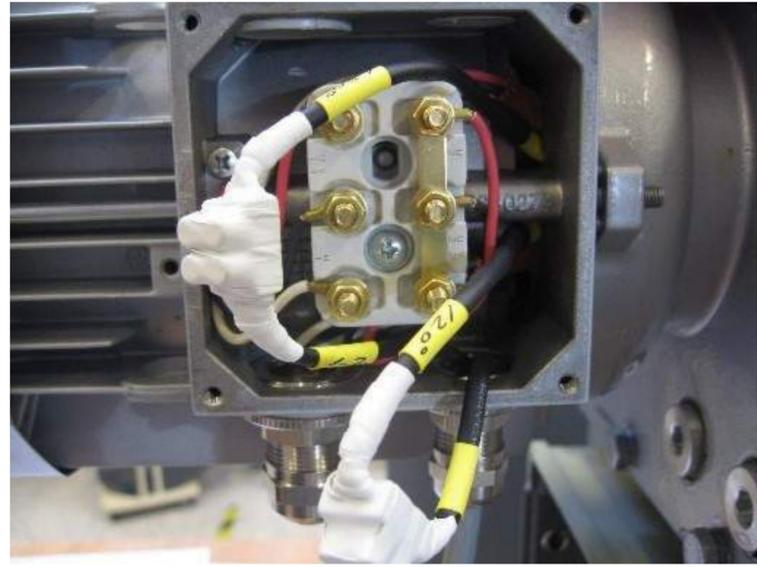


3 x 400V/50Hz

TABLE 3 : TERMINATION

CABLE INLET	FUNCTION	REF DES	TERMINAL	WIRE FUNCTION	SPECIFICATION
M16 x 1,5 E2	Encoder azimuth	TB1	1	ACP2+	BAL 8192 PULSES/REV, RS422, PHASE 2
		TB1	2	ACP2-	
		TB1	3	ARP+	BAL 1 PULS/REV, RS422
		TB1	4	ARP-	
		TB1	5	+5V/+15V	+5V ± 10%, max.120mA, approx. 35mA, 10-30V, max. 100mA, approx. 20mA at 15 V
		TB1	6	GND	
		TB1	17	ACP1+	BAL 8192 PULSES/REV, RS422, PHASE 1
		TB1	18	ACP1-	
M16 x 1,5 E4	2nd Encoder Azimuth (259222-001 OPTION)	TB1	7	ACP2+	BAL 8192 PULSES/REV, RS422, PHASE 2
		TB1	8	ACP2-	
		TB1	9	ARP+	BAL 1 PULS/REV, RS422
		TB1	10	ARP-	
		TB1	11	+5V	+5V ± 10%, max.120mA, approx. 35mA 10-30V, max. 100mA, approx. 20mA at 15 V
		TB1	12	GND	
		TB1	19	ACP1+	BAL 8192 PULSES/REV, RS422, PHASE 1
		TB1	20	ACP1-	
M16 x 1,5 E3		TB1	T1	Normally	MOTOR PROTECTION 155 ± 10°C AUTOMATIC RESET. MAX 2,5A - 250VAC
		TB1	T2	Closed	
		TB1	T3	Normally	MOTOR OVERHEAT ALARM 120 ± 10°C AUTOMATIC RESET. MAX 2,5A - 250VAC
		TB1	T4	Closed	
M20 x 1,5		TB2	U1	MOTOR SUPPLY	PHASE 1
		TB2	V1		PHASE 2
		TB2	W1		PHASE 3
		TB2	GND	SHIELD	
M16 x 1,5 E5	Oil Sensor (304139-001 Option)	TB1	13	Normally closed	Current max.0,5A - 300VAC/DC (breakdown min. 600VDC) Switching Power 50VA
		TB1	T3		

