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Assessment of the Impact of Ainse-A-Valleau Wind Farm on the Local Radio and TV Systems

Report No: 01490R00005

Issue No: 01

Date: 12 May 2004

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Prepared:	**Santi Vila**	Signed Electronically	12 May 2004
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Approved:	**Mike Anderson**	Signed Electronically	12 May 2004

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Signed, Checked and Approved Electronically 12 May 2004

Revision History

Issue	Date	Nature And Location Of Change
01	12/05/04	First Created

CONTENTS

1.0 INTRODUCTION

This report has been prepared by Renewable Energy Systems TEC Limited at the request of RES North America.

Anse-à-Valleau wind farm site is located to the west of L'Anse-à-Valleau village in the Peninsula of Gaspesie, Quebec. This report investigates the possibility that the proposed wind farm may cause interference to local radio and TV reception.

Most of the Peninsula of Gaspesie is sparsely populated, with most of its inhabitants located along the coast. There are four villages close to the site, L'Anse-à-Valleau and Pointe Jaune to the east and Saint-Yvon and Cloridorme at more than 8Km to the north-west of the northernmost turbines.

All transmitter details used in this report have been obtained from the "Broadcasting database and other related information" web page of the Industry Canada [6].

Nine FM radio stations will be considered in this report. Three of them, CBGA-15-FM, CJRV-FM and QUEFM-113 are located in L'Anse-à-Valleau village, east of the site. The next three stations, CBGA-3-FM, CJRE-FM and QUEFM-231 are located in Rivière-au-Renard, 7Km to the south-east of L'Anse-à-Valleau village. The last three stations, CBGA-9-FM, CJMC-FM-6 and QUEFM-047 are located in Cloridorme, 15Km to the north-west of the northernmost turbines.

Six analogue TV stations will be considered in this report. Two of them, CBGAT-18 and CHAU-TV-9 are located in L'Anse-à-Valleau village, east of the site. The next two stations, CBGAT-22 and CHAU-TV-7 are located in Rivière-au-Renard, at 7Km to the south-east of L'Anse-à-Valleau village. And the last two stations, CBGAT-16 and CHAU-TV-8 are located in Cloridorme, at 15Km to the north-west of the northernmost turbines.

A map showing the wind farm site (with the Anse-à-Valleau turbines coloured in blue), the development boundary (black line), surrounding area, transmitters, buildings (coloured in black) and areas that will be studied for each TV transmitter is given in figure 1. Not all buildings are believed to be inhabited. However the worst scenario is considered by including all of them in the analysis. All buildings have been obtained from the 1:20,000 Canadian map series.

It is possible for wind turbines to cause interference to local TV reception either by obstruction or by reflection. Viewers situated forward of a wind farm (so that their TV aerials are pointing through the turbines) may have their signals periodically obstructed by the rotating blades causing a 'scattering' of the signal. Viewers situated to the side may experience periodic reflections from the blades, giving rise to a delayed image or 'ghost'.

In practice, RES have only experienced problems when the receiver already has a poor signal. Specifically, if the wind farm is illuminated by the transmitter, problems can occur when the receiver has no line of sight to the transmitter, but has a clear line of sight to the wind farm.

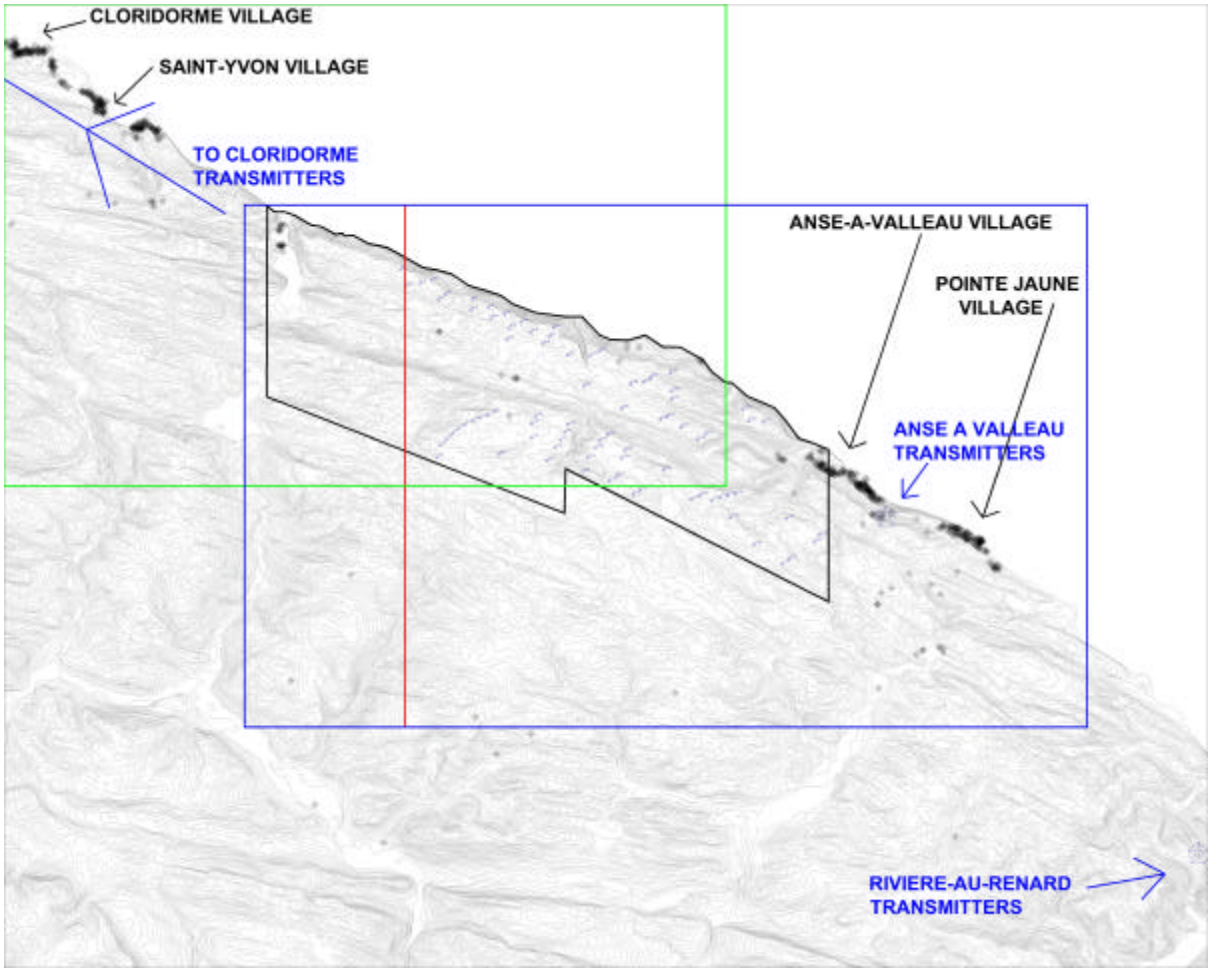

Figure 1: Map showing transmitter, wind farm (blue dots), development boundary (black line), buildings around the site (black dots) and areas that will be studied for each TV transmitter (red rectangle for Anse-à-Valleau transmitters, blue for Rivière-au-Renard transmitters and green for Cloridorme transmitters).

2.0 METHODOLOGY

2.1 Amplitude Modulated (AM) Systems

According to [7]:

"*AM broadcast signal reception is susceptible to interference from various man-made and natural sources of background noise. Due to the fact that a rotating wind turbine blade predominantly modulates the amplitude of an electromagnetic signal in its vicinicity, interference with AM radio reception can be anticipated. However, since AM broadcast frequencies are low and signal wave lengths are very long, any interference will be confined to the immediate vicinity of a wind turbine.* "

Therefore only buildings that are in the immediate vicinity of a wind turbine will be considered as susceptible to interference to AM reception.

2.2 Frequency Modulated (FM) Systems

Results from laboratory simulation techniques [7] show that:

"*… the effects of wind turbine interference on FM radio reception are negligible, except possibly within a few tens of meters of a wind turbine located in a region of low signal-to-noise ratio for a particular FM station*".

Therefore only buildings that are in the immediate vicinity of a wind turbine will be considered as susceptible to interference to FM reception.

2.3 Television Systems

This investigation uses ITU recommendations to assess the potential TV interference caused by the wind farm. ITU Recommendation 805 [1] is used to model the tv interference caused by a single turbine. This is applied in conjunction with ITU Recommendation 526 [2] that describes a knife-edge diffraction model to account for attenuation of the TV signals by the intervening terrain. Multiple turbines are accounted for by applying these models between every turbine and receiver. The resultant field strength of the interfering signals reflected from each turbine is then calculated by adding all the signals together in phase. This is a conservative assumption as it would be realistic to assume that the reflected signals would not all be in phase at the receiver. Some evidence to suggest that the signals do not all add constructively is shown in experiments by the BBC [3].

The RES interference program uses the method described above in conjunction with terrain height data. The program has been tested on existing wind farms where TV interference has been experienced. In order to set the level at which the predicted SNR corresponds to unacceptable TV interference, the model has been applied to existing wind farms where TV interference has actually occurred. One example is Lendrums Bridge wind farm in Northern Ireland. The results of the model are shown in figure 2. The two red circles are where TV interference has actually occurred. It can be seen from the figure that the points correspond to a SNR of below 10 dB. Such a low threshold can be explained by two terms in the model, about which little is known. The first is the reflectivity of a wind turbine, which depends on the precise shape, structure, and material of the rotor. Currently there is little information on this parameter and so it is set to a conservative level in the model. The second area of uncertainty is how to combine the individual interfering signals from each turbine. The assumption is made that the unwanted signals from all turbines add in phase at the receiver.

Based on existing evidence and third party measurements, the threshold of SNR below which TV interference is unacceptable is set to 10 dB. This assumption is supported by the measurements described in references [4] and [5] where TV interference occurred only when the highest secondary signal was within 10dB of the primary signal. Application of the model to existing wind farms (Lendrums, Elliot's Hill and Malhadas), where TV interference has occurred, also supports this assumption [5].

In March 2003 RES commissioned NTL to measure the interference experienced at locations around Lendrums Bridge wind farm [4]. The measurements were taken with the wind farm operating and with the wind farm shut down. This was done in order to quantify the interfering reflections from the rotor. The main objective of the work was to collect a real data set in order to validate the RES TV interference model. The results from this test verify that the model is a good predictor of TV interference [5].

