



STATEMENT OF WORK
For Canadian Coast Guard (CCG)
V1.0

Project Title	Cambridge Bay Tx Site – HF Tower Replacement
Site	Cambridge Bay TX Site

Version	Date	Description	Author
1	May 29, 2017	Initial Release	T. Ip

1.0 Background

The Canadian Coast Guard (CCG) advised NAV CANADA (NC) in December 2016 that they will be replacing two HF towers at the Cambridge Bay Transmitter site. This document outlines NC Engineering requirements related to CCG replacement of the two HF towers at the Cambridge Bay Transmitter site.

2.0 Site Layout and Specifications

CCG is planning to replace the two existing 75ft guyed towers (see figure 1 and 2) with two new 80ft self-support towers. One of the towers (mast #6) to be replaced is currently owned and maintained by NC, whereas the other tower (mast #10) is owned by CCG. The existing mast #6 supports both NC and CCG antennas. The new mast #6 will retain the same antennas, however, it will be owned and maintained by CCG. The following summary depicts the existing antennas with connections to Mast #6.

- Between Mast #6 and Mast #5: Antennas #6 and #7 (owned by NC)
- Between Mast #6 and Mast #7: Antennas #8 and #9 (owned by CCG)
- Between Mast #6 and Mast #10: Antennas #10, #11 and #12 (owned by CCG)

NC currently has HF antennas strung between the aforementioned masts. Baluns are located at the base of each HF antenna mounted on supports. On one side, the balun is connected to a feed ladder that rises vertically to connect to the antenna while the other side of the balun is connected to one run of RF cabling from the equipment shelter.

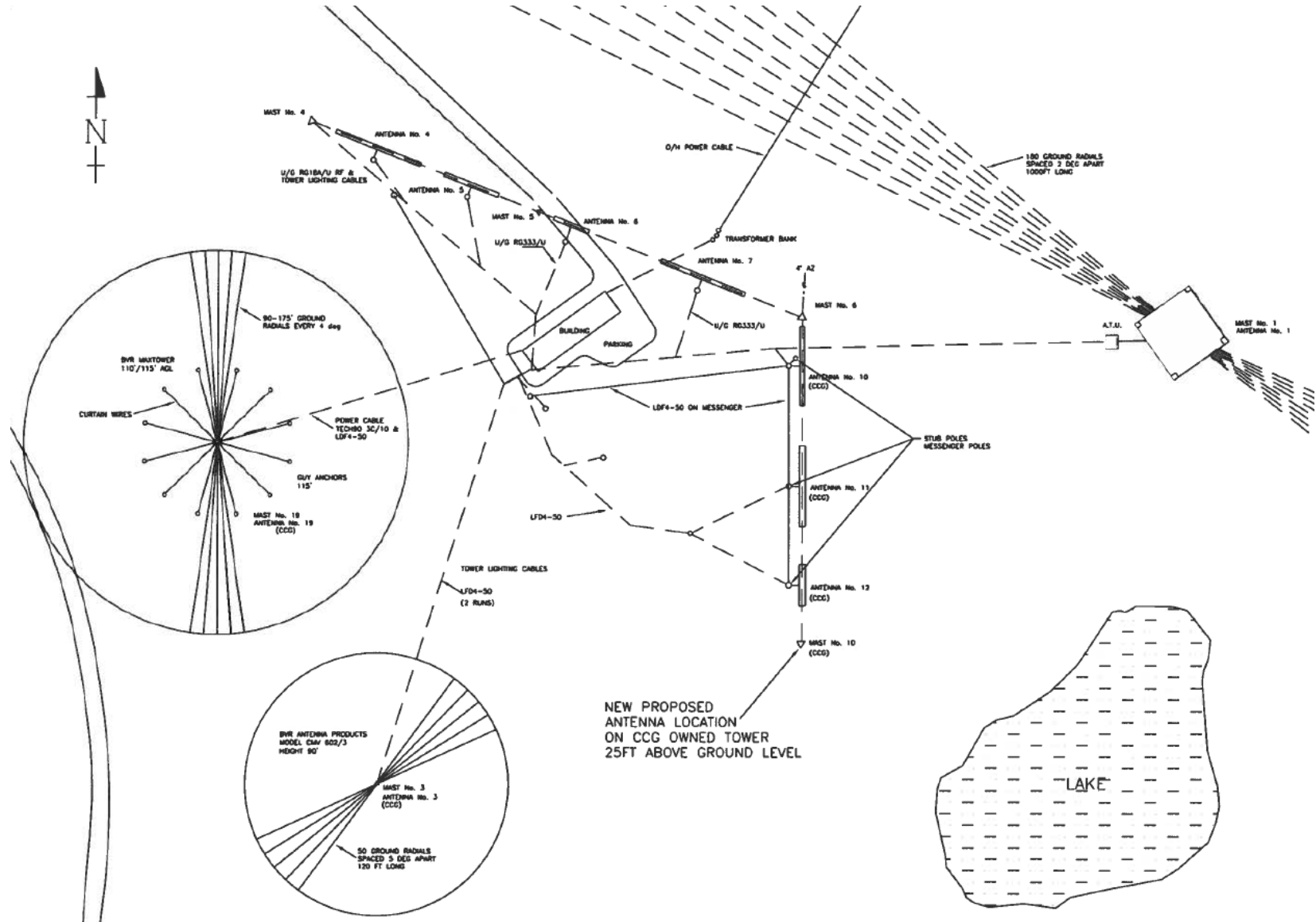
The four NC frequencies at site are:

- The four frequencies providing Nat 'D' service for Gander IFSS (in conjunction with Iqaluit)
 - o 2971KHz M+S, 4675KHz M+S, 8891KHz M+S, 11,279KHz M+S

An antenna layout identifying the NC (identified within the red rectangle) and CCG antennas along with the theoretically calculated lengths of the NC antennas is shown in figure 3.

Based on discussion with CCG:

- CCG is planning to replace two existing towers (mast #6 and #10)
- New mast #6 will be installed a few feet away from the existing mast #6
- All NC antennas and NC feed ladders are planned to be re-used; CCG will install/replace feed ladders if required
- CCG will maintain NC's antennas at the same height AGL and orientation as they currently are
- All baluns and RF cabling are planned to remain untouched
- CCG agrees the new towers construction will not disturb NDB ground radials (see figure 4 for NDB Tower Site Layout; the 90 x 200ft ground radials are to the south only with the 133 x 1000ft ground radials around the rest of the tower and passing the building.)
- CCG cannot confirm the construction schedule until the contract is awarded; however, CCG will need to coordinate construction schedule with NC



Cambridge Bay Tx Site – HF Tower Replacement – CCG SOW – V1 – May 29, 2017

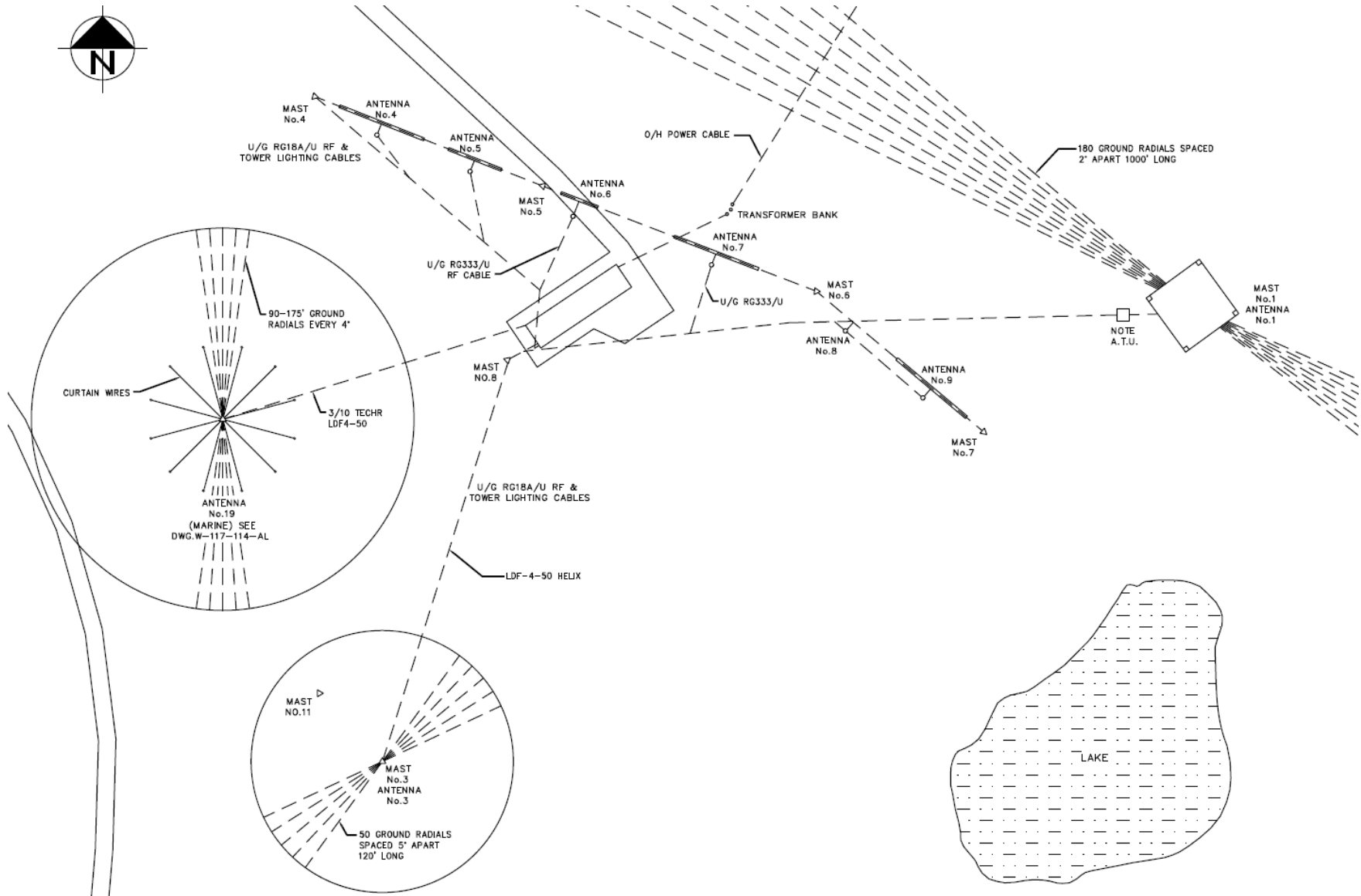


Figure 2: TX Site Layout (NC Drawing)

FREQUENCY	TYPE	LENGTH	MATCH XFMR	MANUFACTURER	HEIGHT	SERVICE	REMARKS
1. 245 KHz	VERTICAL				625'		RG18/U
2. 245 KHz	VERTICAL		A.T.U.		150'	NDB	LDF4-50
3. 2182 KHz B/U	VERTICAL		BROADBAND	WIND TURBINE	110'	MARINE	LDF4-50
4. 4675 KHz	FOLDED DIPOLE	100.1'	3-001-036-AD	M.O.T.	80'	I.C.A.O.	RG333
5. 8913.5 KHz	FOLDED DIPOLE	52.5'	3-001-036-AD	M.O.T.	80'	I.C.A.O.	RG333
6. 11,279 KHz	FOLDED DIPOLE	41.5'	3-001-036-AD	M.O.T.	75'	I.C.A.O.	RG333
7. 2868 KHz	FOLDED DIPOLE	163.1'	3-001-036-AD	M.O.T.	75'	I.C.A.O.	RG333
8. SPACE					75'		RG331
9. 5649 KHz	FOLDED DIPOLE	82.8'	HATFIELD 45		75'		RG331
10. 4363.6 KHz	FOLDED DIPOLE	107'	BALUN	RACAL	65'	MARINE	LDF4-50
11. 6351.5 KHz	FOLDED DIPOLE	72'	BALUN	RACAL	65'	MARINE	LDF4-50
12. 5803 KHz	FOLDED DIPOLE	81'	BALUN	RACAL	65'	MARINE	LDF4-50
13. 5680 KHz	FOLDED DIPOLE	82.4'	RACAL		75'	A/G	RG331
14. 5245 KHz	FOLDED DIPOLE	89.2'	RACAL		75'	TAM	RG331
15. 2220 KHz	FOLDED DIPOLE	210.8'	C.N.T.		75'	SPARE	HELIX FOAMFLEX
16. 5850 KHz	FOLDED DIPOLE	80'			75'	SPARE	HELIX FOAMFLEX
17. SPACE							RG18/U
18. 5803 KHz	VERTICAL S&T AC-22-E	20'	W-152-150-SC	SPILSBURY-TINDALL	20'	MARINE	RG331
19. 2182/2558KHz	VERTICAL		BROADBAND	MAXTOWER	110'	MARINE	LDF4-50