TB2



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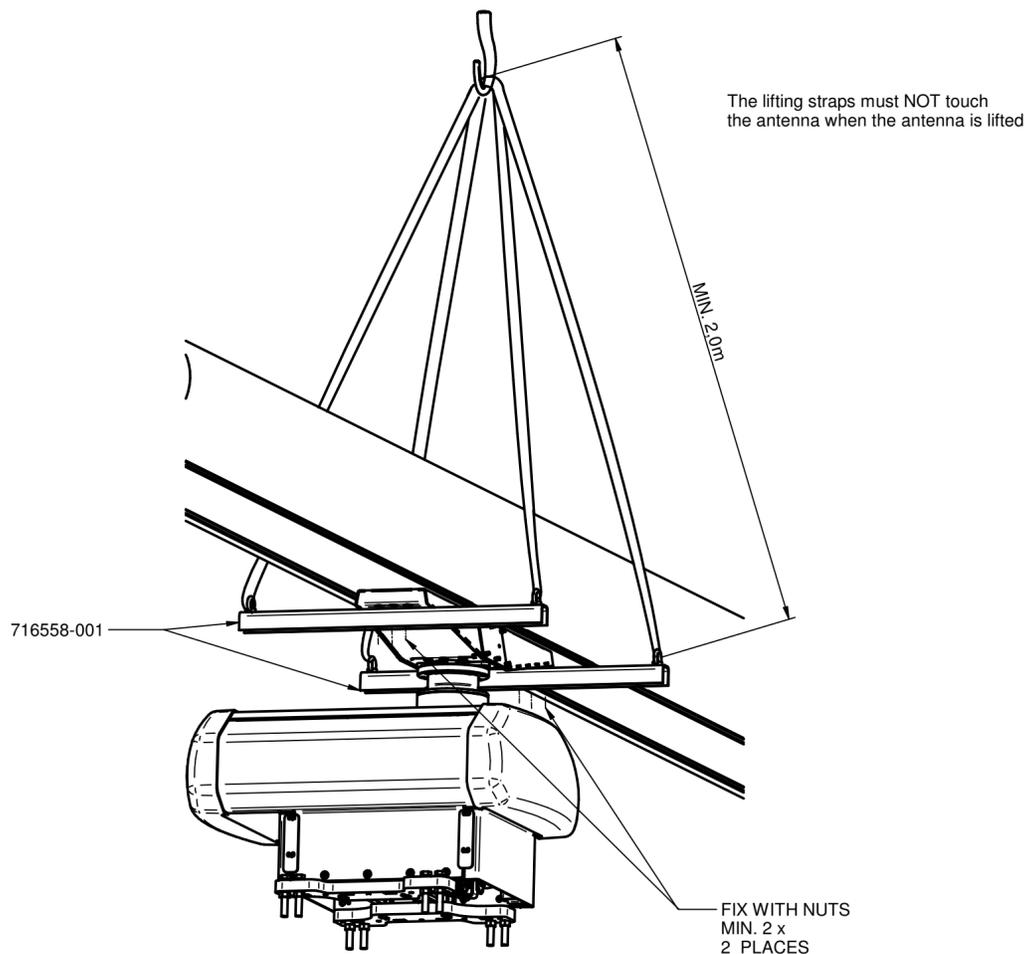
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A2 FORM 200000 FF Rev H

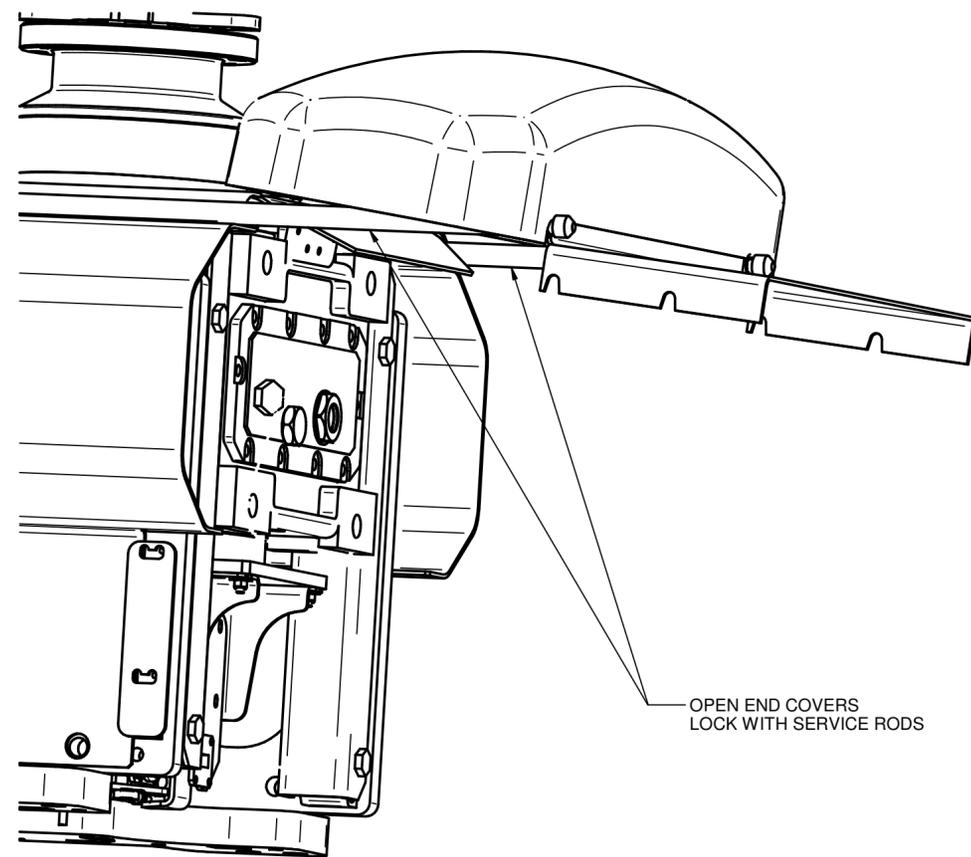
Lifting Instruction for variant -931 see page 6