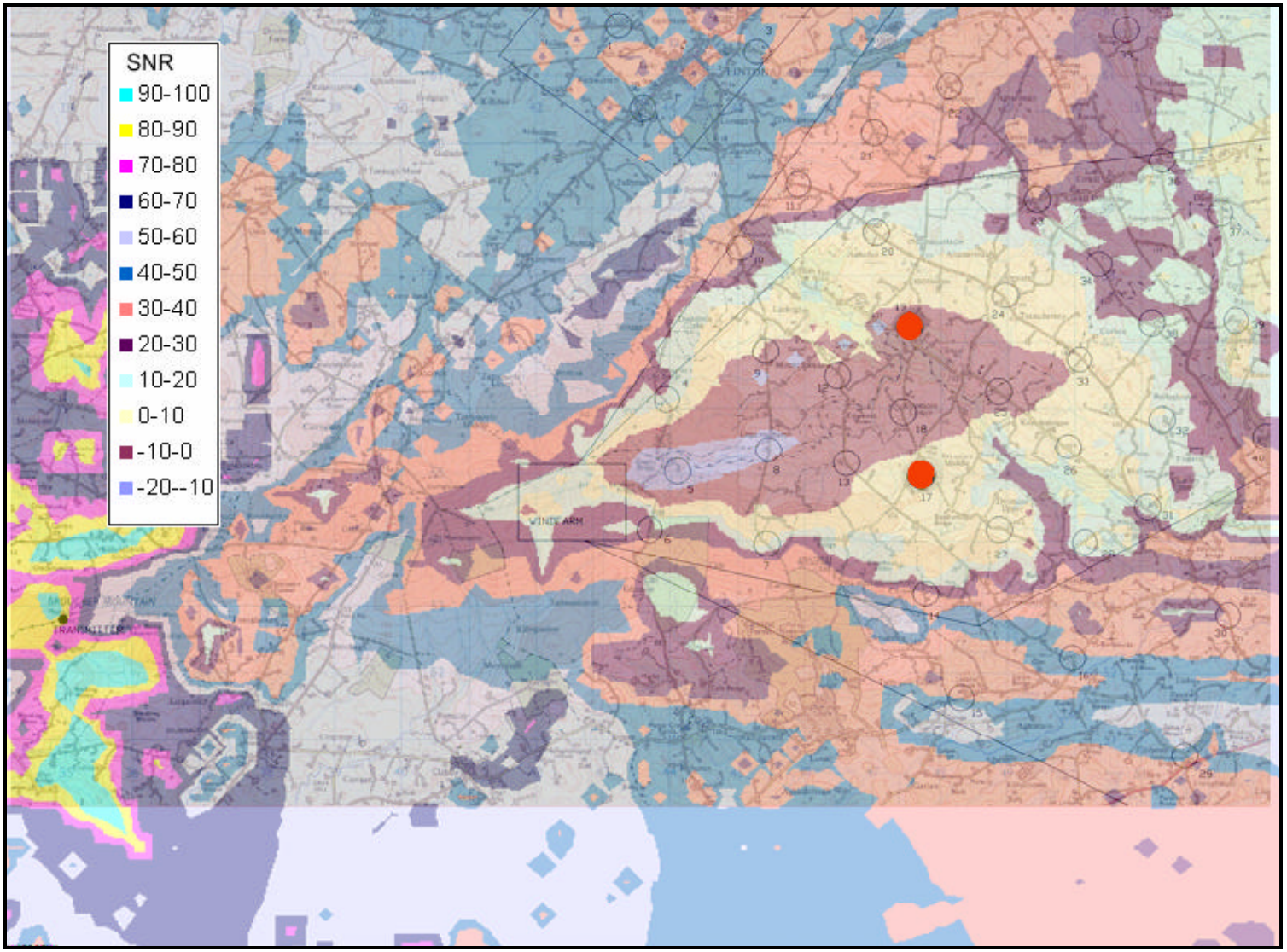

Figure 2: Predicted Interference at Lendrums Bridge.

3.0 RADIO SYSTEMS (AM, FM)

3.1 Amplitude Modulated (AM) Systems

Due to the existing distances between turbines and buildings no interference to AM radio systems is expected. It must be also noted that according to [6] there are no AM radio stations in the area.

3.2 Frequency modulated (FM) Systems

Table 1 shows the details of the existing FM radio stations in the area [6].

Station	Latitude (ddmmss)	Longitude (ddmmss)	Channel	Frequency (MHz)
Stations in Anse-à-Valleau				
CBGA-15-FM	490424	643219	268	101.5
CJRV-FM	490424	643219	237	95.3
QUEFM-113	490424	643219	226	93.1
Stations in Rivière-au-Renard				
CBGA-3-FM	485952	642555	218	91.5
CJRE-FM	485952	642555	250	97.9
QUEFM-231	485900	642300	224	92.7
Stations in Cloridorme				
CBGA-9-FM	491127	645334	286	105.1
CJMC-FM-6	491115	645135	276	103.1
QUEFM-047	491100	645000	255	98.9

Table 1: Details of FM Stations in the Wind Farm Area.

Due to the distance between buildings and turbines no interference is expected on FM radio systems.

4.0 TELEVISION SYSTEMS

4.1 Coverage Predictions

This section gives coverage predictions for each transmitter. These enable us to predict the current quality of the signal from each transmitter around the wind farm. Transmitters details are shown in table 2.

Stations	Latitude (ddmmss)	Longitude (ddmmss)	ERP Power (KW)	Aerial Height (m agl)	Channel	Frequency (MHz)
Stations in Anse-à-Valleau						
CBGAT-18	490424	643219	0.01	36.6	10	192
CHAU-TV-9	490424	643219	0.06	36.6	12	204
Stations in Rivière-au-Renard						
CBGAT-22	485952	642555	4.2	42.6	2	54
CHAU-TV-7	485952	642555	5.5	42.6	4	66
Stations in Cloridorme						
CBGAT-16	491127	645334	0.24	42.7	8	180
CHAU-TV-8	491127	645334	0.2	42.7	11	198

Table 2: Details of TV Transmitters in the Wind Farm Area.

The predictions are given in the following sections. A signal of 48dBµV/m is regarded as the minimum level required for an acceptable quality of service for the CBGAT-22 and CHAU-TV-7 transmitters. A signal of 55dBµV/m is regarded as the minimum level required for an acceptable quality of service for the CBGAT-18, CHAU-TV-9, CBGAT-16 and CHAU-TV-8 transmitters. In the coverage images, areas in yellow and red are predicted to be receiving a low TV coverage whereas all other areas are predicted to be receiving a good or acceptable TV signal.

According to [6] all these TV transmitters emit directionally towards the populations nearby them. The predicted coverage, however, has been made assuming that all transmitters use omnidirectional antennas to emit their signal. This fact does not affect the validity of this analysis as only those areas believed to be covered by a transmitter are analysed for interference.

4.1.1 Anse-à-Valleau Transmitters Coverage

Predicted coverage for the CBGAT-18 and CHAU-TV-9 stations is shown in figures 3 and 4. These small transmitters provide good coverage only to the nearby villages, namely Anse-à-Valleau and Point Jaune, where almost all the dwellings are located.

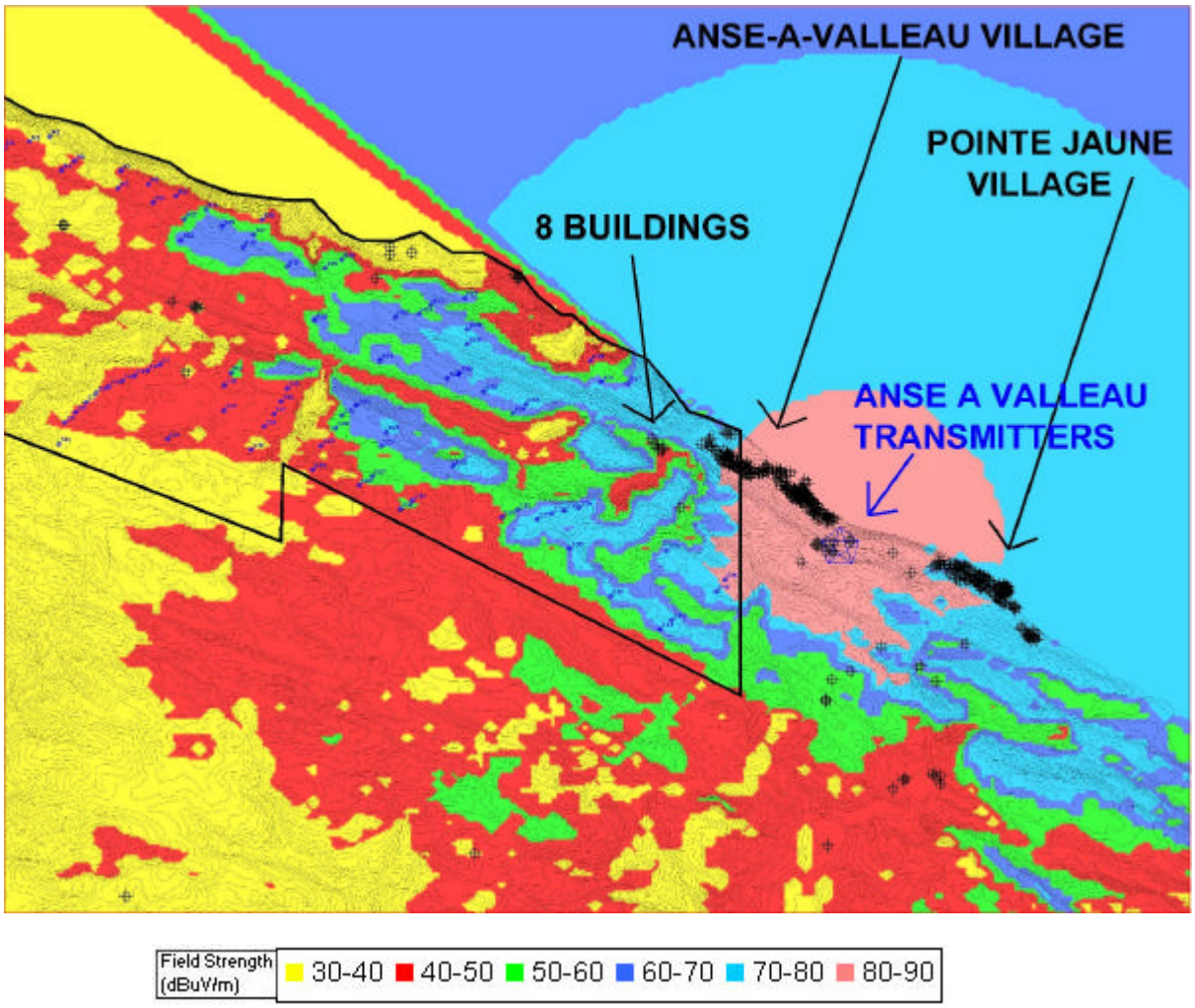

Figure 3: CBGAT-18 coverage (Anse-à-Valleau transmitter).

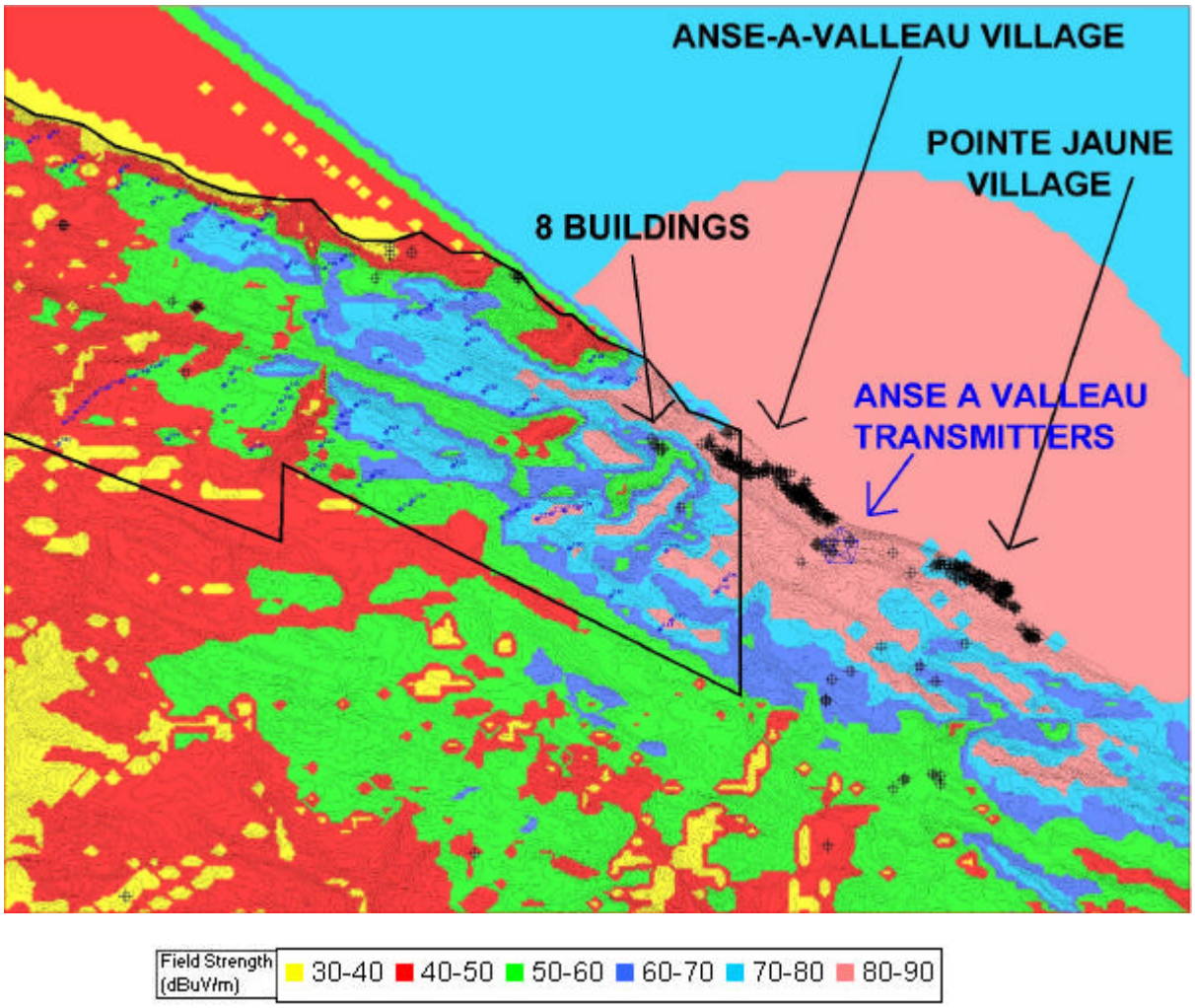

Figure 4: CHAU-TV-9 coverage (Anse-à-Valleau transmitter).

