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Database Specifications

White Space Database Specifications

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Preface

Database Specifications DBS-01, issue 3, *White Space Database Specifications*, replaces *White Space Database Specifications*, issue 2.

List of changes:

1. The definition for "less congested areas" has been revised.
2. A new class of Mobile White Space Devices has been added.
3. New sections have been added relating to the operation of Mobile WSDs within geo-fenced areas.
4. New requirements have been added relating to the operation of Narrowband WSDs.
5. The protection criteria for developmental licence stations have been removed.
6. The limits to WSD antenna heights above ground level (AGL) have been removed.
7. References to taboo channels have been removed.
8. Fixed WSDs operating with an equivalent isotropically radiated power (e.i.r.p.) level of 16 W have been permitted in less congested areas.
9. Minimum separation distances between WSDs and TV-protected contours have been updated to new values which better harmonize with other international standards.
10. The implementation of some provisions in this standard have been made optional in a manner which still ensures the protection of licenced services.
11. White space database synchronization requirements have been updated.
12. Editorial changes and clarifications have been made.

Issued under the authority of
the Minister of Innovation, Science and Industry

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List of acronyms

AGL	Above ground level
AMSL	Above mean sea level
dirHAAT	Directional height above average terrain
EHAAT	Effective height above average terrain
ERP	Effective radiated power (dipole)
e.i.r.p.	Equivalent isotropically radiated power
HAAT	Height above average terrain
ISED	Innovation, Science and Economic Development Canada
IC ID	Innovation, Science and Economic Development Canada Identification Number
ISP	Internet service provider
LP	Low-power
LPA	Low-power apparatus
RRBS	Remote rural broadband systems
UHF	Ultra high frequency
VHF	Very high frequency
VLP	Very low power
WS	White space
WSDB	White space database
WSDBA	White space database administrator
WSD	White space device

1. Scope

DBS-01, issue 3, *White Space Database Specifications*, sets out the technical requirements for the designation of a database capable of identifying available channels for use by white space devices (WSDs) in the white space frequency bands (i.e. 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 657-663 MHz).

2. Coming into force and transition period

This document will come into force upon its publication on the Innovation, Science and Economic Development Canada's (ISED) Spectrum management and telecommunications website and WSDBA applications based on the current issue may be submitted at any time once the document has come into force.

Within six months from the date of publication of this standard, a white space database administrator (WSDBA) having an existing white space database (WSDB) designation from ISED shall submit an application to ISED demonstrating compliance with the current issue of this standard. In preparing for this application, existing WSDBAs are reminded that DBS-01 offers a number of areas of flexibility that may be drawn upon if desired to minimize the number of changes needed to update to the current issue of the standard. Upon reception of a WSDBA application to upgrade to the current issue of this standard, ISED will review and assess compliance based on the same procedure as is used for new WSDBA applications.

If an existing WSDBA has not applied for approval within 6 months of coming into force of the current issue of this standard, ISED will consider the WSDBA to be inactive. Furthermore, if the approval process has not been completed within 12 months of the current issue of the standard coming into force, ISED will consider the WSDBA to be inactive until the approval process is completed. On a case-by-case basis, ISED may grant a WSDBA an extension to these timelines.

In order to maintain its designation, the WSDBA shall comply at all times with the terms and conditions of its Designation Agreement with ISED and ISED may take action as laid out under the terms of this agreement in the event of any non-compliance up to and including revoking its designation status.

Inactive and revoked WSDBs are prohibited from providing any active channels in response to queries from WSDs.

The application and approval status of WSDBs are shown on ISED's white space website.

3. New white space database designations

New WSDBs submitted to ISED for designation shall be required to comply with the requirements of DBS-01, issue 3. Upon reception of an application for designation, ISED will review and assess

compliance to the current issue of this standard in accordance with the procedures set out in CPC-4-1-01.

A list of designated WSDBs is available on ISED's website.

4. Purpose and application

A WSDB is a database system recognized by ISED. This database provides lists of available channels and the corresponding maximum permitted power for each available channel to white space devices (WSDs), while ensuring protection of all licensed services and systems operating in the white space frequency bands. WSDs are licence-exempt, low-power wireless devices that operate on a no-protection, no-interference basis from licensees operating in the same white space frequency bands. A WSDB uses information provided by a WSD, such as geolocation data, to dynamically manage their access to spectrum.

White spaces (WSs) are unused portions of the spectrum in the very high frequency (VHF) and ultra high frequency (UHF) bands that are available for radiocommunication systems, at a specific time and in a given geographic area.

Even if a WSDB meets the requirements of this document, ISED may impose corrective measures whenever harmful interference to licensed services or systems is caused by the operation of WSDs.

5. Provisions for Incremental Databases and Alternative Calculation Methodologies

This technical standard provides a specific methodology through which a WSDB calculates the list of channels available to WSDs. In particular, sections 13 to 16 describe the calculation that ensures the protection to other services, including TV systems, remote rural broadband systems (RRBS), low-power apparatus (LPA), and radio astronomy observatories. In order to provide a maximum of flexibility for WSDB implementation consistent with protection of licensed services, on a case-by-case basis, ISED may accept at its discretion, a WSDB implementing a calculation methodology different from the one described in this technical standard, as long as it ensures a greater level of protection of licensed services. As further examples:

- a WSDB could use an alternative methodology that would result in larger protected contours for TV broadcasting stations than those calculated with the specifications contained in Table 2.
- a WSDB could use an alternative methodology that would result in larger minimum separation distances between WSDs and TV broadcasting stations than those contained in tables C1 to C6 of Annex C.
- a WSDB could use an alternative methodology that would result in larger minimum separation distances between WSDs and RRBS stations than those contained in section 14.
- a WSDB could apply for approval where it only addresses a portion of the Canadian geography and/or a portion of the permitted frequency range, provided that it will return a result of no available channels for operation outside this area or frequency range.