LIFTING INSTRUCTIONS

- USE LIFTING YOKES
TERMA PART NO.:716558-001
- MOUNT LIFTING YOKES AS SHOWN, AND FASTEN WITH NUTS
- MINIMUM SLING LENGTH: 2,0m
- REMOVE LIFTING YOKES AFTER MOUNTING ANTENNA
- HANDBOOK DOC. 716558-HC



SERVICE



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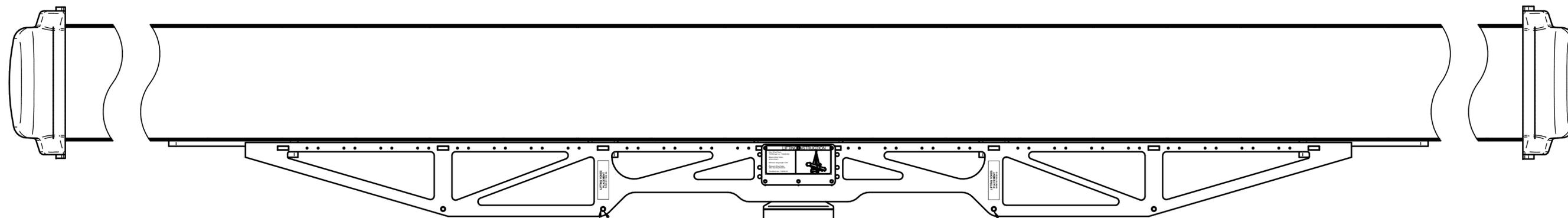
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-931

Specific dimensions are shown in this view
(Otherwise, see sheet 1 - 2)

Only The lifting yoke 716558-002 is CE approved for this variant

D



C

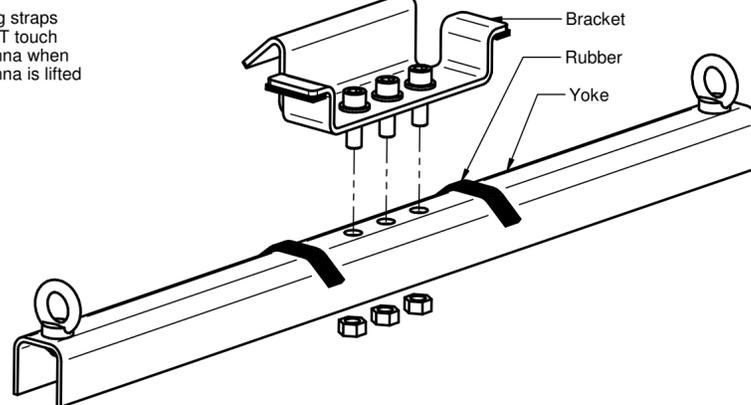
LIFTING INSTRUCTIONS
for -931

- USE LIFTING YOKES
TERMA PART NO. 716558-002
- MOUNT LIFTING YOKES
AS SHOWN, AND FIX WITH Bolts
and NUTS M12
- MINIMUM SLING LENGTH: 2,5 m
- REMOVE LIFTING YOKES
AFTER MOUNTING ANTENNA

- 1 Place Bracket on the Antenna Arm as shown.
- 2 Avoid scratches on the antenna arm.
Place the rubber band on the yokes 4 places
- 3 Then mount the yokes to the bracket .