4.1.2 Rivière-au-Renard Transmitters Coverage

Predicted coverage for the CBGAT-22 and CHAU-TV-7 stations is shown in figures 5 and 6. These transmitters emit at a higher power than the Anse-à-Valleau ones and are providing an acceptable signal to most of the area around the site.

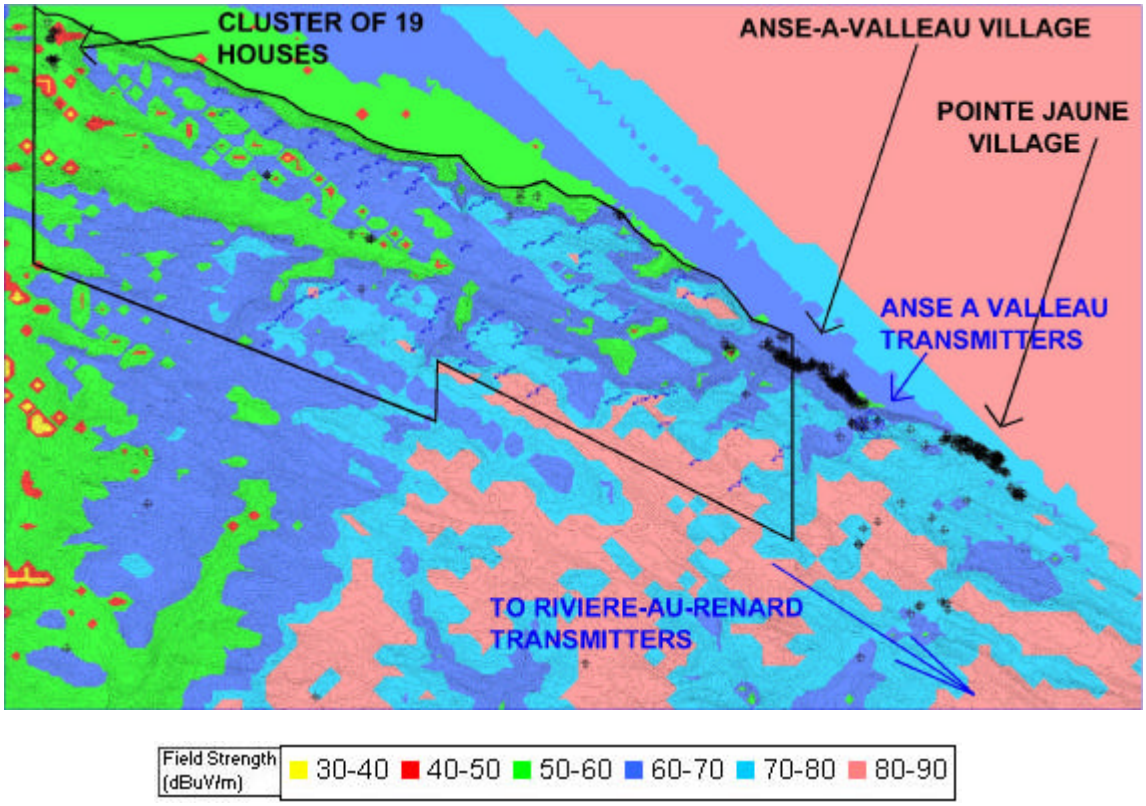

Figure 5: CBAT-22 coverage (Rivière-au-Renard transmitter).

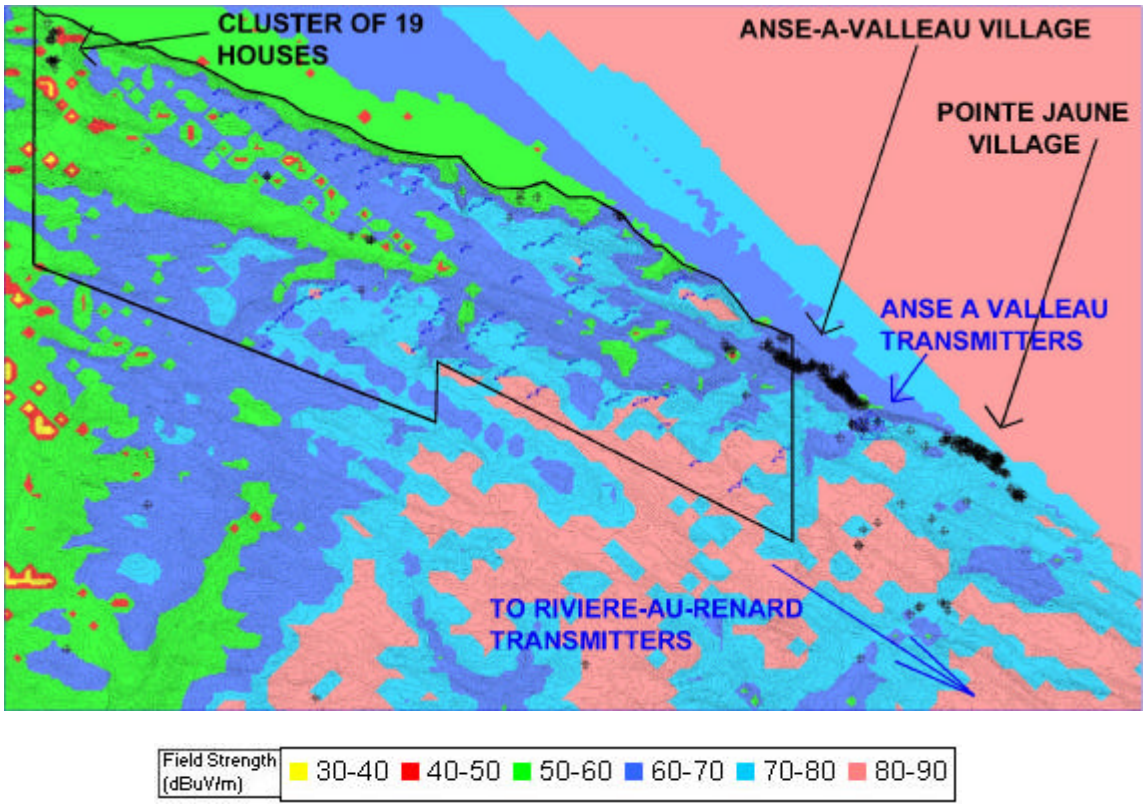

Figure 6: CHAU-TV-7 coverage (Rivière-au-Renard transmitter).

4.1.3 Cloridorme Transmitters Coverage

Transmitters at Cloridorme (CBGAT-16 and CHAU-TV-8) are located at 15Km to the north-west of the northernmost turbines and they provide coverage to the villages Cloridorme and Saint-Yvon. These villages are located far from the turbines (8 Km), they are receiving a good TV signal (figures 7 and 8) and no interference is expected at them.

However these stations have been included in this analysis as they could be providing coverage to a cluster of 19 buildings within the development boundary (see figures 7 and 8), coverage that might be impaired by the wind farm. These buildings could be receiving the TV signal from either the Cloridorme transmitters or the Rivière-au-Renard transmitters, as all these transmitters are predicted to provide a low signal at these buildings (see also figures 5 and 6). The signal is predicted to be low as it is highly screened by the terrain in between the buildings and the transmitters (see figures 9 and 10 that show terrain profiles between these buildings and the Cloridorme transmitters and the Riviere-au-Renard transmitters). Due to proximity it is likely that these buildings are tuned to the Cloridorme transmitters. It is also likely that they have some means of improving their TV reception.

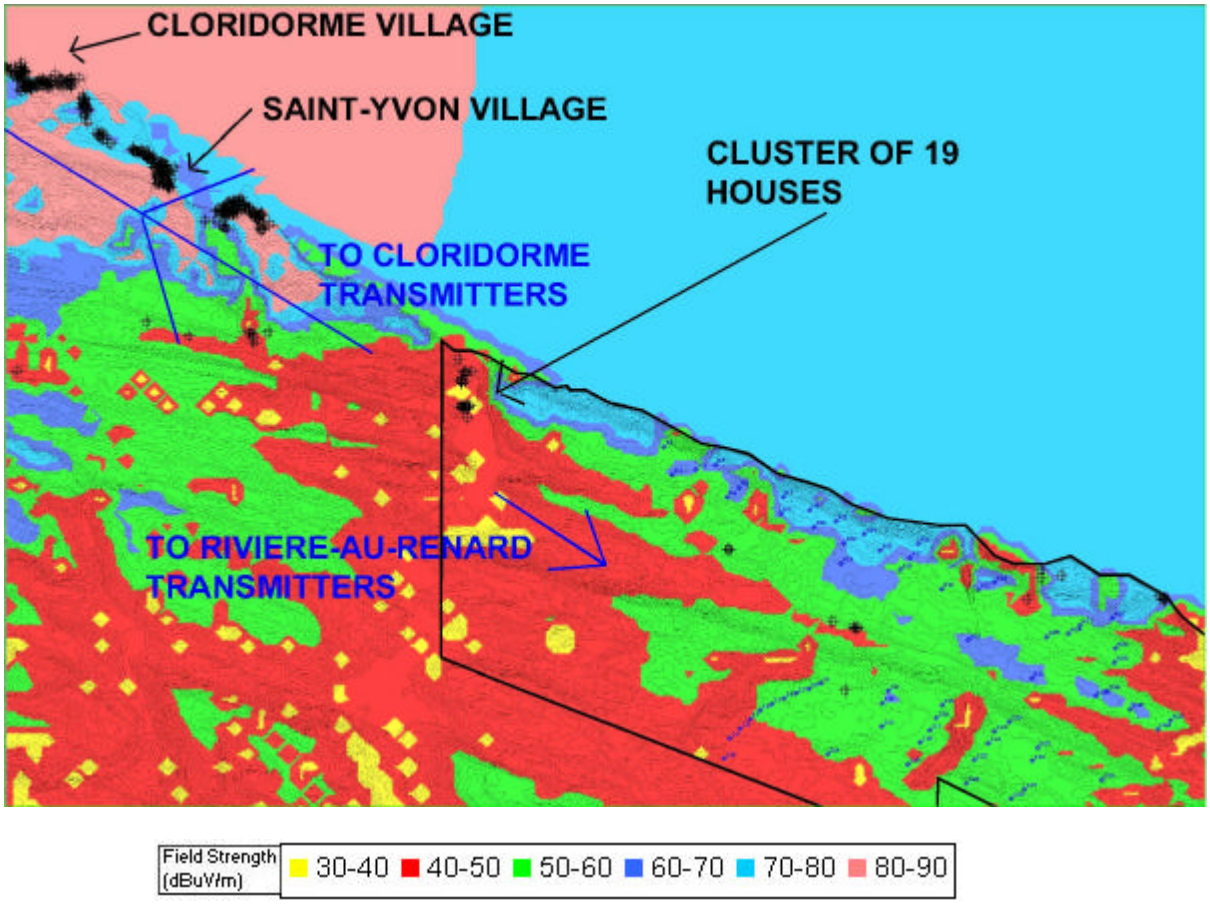

Figure 7: CBGAT-16 coverage (Cloridorme transmitter).