Figure 3: Antenna Details

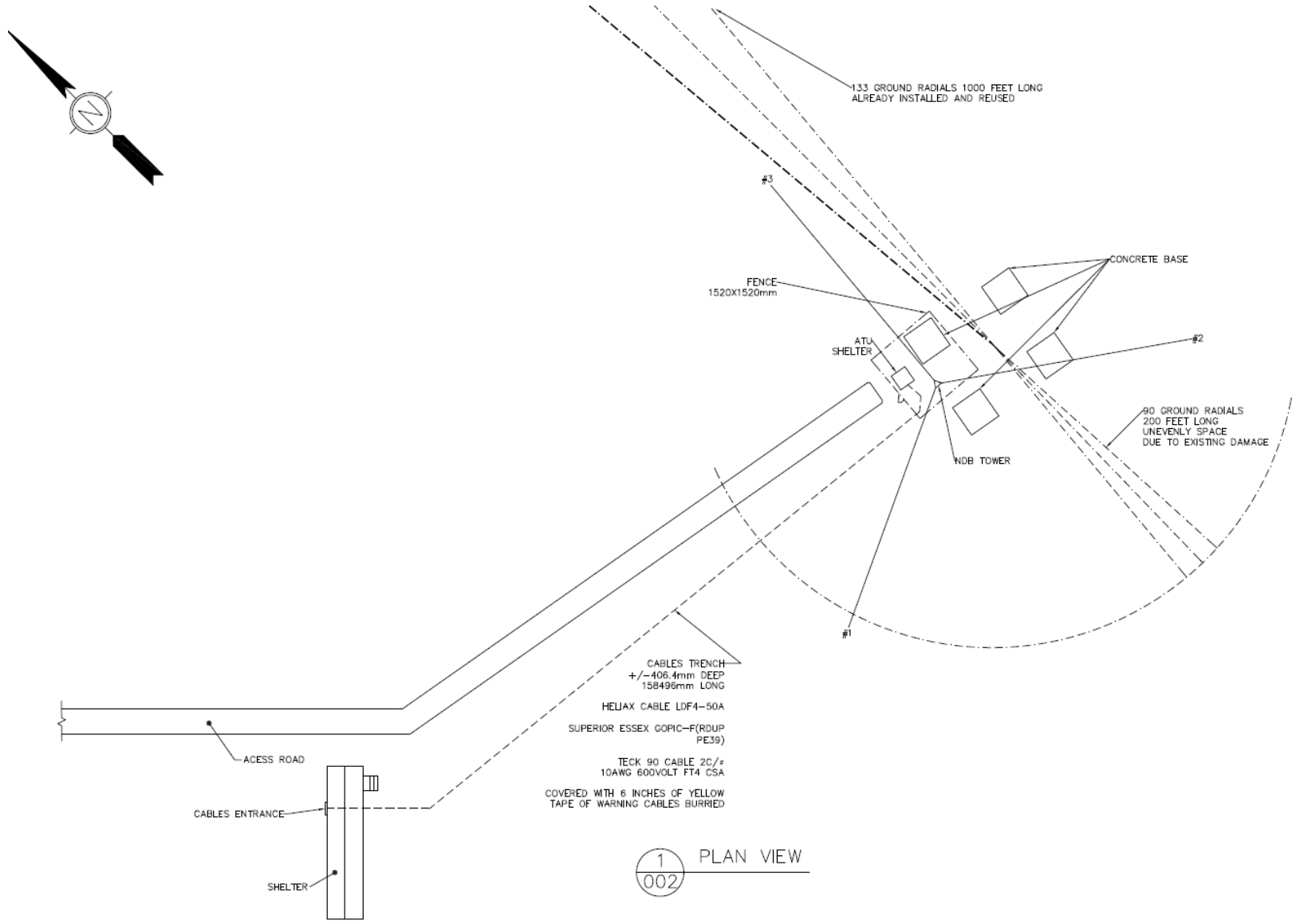


Figure 4: Cambridge Bay NDB Tower Site Layout

3.0 Tower and Antenna Specifications

It is agreed by NAV CANADA that the new towers will be 5ft higher than the current towers. The new tower (mast #6) shall be a stand-alone type and installed with a consistent 3-foot (maximum) offset of the existing towers. To maintain existing coverage, CCG shall ensure that the existing tower layout geometry and antenna orientations are maintained (see figure 2 for existing tower layout). CCG shall ensure that all NC antennas are re-installed at the same height AGL as they currently are. The table in figure 3 identifies what are believed to be the existing antenna heights AGL but this should be verified on-site.

Given that the existing baluns won't be moved and the towers will be slightly offset from their current location, the feed ladders will not be oriented exactly vertical but rather will be on an angle between the balun connection and the antenna connection. This has been determined to be an acceptable installation approach from an RF standpoint and won't affect the propagation provided the system is tuned on-site with NAV CANADA present to ensure acceptable VSWR is maintained. CCG shall coordinate the tower replacement work with NAV CANADA well in advance to ensure on site work and outages are managed.

If CCG believes any changes to NC HF equipment/cabling are required, for example RF cables or feed ladders, they shall consult with NC Engineering prior to proceeding.

In order to raise and lower the antennas to facilitate future maintenance and repairs, new pulleys, steel tie cables and winches are to be installed on new mast #6. The winch should be a "Jet Winch" Model # IWF-1000N product # 113264 or equivalent. (see Appendix A for an example of previous NC tower installation at Resolute Bay)

CCG shall install required obstruction lighting and markings for the new towers per Transport Canada regulations.

4.0 Canadian Coast Guard Responsibilities

- Coordinate a frequency outage strategy with NC
- Surveys, locates for RF, Power and Telecom cables and overall supervision of contractors
- Procure and install towers
- Verify NC antenna heights AGL prior to removal
- Physical removal of NC antenna and reinstallation per this document
- Ensure contractor is familiar with HF antenna design and that any changes to feed line/antenna materials impacted during installation are assessed by NC prior to installation
- Coordinate with NC to complete required system checks
- Grounding of towers as required
- Submission of as-built drawings to NC
- Disposal of all obsolete materials including NC tower
- TC and NC Land Use applications
- Procurement and installation of the required obstruction lights and painted markings for the towers as per Transport Canada requirements
- Lease agreement amendments in coordination with NC Real Estate as required