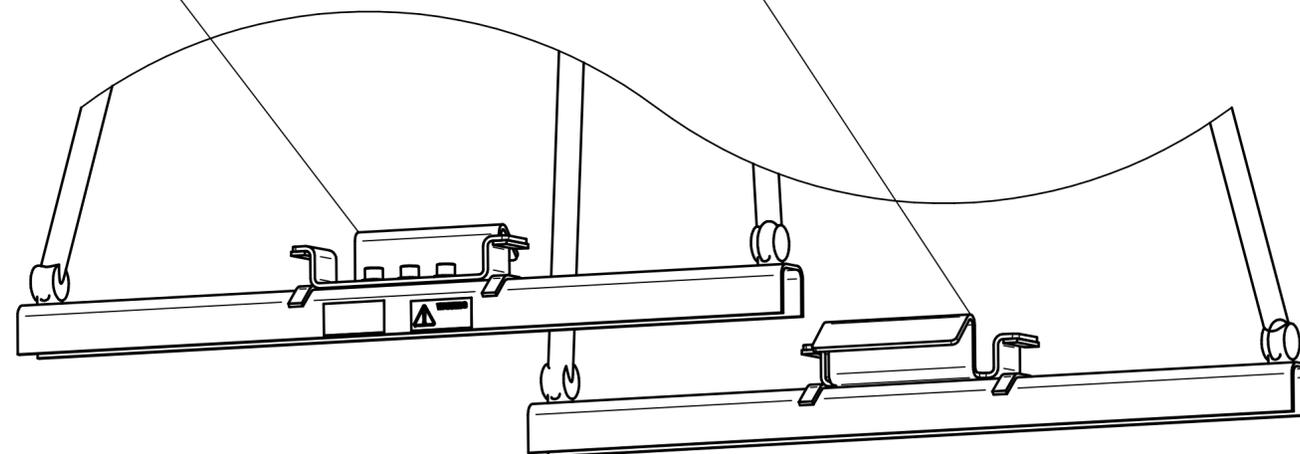
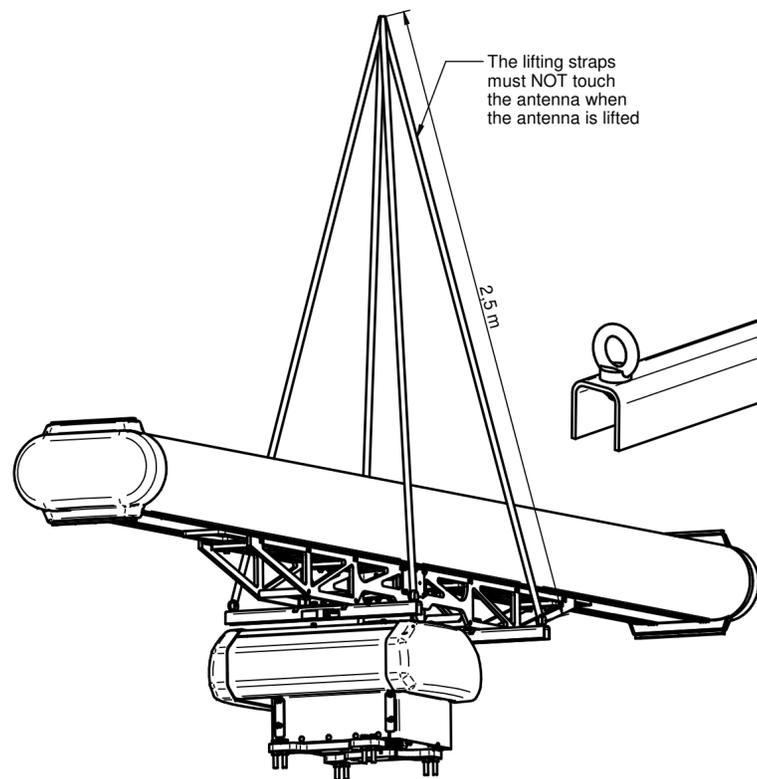
B

The lifting straps
must NOT touch
the antenna when
the antenna is lifted



Bracket
Rubber
Yoke

A



A2 FORM 200000 FF Rev H

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