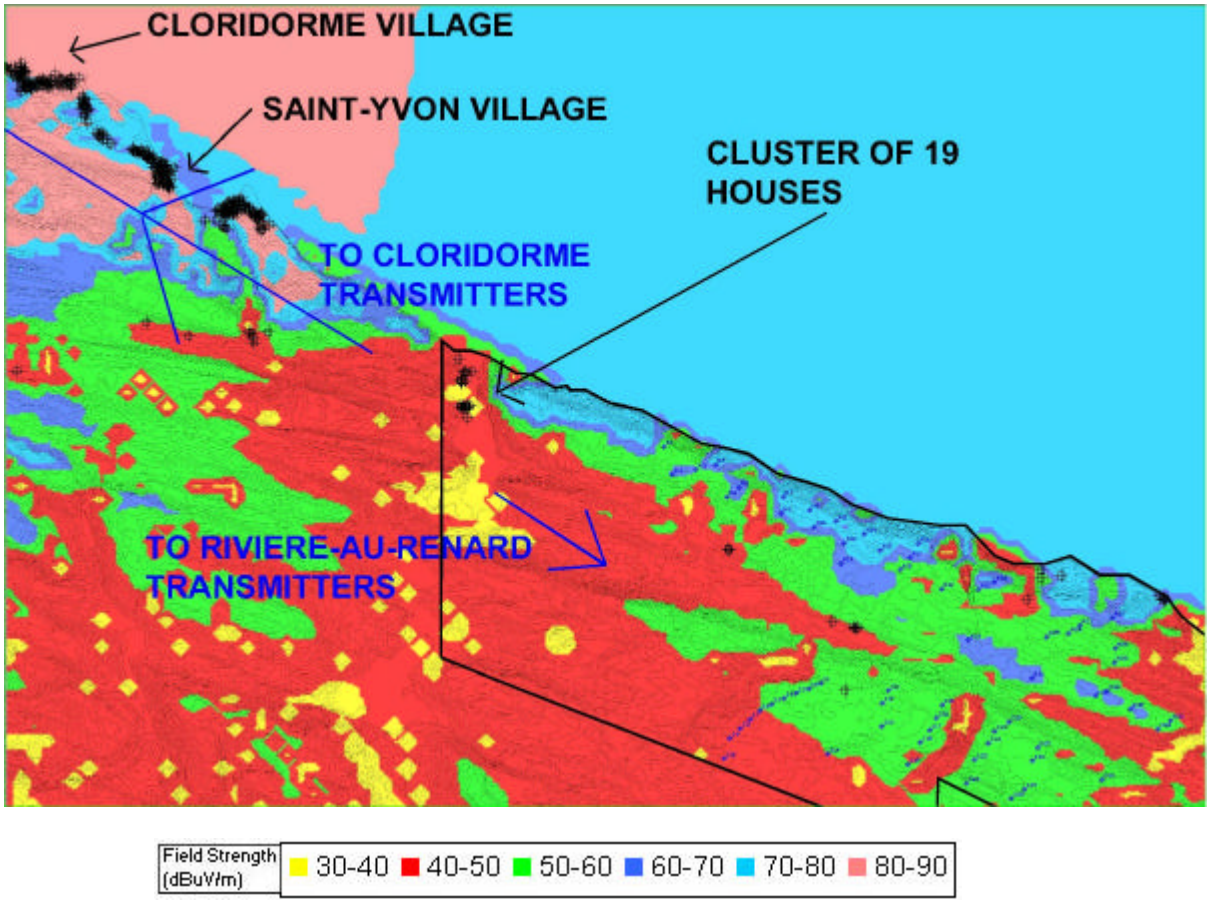

Figure 8: CHAU-TV-8 coverage (Cloridorme transmitter).

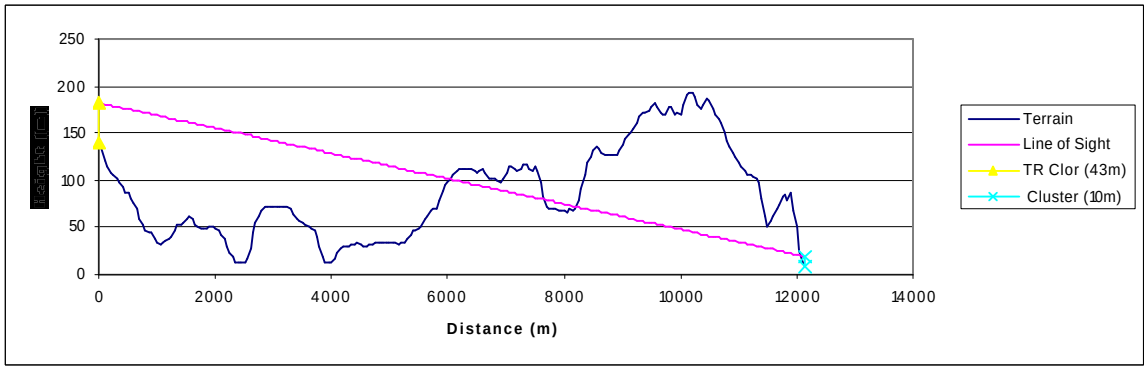

Figure 9: Terrain profile between cluster of 19 nineteen buildings and the Cloridorme transmitter.

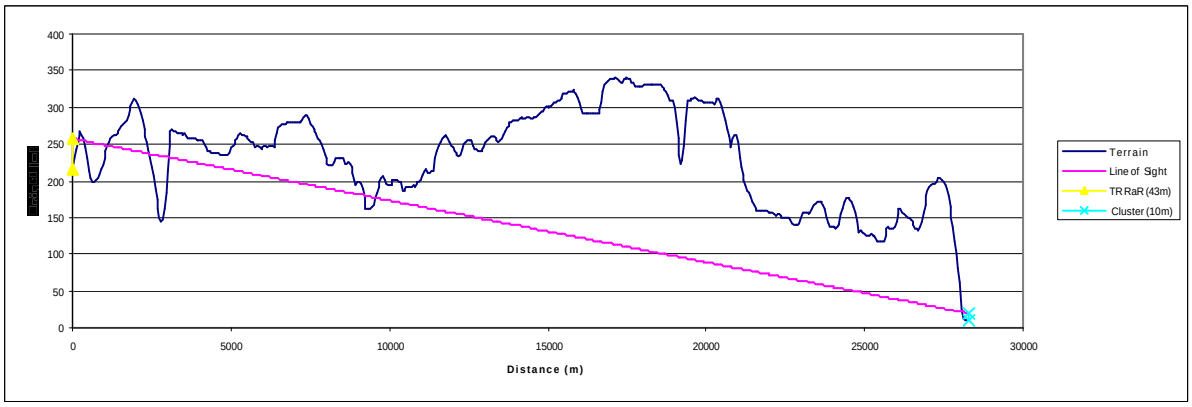

Figure 10: Terrain profile between cluster of 19 nineteen buildings and the Rivière-au-Renard transmitter.

4.2 Wind Farm Interference Predictions

In this section the results from the RES TV interference model are given. The model predicts signal to noise ratios (SNR) at locations around the wind farm. In this context the signal is the direct signal from the transmitter and the noise is the indirect, unwanted signal reflected by the wind farm. In all the interference images, areas in yellow and red may experience interference to TV reception whereas all other areas are not predicted to experience it.

The Anse-à-Valleau turbine layout used in this study consists of 81 GE 1.5MW machines (layout 20). Each machine will have hub height of 80 m, and a three bladed rotor 77 m in diameter. This gives a maximum tip height of 118.5 m for each structure. The coordinates of the turbines used in this investigation are given in Table 3 below.

Turbine ID	X (m)	Y (m)
N1	289885	5443388
N2	290657	5443124
N3	290369	5443050
N4	290009	5442972
N5	291010	5442776
N6	290829	5442640
N7	291674	5442636
N8	291641	5442387
N9	292072	5442441
N10	292137	5442186
N11	292467	5442275
N12	292590	5441945
N13	292540	5441640
N14	292894	5442081
N15	293127	5441838
N16	293698	5441936
N17	293582	5441727
N18	293428	5441544
N19	294050	5441258

Turbine ID	X (m)	Y (m)
S1	292240	5439860
S2	292055	5439772
S3	291865	5439702
S4	291685	5439625
S5	291495	5439541
S6	291323	5439448
S7	291174	5439319
S8	291030	5439177
S9	290870	5439026
S10	290790	5438721
S11	293254	5439742
S12	293157	5439561
S13	293153	5439203
S14	292343	5438792
S15	294057	5439524
S16	293974	5439334
S17	293867	5439150
S18	293730	5438967
S19	293540	5438638

N20	294841	5441359
N21	294603	5441245
N22	294450	5440493
N23	296112	5440712
N24	295947	5440587
N25	295616	5440539
N26	295391	5439925
N27	296606	5440816
N28	296643	5440367
N29	296638	5440155
N30	296527	5439733
N31	296357	5439662
N32	296876	5439469
N33	297479	5439294
N34	297289	5439163
N35	298406	5439912
N36	298555	5439615
N37	298934	5439591

S20	295054	5439275
S21	294841	5439133
S22	294751	5438953
S23	294543	5438702
S24	294426	5438356
S25	295478	5438890
S26	295400	5438692
S27	295283	5438264
S28	295086	5438129
S29	296442	5438406
S30	295852	5437913
S31	295684	5437787
S32	297355	5437783
S33	297129	5437673
S34	298239	5437805
S35	298033	5437770
S36	297854	5437725
S37	297639	5437645
S38	298102	5437225
S39	299495	5437188
S40	298692	5436542
S41	300332	5436783
S42	300204	5436611
S43	299569	5436201
S44	299394	5436068

Table 3: Anse-à-Valleau Turbine Layout used in Interference Model

4.2.1 Interference Prediction for Viewers of Anse-à-Valleau Transmitters

Figures 11 and 12 show the predicted interference for viewers of the Anse-à-Valleau transmitters. As it can be seen no village is expected to suffer interference. Only eight isolated buildings located to the west of Anse-à-Valleau village (see figure 11 and 12) fall within the area where interference is predicted. The co-ordinates of these buildings can be found in Annex B. These buildings are not predicted to be receiving a high TV signal (figures 3 and 4) as they are screened from the transmitters by the intervening terrain (see figure 13 that shows the terrain profile between one of these buildings and the Anse-à-Valleau transmitters). Therefore it is likely that they have some means of improving the signal they are receiving (e.g. an aerial mounted on top of a high pole..), which will also decrease the likelihood of interference.

It is important to note that, although the signal these buildings are receiving is screened by the terrain, it never propagates through the wind farm, which rules out the most likely cause of interference occurring. RES experience suggests that in the case of these buildings they might experience interference only if they are already receiving a very low signal. Therefore if these buildings currently enjoy improved reception then no interference is expected.