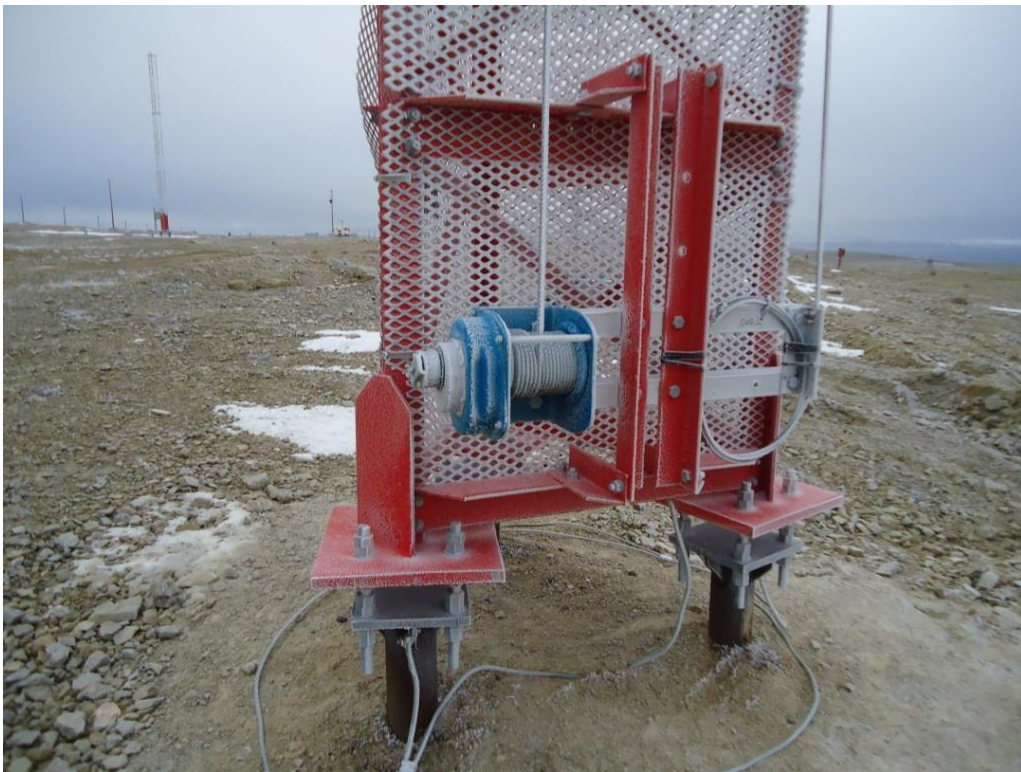
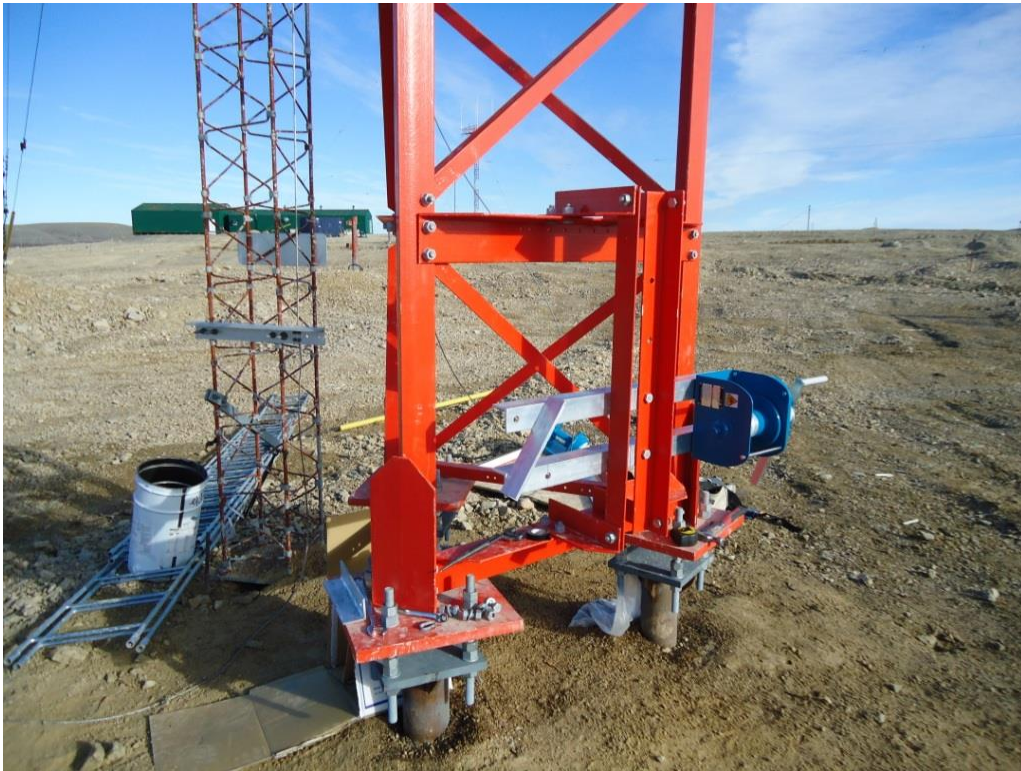
5.0 NAV CANADA Responsibilities

- Coordinate frequency outage strategy with NC Operations and CCG to establish overall schedule
- Removal of electronic equipment from service through onsite coordination with CCG
- System verification upon CCG installation of the antenna on the new tower

6.0 Schedule

It is understood CCG would like to perform the work described in this document in the Summer of 2017. NC and CCG will need to work together to establish a mutually agreeable schedule.