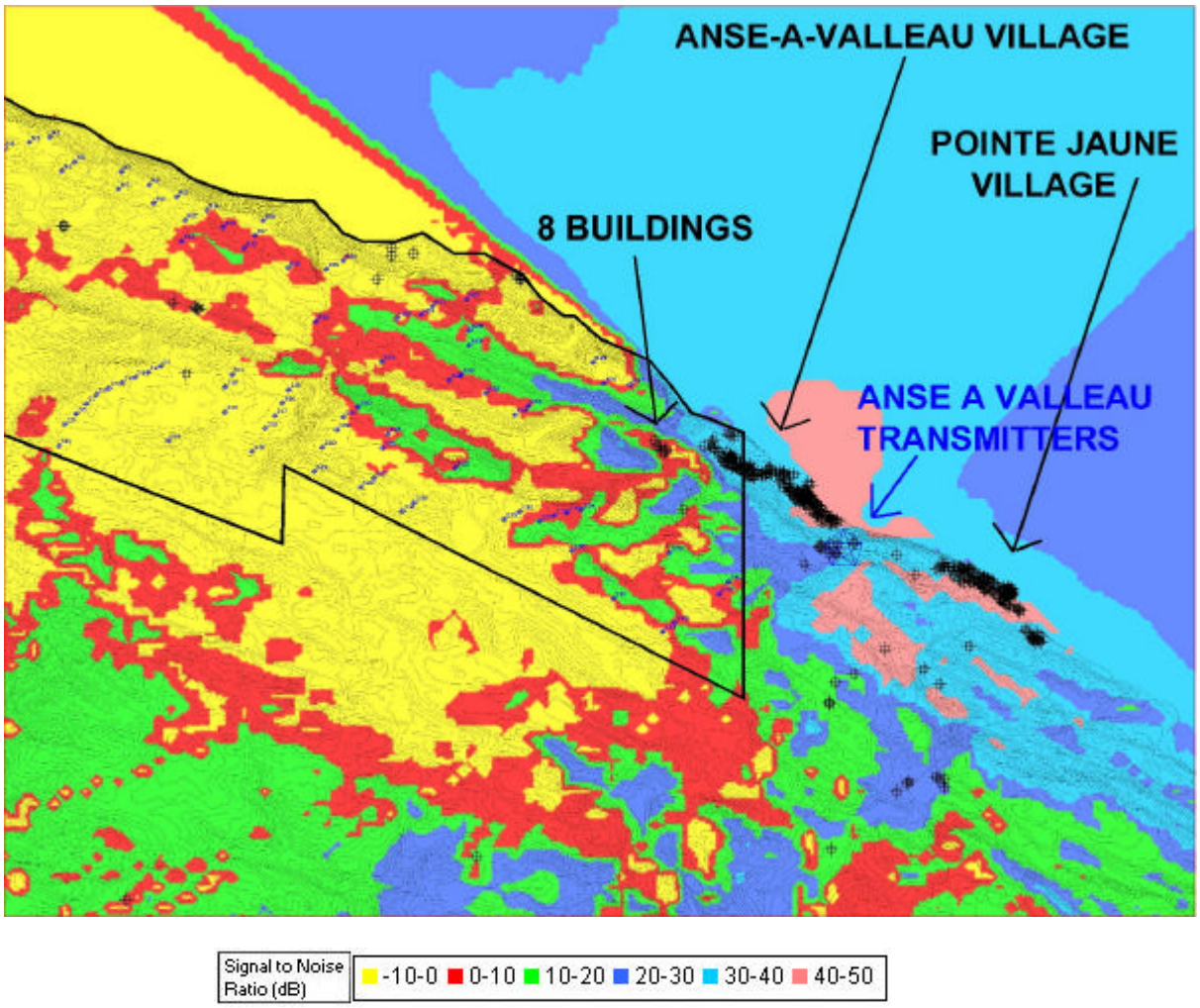

Figure 11: Predicted Interference to CBGAT-18 (Anse-à-Valleau transmitter) east of the wind farm.

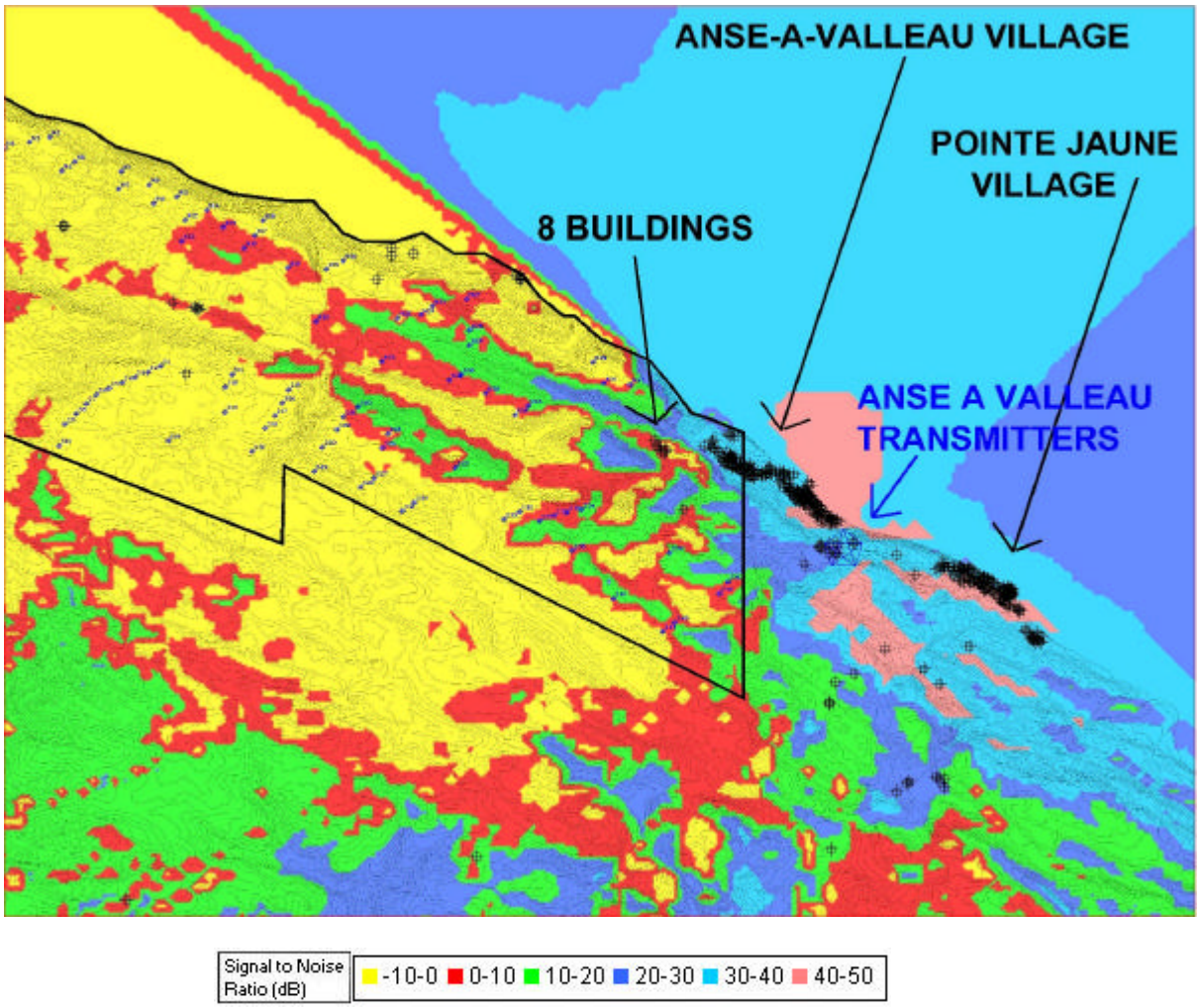

Figure 12: Predicted Interference to CHAU-TV-9 (Anse-à-Valleau transmitter) east of the wind farm.

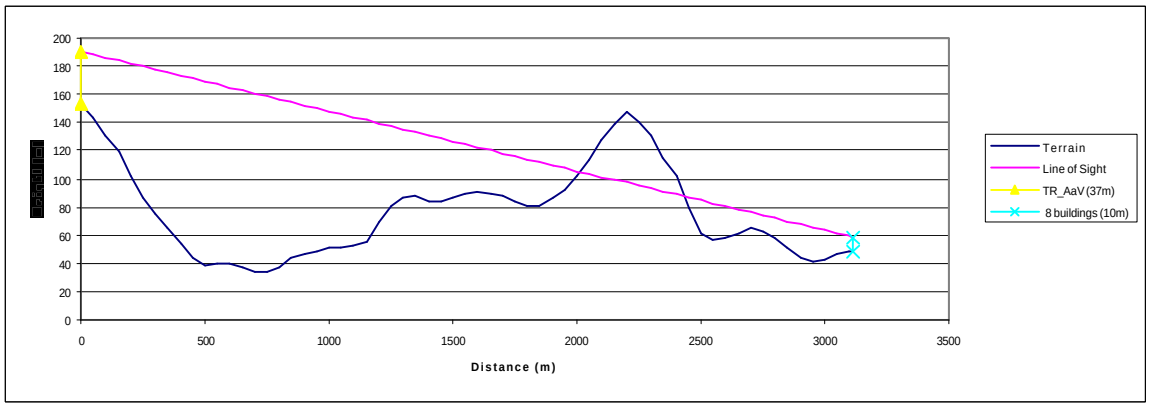

Figure 13: Terrain profile between one the 8 buildings with predicted interference and the CBGAT-18 transmitter.

4.2.2 Interference Prediction for Viewers of Rivière-au-Renard Transmitters

Figures 14 and 15 show the predicted interference for viewers of the Rivière-au-Renard (CBGAT-22 and CHAU-TV-7) transmitters. As it can be seen interference is predicted only in locations next to the turbines. No village covered by these transmitters is predicted to be affected.

There are fifteen buildings located within the site development boundary. According to the coverage predictions it is possible that these buildings are tuned to the Rivière-au-Renard transmitters and therefore they experience interference to TV reception. The co-ordinates of these buildings can be found in Annex B.

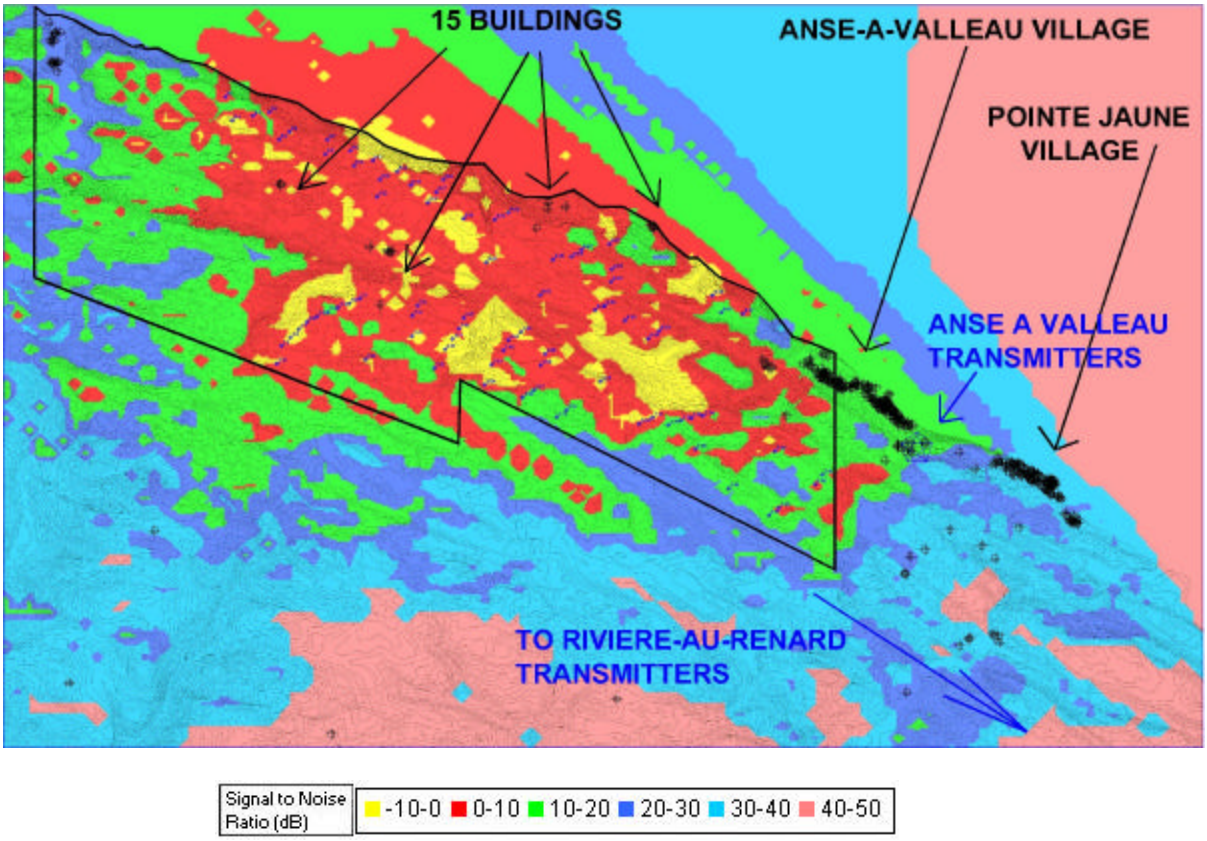

Figure 14: Predicted Interference to CBGAT-22 (Rivière-au-Renard transmitter).