Appendix A – Previous NC tower installation at Resolute Bay with pulley, steel tie cables and winch



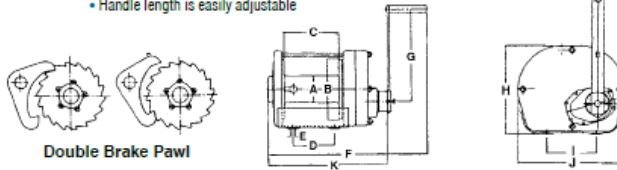
WINCHES

HEAVY DUTY



INDUSTRIAL WINCHES

- Free wheeling feature enables the operator to pay out cable fast with no load attached
- Will not free wheel under load
- Safe and dependable braking system includes a double-tipped brake pawl ensuring that either tip is always engaged under all conditions
- Non-asbestos brake discs using a high quality low abrasion aramid fibre material for a safer and healthier environment
- Dust and weather-tight housing using an ABS plastic cover to seal out dust and rain
- All braking components are plated with a rust resistant finish
- Handle grip is designed to allow maximum comfort during winding
- Handle length is easily adjustable



PROD. NO.	MOD. NO.	Rated Lifting Capacity (lbs)	Drum Capacity	Overall Dimensions (L x W x H) (in)	Cable Length Pulled per Turn (in)	Force Req. to Lift Capacity (lbs)	Handle Length (in)	Gear Ratio	Ship Weight (lbs)
113261	IWF-100N	220	5/32" x 131'	10-7/8 x 6-5/16 x 6-13/16	6-1/2	26	9-13/16	1:1	16
113262	IWF-300N	551	3/16" x 131'	14-1/4 x 8-11/16 x 6-7/8	2-7/8	20	13-3/4	2.88:1	27
113263	IWF-500N	882	1/4" x 98'	14-1/4 x 9-11/16 x 7-3/16	2-3/16	25	13-3/4	4.33:1	30
113264	IWF-1000N	1,653	5/16" x 98'	15-7/8 x 10-1/2 x 8-7/16	1	22	13-3/4	12.2:1	43
113266	IWF-3000N	3,748	1/2" x 66'	20-1/16 x 14-1/4 x 11-11/16	5/8	33	13-3/4	28.8:1	101

Dimensions in Inches

MOD. NO.	A	B	C	D	E	F	G	H	I	J	K
IWF-100N	1-7/8	4-1/32	4-11/16	3-1/4	7/16	15-15/16	9-13/16	5-51/64	3-35/64	6-19/64	9-5/8
IWF-300N	2-3/8	4-59/64	5-29/32	3-15/16	19/32	19-13/64	13-3/4	6-55/64	5-1/8	8-43/64	12-15/16
IWF-500N	2-3/4	5-33/64	5-29/32	3-15/16	19/32	19-13/64	13-3/4	7-11/64	5-1/8	9-21/32	12-15/16
IWF-1000N	3-1/2	6-57/64	6-7/64	4-21/64	45/64	20-53/64	13-3/4	8-7/16	6-45/64	10-31/64	14-9/16
IWF-3000N	5-1/2	9-1/16	8-5/64	6-7/64	45/64	24-63/64	13-3/4	11-21/32	6-45/64	14-17/64	18-23/32



GENERAL PURPOSE WINCHES

- Galvanized winches are coated with "Posi-Glaze," an oven cured epoxy providing exceptional resistance to rust, salt and chemical corrosion
- One piece pinion gear and shaft design eliminates gear to shaft bonding failures
- Oil impregnated bearings ensure smooth operation
- High tensile alloy steel is used for all shafts and gears
- Frames are embossed for extra strength
- Ideal for a wide range of applications such as industrial, automotive, agri-motive, marine and construction

PROD. NO.	MOD. NO.	Load Capacity (lbs)	Gear Ratio	Hub Diameter	Reel Capacity – Rope				Reel Capacity – Cable		Net Weight (lbs)	Ship Weight (lbs)
					5/16"	3/8"	7/16"	1/2"	1/8"	3/16"		
113106	GPW-1200	1,200	4.2:1	3/4"	50'	25'	20'	–	200'	90'	6	7
113107	GPW-2500	2,500	5.1:1 / 12.2:1	1"	–	50'	35'	30'	–	170'	14	15