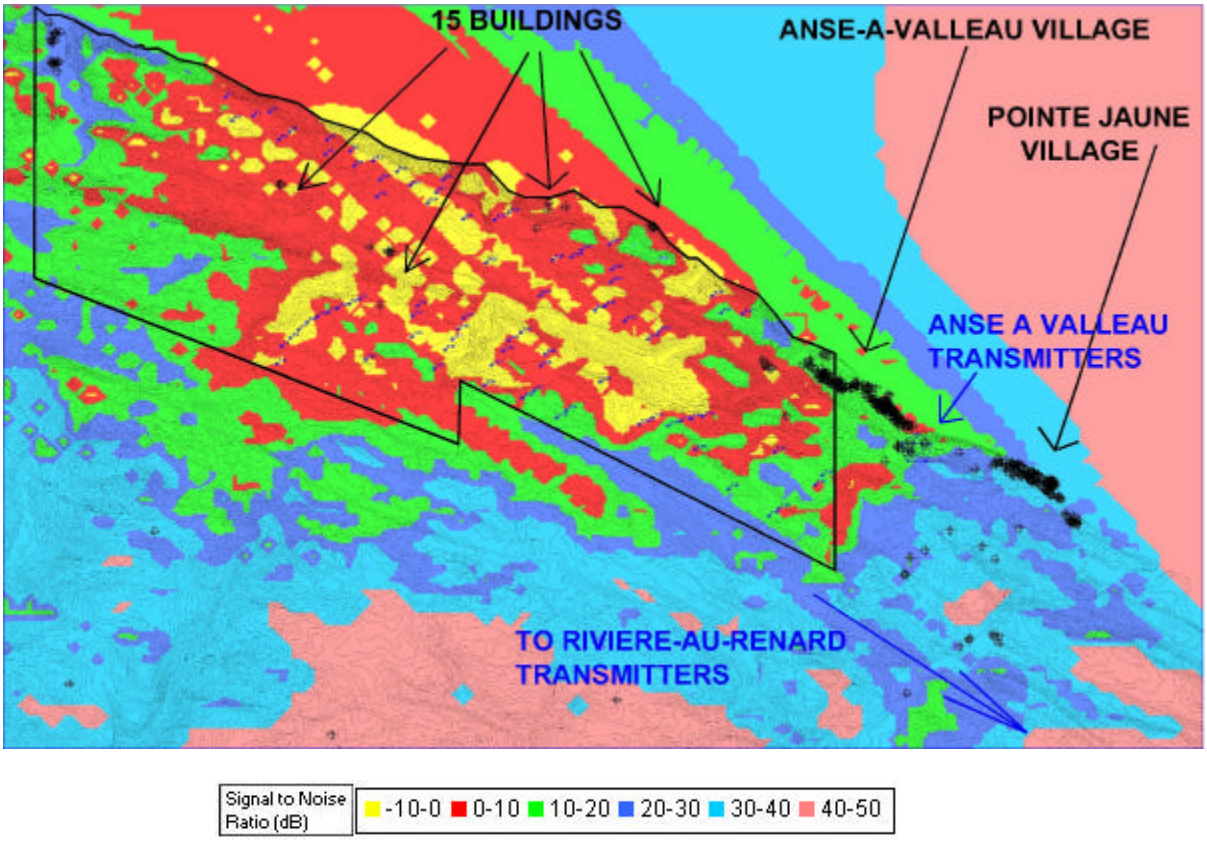

Figure 15: Predicted Interference to CHAU-TV-7 (Rivière-au-Renard transmitter).

4.2.3 Interference Prediction for Viewers of Cloridorme Transmitters

Figures 16 and 17 show the predicted interference for viewers of the Cloridorme (CBGAT-16 and CHAU-TV-8) transmitters. Due to the low signal they are predicted to be receiving, the cluster of 19 buildings fall within the area of predicted interference. It must be noted, however, that they are not located between the transmitter and the wind farm which means that they do not look directly through the wind farm. This fact, together with the fact that probably they are currently enjoying a reception improved by some means, decreases the likelihood that they experience interference to TV reception. The co-ordinates of these buildings can be found in Annex B.

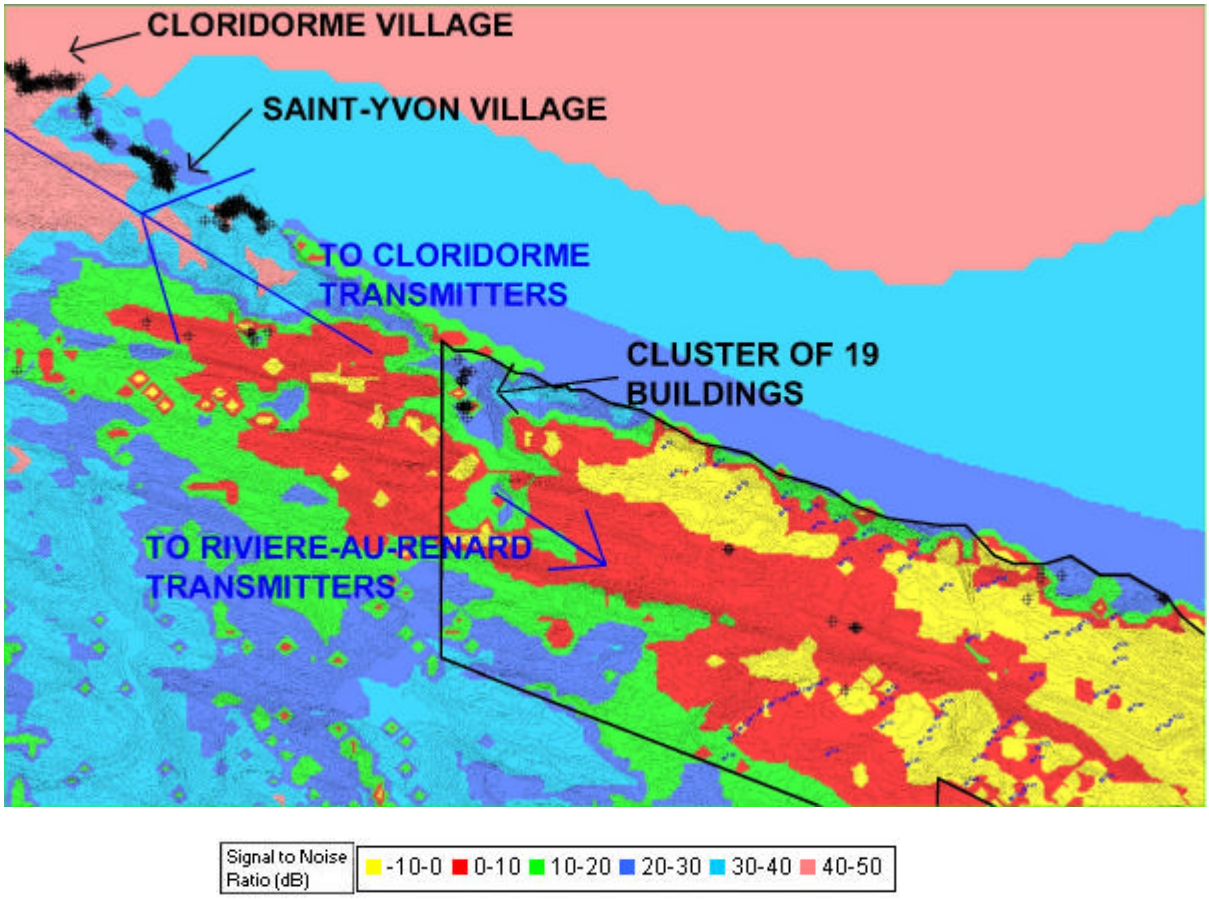

Figure 16: Predicted Interference to CBGAT-16 (Cloridorme transmitter) west of the Wind Farm.

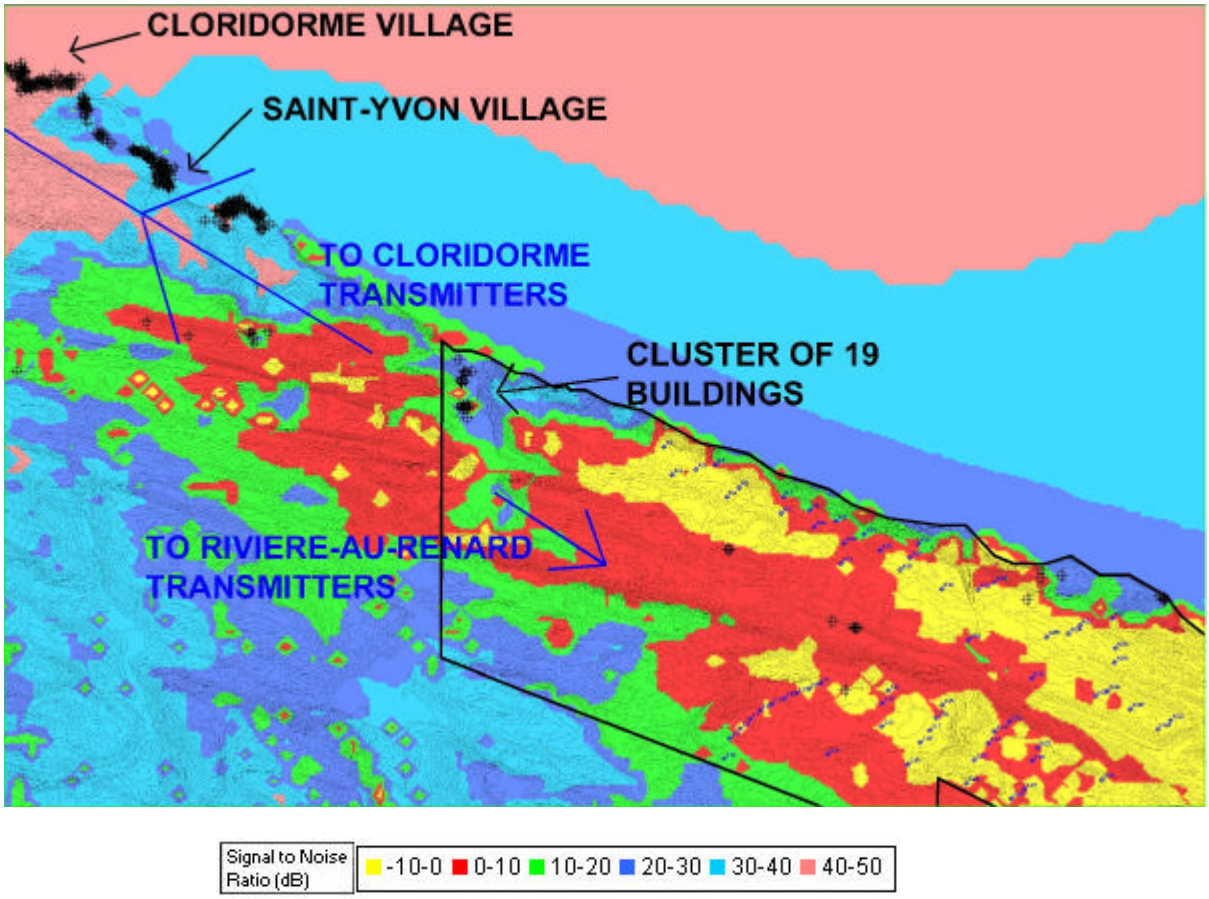

Figure 17: Predicted Interference to CHAU-TV-8 (Cloridorme transmitter) west of the Wind Farm.

4.3 Links between TV Stations

Table 4 and Figure 18 show rebroadcast (RBL) links between TV transmitters in the area.

Station	Receives Signal from	Sends Signal to
CBGAT-18 (Anse-à-Valleau)	(1)	-
CHAU-TV-9 (Anse-à-Valleau)	CHAU-TV-7 (Rivière-au-Renard)	-
CBGAT-22 (Rivière-au-Renard)	GASPE 51 (Gaspe)	(1)
CHAU-TV-7 (Rivière-au-Renard)	CHAU-TV-5 (Perce)	CHAU-TV-8 (Cloridorme) CHAU-TV-9 (Anse-à-Valleau)
CBGAT-16 (Cloridorme)	CBGAT-3 (Grande-Vallee)	-
CHAU-TV-8 (Cloridorme)	CHAU-TV-7 (Rivière-au-Renard)	-

Table 4. Radio Links between TV Stations.

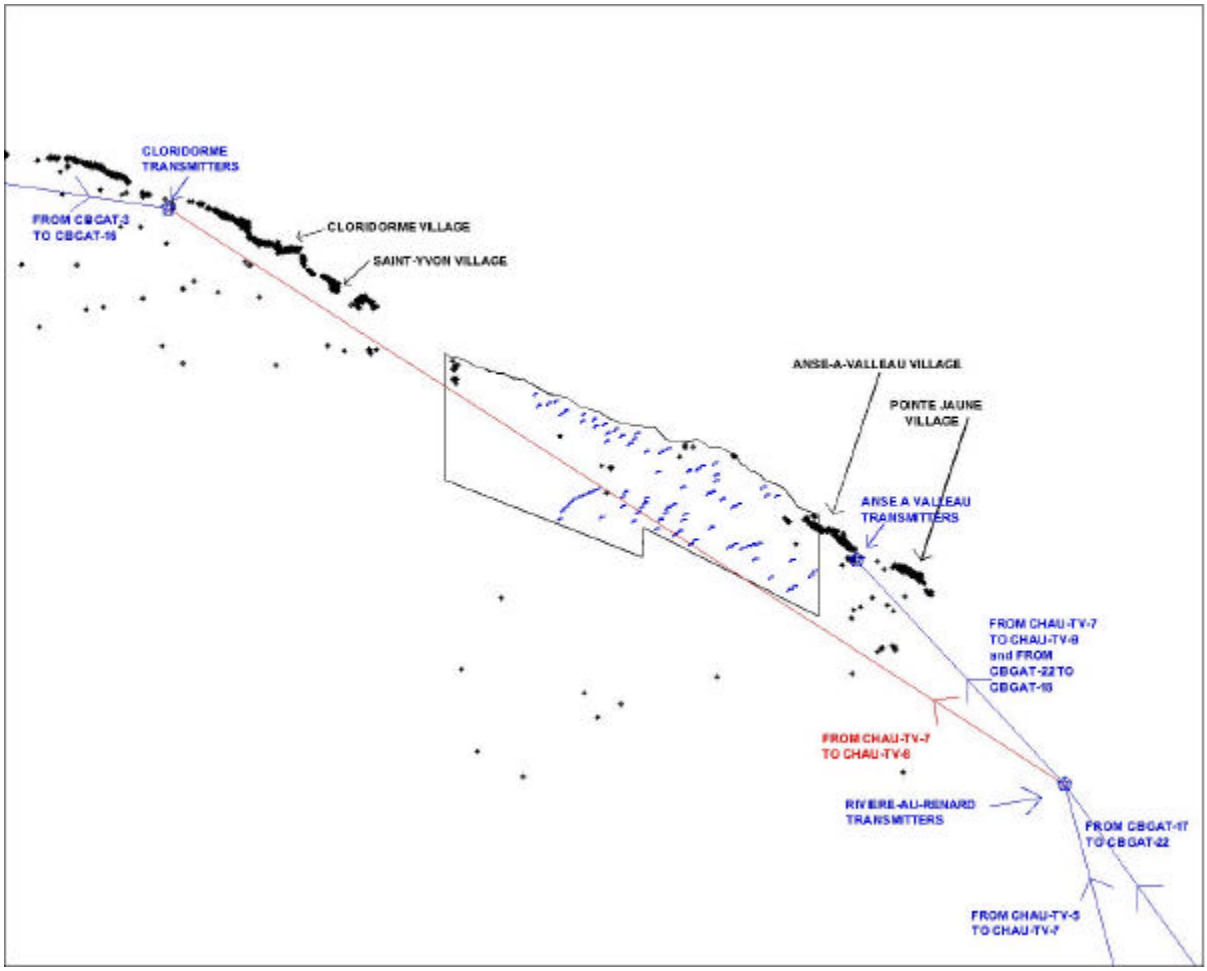

Figure 18. Radio Links between TV Stations.

(1) There is no data in the Industry Canada database [6] stating the source of CBGAT-18 (Anse-à-Valleau) station's main signal. Due to the proximity and high power of the CBGAT-22 (Rivière-au-Renard) station it is likely that CBGAT-18 receives its signal from CBGAT-22.

Only one link, from station CHAU-TV-7 (Rivière-au-Renard) to CHAU-TV-8 (Cloridorme) travels through the wind farm (see link colored in red in figure 18). The impact of the wind farm on this RBL link is assessed in the following sections.

4.3.1 Description of the RBL Link

This is a VHF RBL link of approximately 40km that operates with the frequency 66 MHz. The transmitting station, CHAU-TV-7 at Rivière-au-Renard, is 42.6m tall and emits with a power of 5.5KW. The receiving station, CHAU-TV-8 at Cloridorme, is 42.7m tall. There is no line-of-sight (LOS) between the two transmitters (see figure 19 that shows the terrain profile between the two stations).

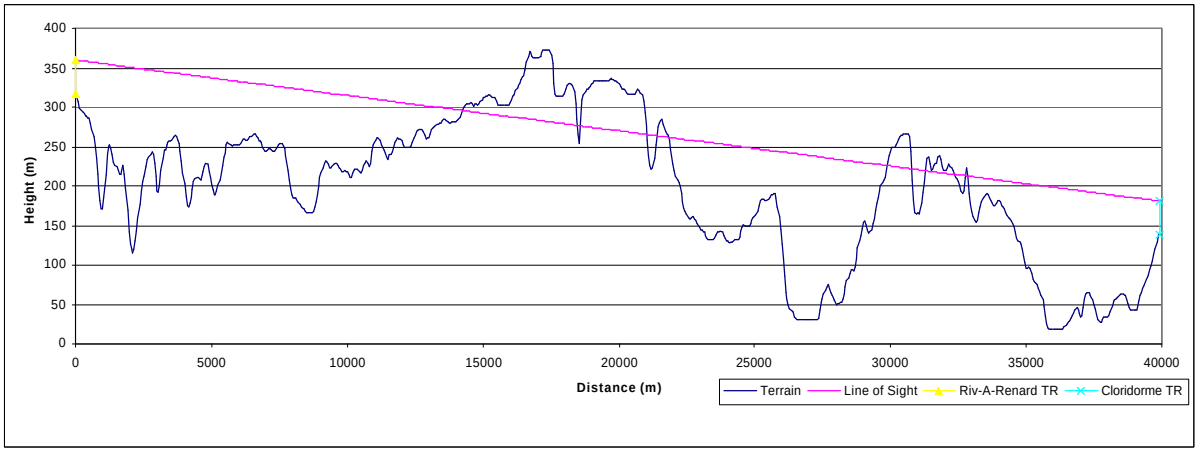

Figure 19. Terrain profile between CHAU-TV-7 (Rivière-au-Renard) and CHAU-TV-8 (Cloridorme).

4.3.2 Effect of the Wind Farm on the RBL Link

The station at Cloridorme receives the main signal from the Rivière-au-Renard station. As there is no LOS between the transmitters the signal propagates mainly by diffraction on the obstacles that it finds along the path. The signal may reach the turbines which could reflect secondary signals to the Cloridorme station, which may impair its reception. To assess the effect of the wind farm on the reception at the Cloridorme station the field-strength of the main and reflected signals received at this station will be estimated and compared. This is done applying the concept of signal-to-noise ratio (SNR). In this context the signal is the main diffracted TV signal, whereas the noise is the individual signal reflected by each turbine. All these values have been calculated using the software described in section 2.3 which is based on the ITU-R recommendations "Propagation by diffraction" [2] and "Assessment of Impairment to Television Reception by a Wind Turbine" [1].

Table 5 shows a summary of the most relevant results from this calculation. The complete results can be found in Annex A.

Field-Strength at CHAU-TV-8 station (dBµV/m):	60.8
Maximum Field-Strength at the turbines (dBµV/m):	91.2
Minimum Field-Strength at the turbines (dBµV/m):	68.6
Maximum Reflected Field-Strength at CHAU-TV-8 station (dBµV/m):	26.9
Minimum Reflected Field-Strength at CHAU-TV-8 station (dBµV/m):	3.4
Minimum Signal-to-Noise Ratio at CHAU-TV-8 station (dBµV/m):	33.9

Table 5. Estimation of the Field-Strength and Signal-to-Noise Radio at CHAU-TV-8 station and at the turbines.

The minimum signal-to-noise ratio predicted at the CHAU-TV-8 station is 33.9 dBµV/m. This means that the predicted wanted field-strength at the Cloridorme transmitter is predicted to be always at least 33.9 dBµV/m higher than any of the unwanted reflected signals from the turbines. According to [1] 34 dBµV/m is the minimum signal-to-noise value that guarantees a good TV reception in the CCIR-ITU assessment quality scale. Therefore it is concluded that the

construction of the wind farm will not impair the existing RBL link between the CHAU-TV-7 and CHAU-TV-8 stations.

Supporting this conclusion is the fact that all distances between turbines and the CHAU-TV-8 station at Cloridorme are at least 15Km. Standard studies on interference to TV reception due to turbines do not usually go further than 10Km from any turbine, due to the increased attenuation of the low level reflected signals compared with the main signal.

Finally, it can be said that this analysis is also conservative in the sense that it assumes that a receiving aerial with standard angular discrimination is employed, whereas for an RBL link a high quality receiving aerial would be expected.

5.0 MITIGATION TO TV INTERFERENCE

In the event of interference occurring, a solution is usually available by considering one or more of the following options appropriate for this area:

- Improved aerial system
- Alternative transmitter
- Digital Television- terrestrial or satellite
- Self-help system

Each of these options is evaluated below.

5.1 Improved aerial

A standard aerial has an angular discrimination of approximately 60 degrees. If the receiver suffering interference is positioned such that there is a large angular difference between the wanted and reflected signals, that is, the transmitter and the wind farm, then an improved aerial may help. Aerials with improved “back-to-front” ratios may also provide a solution, in rare cases, close to the wind farm where aerials receive a reflected signal from behind.

Many other improvements can be made to a household’s reception equipment, depending on requirements. For example the height of the aerial can be increased, the signal can be amplified and the aerial can be directed away from or shielded from the wind farm.

In some of the identified areas at risk in this case it has been seen that any potential interference may come from an already low received signal impaired by an unwanted signal reflected by the wind farm. RES experience suggests that although this type of interference is less likely to happen, it can still appear. This is caused by the fact that although aerials are designed to receive signals only from the direction they are pointing at, they still pick up unwanted signals from behind. Figure 20 shows this scenario. The “back-to-front” ratio of an aerial quantifies its capability of picking up unwanted signals from behind compared to the main received signal. Hence any means of improving the main received signal, and also of reducing the unwanted back signal will decrease the likelihood of experiencing interference. A higher aerial with a good “back-to-front” ratio directed away from the wind farm is a straightforward way to achieve this, and therefore it is a likely possible solution for the 8 buildings west of Anse-à-

Valleau and for the cluster of 19 buildings to the westernmost part of the development boundary. Figure 21 shows this improved scenario.

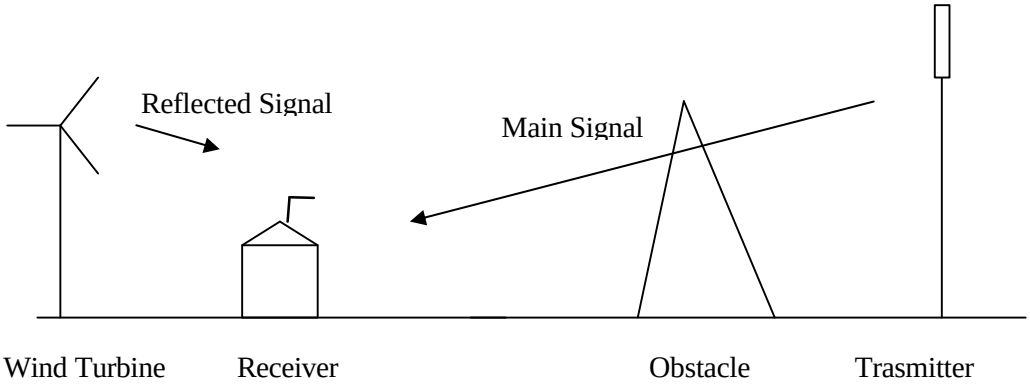

Figure 20: Scenario where an aerial can pick up unwanted signals from behind.

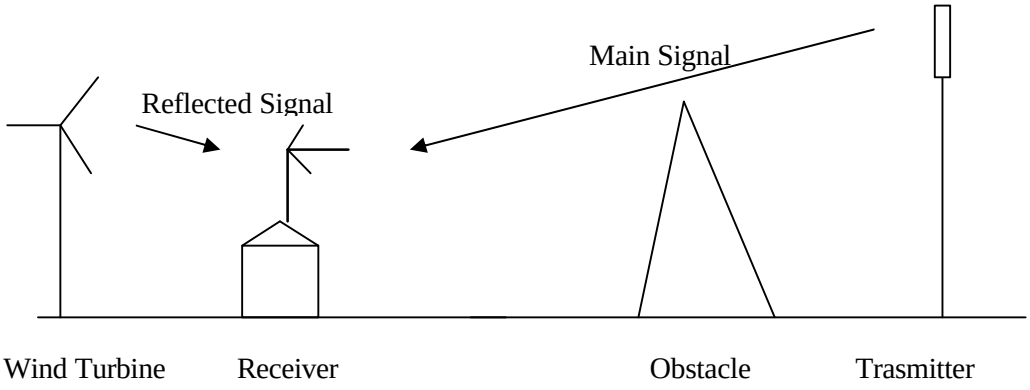

Figure 21: Improved scenario to avoid picking up unwanted signals from behind.

5.2 Alternative Transmitter

In the case of interference appearing in the 15 buildings identified within the development boundary, the solution of tuning the existing aerial to an alternative transmitter should be considered as although low, the signal from Cloridorme could still be usable in the area.

5.3 Digital Television

The impact of wind farms on terrestrial digital television (DTV) has not been fully assessed, but limited experience shows that it is less prone, though not immune, to interference than analogue signals.

The availability of cable TV, terrestrial DTV and satellite DTV are three options that should be further investigated in the event of interference appearing. An advantage of these mitigation

options is that they may be viewed by the householder as an improvement to their television service rather than a restoration of service.

5.4 Self Help Transmitter

A self-help system is a small licensed relay station located to receive a clean signal and to transmit to affected households without interference from the wind farm. Normally new aerials are required as well as a license to operate the transposed frequencies. In the case of interference appearing and that none of the previous measures are available, a self-help transmitter is an option to be considered.

6.0 CONCLUSIONS

A prediction of interference to radio and TV reception around Anse-à-Valleau wind farm has been made. The results show that no widespread interference is predicted to be caused by the wind farm.

No interference to AM or FM radio reception is predicted.

TV interference may occur at 15 buildings within the development boundary. Although less likely, interference may also appear in two clusters of buildings, 8 buildings west of Anse-à-Valleau village and 19 buildings east of Cloridorme village. This is mainly due to the fact that these areas are predicted to be already receiving a low TV signal. Isolated cases of interfence cannot be ruled out either.

It has been proposed that TV interference at buildings within the development boundary can be mitigated by tuning the aerials to an alternative transmitter or by providing them with digital TV if available. TV interference in the two identified clusters of 19 and 8 buildings can be mitigated by installing an aerial with a good “back-to-front” ratio, as these signals would have been impaired by reflected signals from the wind farm, received on the back of household aerials. RES experience suggests, however, that this type of interference is unusual.

RBL links between TV stations have been assessed and only a VHF one, going from CHAU-TV-7 (Rivière-au-Renard) station to CHAU-TV-8 (Cloridorme) station, has been found to be travelling through the wind farm. It is not predicted that the wind farm will have any effect on this RBL link.

This is a desktop study and has been undertaken assuming that viewers in the areas studied for each transmitter are actually tuned to that transmitter, but this may not be the case. This assumption has been taken in order to establish the worst scenario. If required it can be complemented with an on-field survey.

7.0 REFERENCES

[1] ITU-R Recommendation 805, “Assessment of Impairment to Television Reception by a Wind Turbine”.

[2] ITU-R Recommendation 526-7, “Propagation by diffraction”

[3] BBC Research Department Report RD 1992/7.

[4] "TV Measurements Near Lendrum's Bridge Wind Turbines", J.E.Goodson, Spectrum Planning Group, NTL, September 2003

[5] RES Internal Report: 01142R0003, "The RES TV Interference Model. Description and Validation", Santi Vila-Moreno, June 2003.

[6] Industry Canada (20/04/2004): Broadcasting Database and other Related Informations, Available online: http://spectrum.ic.gc.ca/infoback/dgse/english/baserade.html [Accessed: 23/04/2004]

[7] Sengupta, D.L. and Senior, T.B.A. (1994) Chapter 9, Electromagentic Interference from Wind Turbines, Wind Turbine Technology, Spera D.A., ASME PRESS (p: 479)

ANNEX A. CALCULATED FIELD-STRENGTH AND SIGNAL-TO-NOISE RATIO VALUES AT THE TURBINES AND AT THE CHAU-TV-8 TRANSMITTER (CLORIDORME)

Turbine ID	Field-Strength at turbine (dBµV/m)	Unwanted F-S at Cloridorme transmitter per turbine (dBµV/m)	Distance Rivière-Au-Renard Transmitter - turbine (Km)	Distance Cloridorme TR - turbine (Km)	Total Distance (Km)
N1	68.9	11.4	24.6	15.4	40.0
N2	68.6	10.7	23.9	16.2	40.1
N3	69.0	11.2	24.1	16.0	40.0
N4	69.0	11.4	24.3	15.7	40.0
N5	70.7	12.5	23.4	16.7	40.1
N6	70.1	11.3	23.4	16.6	40.0
N7	71.0	12.4	22.8	17.3	40.1
N8	70.8	12.1	22.6	17.4	40.1
N9	80.3	21.5	22.3	17.8	40.1
N10	72.0	13.2	22.1	17.9	40.1
N11	80.8	21.8	21.9	18.2	40.1
N12	80.4	21.3	21.6	18.5	40.1
N13	71.8	10.5	21.5	18.6	40.0
N14	82.5	23.3	21.5	18.7	40.1
N15	83.5	24.2	21.1	19.0	40.1
N16	82.7	23.1	20.7	19.5	40.2
N17	83.0	23.4	20.7	19.4	40.1
N18	81.7	21.3	20.7	19.4	40.1
N19	81.9	19.9	20.0	20.1	40.1
N20	84.2	24.0	19.5	20.7	40.2
N21	83.1	22.4	19.6	20.6	40.2
N22	81.4	18.9	19.3	20.8	40.0
N23	85.1	23.5	18.1	22.2	40.3
N24	85.8	23.4	18.1	22.1	40.2
N25	84.2	20.4	18.4	21.8	40.2
N26	83.3	20.0	18.2	21.9	40.0
N27	85.7	24.6	17.8	22.6	40.4
N28	85.9	23.4	17.5	22.8	40.3
N29	86.0	21.5	17.3	22.9	40.2
N30	85.3	21.3	17.2	23.0	40.1
N31	85.2	20.6	17.2	22.9	40.1
N32	86.0	21.4	16.7	23.4	40.1
N33	86.6	21.5	16.1	24.0	40.2
N34	85.3	19.5	16.2	23.9	40.1
N35	88.1	25.1	15.9	24.6	40.4
N36	88.3	23.9	15.6	24.8	40.4
N37	89.0	26.9	15.3	25.2	40.5
S1	83.6	19.1	20.7	19.2	39.9
S2	85.3	12.0	20.8	19.1	39.9
S3	86.2	12.2	21.0	19.0	39.9
S4	85.3	11.4	21.1	18.9	39.9

S5	83.4	6.9	21.2	18.8	40.0
S6	82.6	5.0	21.3	18.7	40.0
S7	82.3	4.6	21.4	18.6	40.0
S8	81.5	3.7	21.4	18.6	40.0
S9	81.8	3.4	21.5	18.6	40.1
S10	83.2	4.0	21.4	18.7	40.1
S11	86.2	22.2	19.8	20.1	39.9
S12	85.4	21.6	19.8	20.1	39.9
S13	85.5	9.4	19.6	20.3	39.9
S14	83.9	5.9	20.1	19.9	40.0
S15	83.8	18.6	19.0	20.9	39.9
S16	85.8	20.8	19.0	21.0	39.9
S17	85.2	20.1	19.0	21.0	39.9
S18	85.2	19.7	19.0	20.9	39.9
S19	87.5	12.7	19.0	21.0	39.9
S20	85.7	20.4	18.0	21.9	40.0
S21	86.5	21.6	18.1	21.8	39.9
S22	86.7	21.4	18.1	21.8	39.9
S23	87.5	22.1	18.1	21.8	39.9
S24	88.0	13.9	18.1	21.9	39.9
S25	87.1	21.7	17.5	22.5	39.9
S26	87.3	21.9	17.4	22.5	39.9
S27	88.3	23.4	17.3	22.6	39.9
S28	88.3	23.5	17.4	22.5	39.9
S29	88.5	22.4	16.4	23.5	40.0
S30	88.7	23.1	16.6	23.3	39.9
S31	88.6	23.0	16.7	23.2	39.9
S32	89.4	22.7	15.3	24.6	40.0
S33	89.0	22.2	15.4	24.5	39.9
S34	89.8	23.3	14.6	25.4	40.0
S35	89.7	22.8	14.8	25.2	40.0
S36	89.6	22.4	14.9	25.1	40.0
S37	89.6	22.8	15.0	25.0	40.0
S38	90.0	23.1	14.4	25.6	39.9
S39	90.6	23.4	13.2	26.8	40.0
S40	90.4	22.6	13.5	26.4	39.9
S41	91.2	23.8	12.3	27.7	40.1
S42	91.2	15.0	12.3	27.7	40.0
S43	91.1	15.2	12.6	27.4	39.9
S44	91.0	14.8	12.7	27.3	39.9

ANNEX B. CO-ORDINATES OF HOUSES

Cluster of 19 buildings		
House	**X (m)**	**Y (m)**
1	286946	5443834
2	286972	5444002
3	286942	5443989
4	286928	5443984
5	286895	5444496
6	286918	5444492
7	286923	5444515
8	286812	5444687
9	287010	5444510
10	286900	5444368
11	286859	5444340
12	286856	5444366
13	286854	5444383
14	286838	5444383
15	286910	5443979
16	286889	5443976
17	286870	5443979
18	286852	5443992
19	286834	5443993

Cluster of 8 buildings		
House	**X (m)**	**Y (m)**
1	299415	5438630
2	299422	5438658
3	299290	5438797
4	299337	5438722
5	299363	5438664
6	299311	5438722
7	299453	5438665
8	299695	5437823

15 buildings within boundary		
House	**X (m)**	**Y (m)**
1	290846	5441863
2	290860	5441852
3	292791	5440680
4	292722	5440692
5	292760	5440671
6	292407	5440764
7	292596	5439746
8	295323	5441095
9	295528	5441430
10	295530	5441542

11	295837	5441461
12	297318	5441143
13	297367	5441092
14	297378	5441130
15	297398	5441107