Furthermore, the implementation of some provisions covered in this technical standard are indicated to be optional to the WSDBA. Notably, the implementation of less congested areas, support for mobile WSDs, and EHAAT of 700 m provisions are optional for WSDBs. For example, a WSDB may avoid the need to calculate less congested areas if they limit all WSDs' e.i.r.p. levels to 4 W or less.

ISED may require the WSDB applicant to demonstrate that the alternate methodology ensures a greater level of protection of those services. Regardless of the methodology implemented, a WSDB must apply the same calculation methodology to all WSDs for which it is providing a list of available channels. If a WSDBA that is designated under this condition would like to make any subsequent changes to its calculation methodology for a WSDB, it must first obtain written approval from ISED and may be required to submit a new application to be designated with an updated calculation methodology.

6. Contact point in case of concerns

Anyone having concerns of interference or regarding calculations performed by designated WSDBs, or to resolve issues and address any disagreements, is encouraged to contact ISED directly by email.

7. Definitions

Above ground level (AGL): The height of the centre of radiation of the antenna above the ground directly below the antenna.

Adjacent channel: A channel that is immediately adjacent to the protected channel.

Available channels*:* A range of frequencies available for use by white space devices.

Dynamic spectrum access: A technique by which a radio system dynamically adapts to the local radio spectrum environment in order to determine, and then access, available channels at specific locations.

Effective height above average terrain (EHAAT): The average of the height above average terrain values determined for eight standard radials spaced every 45 degrees of azimuth starting from true north.

Fixed WSD: A device that transmits and/or receives radiocommunication signals at a specified fixed location. The fixed device selects potential operational frequencies from a list of available channels, as provided by a WSDB.

Geo-fenced area: A geographic area defined by a boundary over which the white space database has determined a list of available channels.

Geolocation capability: The ability of a white space device to determine its geographic coordinates within a required level of accuracy and confidence level.

Height above average terrain (HAAT): The height of the centre of radiation of the antenna above the average terrain elevation profile (see its definition below) within a specified distance segment from the antenna along a particular radial.

- For WSDs, RRBS and TV Stations, the specified distance segment for calculation shall be from 3 to 16 km.
- For Low Power TV stations, the specified distance segment for calculation shall be from 0 to 5 km.

Determination of HAAT does not stop at the border or over bodies of water. Each HAAT determination shall incorporate the full radial segment and shall not be truncated at the border nor over bodies of water.

Height above average terrain in the direction of the affected TV station (dirHAAT): The largest of the HAAT values determined for standard radials spaced every 5 degrees of azimuth within an arc of ±22.5 degrees from a line between the WSD location and the closest point on the contour in the direction of the affected TV transmitter.

Innovation, Science and Economic Development Canada Identification (IC ID): The ISED certification number of a WSD.

Less congested area: Geographical area where at least half of the TV channels, within a specific TV band (i.e. 54-72 MHz and 76-88 MHz for the low VHF band; 174-216 MHz for the high VHF band; 470-608 MHz for the UHF band), are not being used for broadcast and other protected services, and could be available for use by a WSD. Less congested areas are determined separately for each of the three TV bands listed. WSDs can only operate at levels prescribed for the less congested area in the particular TV band and geographical area identified. For the purpose of this definition, a channel is considered available for WSD use if it is available for fixed devices operating with 40 mW e.i.r.p. at 3 meters HAAT. The implementation of less congested areas provisions is optional for WSDBs. A WSDB may avoid the need to calculate less congested areas if they limit all WSDs to an e.i.r.p. level less than or equal to 4 W.

Low-power apparatus (LPA): A wireless microphone device certified under RSS-210 - *Licence-Exempt Radio Apparatus: Category I Equipment* with a voluntary licence issued under CPC-2-1-28 - *Voluntary Licensing of Licence-Exempt Wireless Microphones in the TV Bands*

Mobile white space device (WSD): A WSD that transmits and/or receives radiocommunication signals on available channels while stationary or in motion within a defined geo-fenced area. The mobile WSD selects potential operational frequencies from a list of available channels, as provided by a WSDB. A mobile WSD uses an incorporated geolocation capability to determine its location with respect to the boundaries of the defined geo-fenced area. The operation of mobile WSDs is limited to less congested areas. The operation of Mobile WSDs on satellites and aircraft, including unmanned aerial vehicles, is prohibited. The implementation of provisions to support mobile WSDs is optional for WSDBs.

Mode I personal/portable device: A personal/portable WSD that does not use an internal geolocation capability and does not directly access a WSDB to obtain a list of available radio frequency channels. A mode I personal/portable device must obtain a list of available channels on which it may operate through an indirect connection via either a fixed WSD, a mobile WSD or a mode II personal/portable device. A mode I personal/portable device does not initiate a network of WSDs nor provide a list of available radio frequency channels to another mode I device for use by such a device.

Mode II personal/portable device: A personal/portable WSD that uses internal geolocation and accesses a WSDB for a list of available radio frequency channels. Access to the database may be through a direct connection to the Internet or through an indirect connection via a fixed WSD, mobile WSD or other mode II personal/portable device. A mode II personal/portable device may provide its lists of available radio frequency channels to another personal/portable device for use by that device.

Narrowband WSD: A fixed or personal/portable WSD that transmits and/or receives radiocommunication signals with a bandwidth of no greater than 100 kHz.

Personal/portable WSD: A device that transmits and/or receives radiocommunication signals while stationary or in motion at unspecified fixed points.

Protected contour: A contour within which a station and its associated receivers or remote stations have protection from other devices operating in the same frequency bands and which might interfere with the station.

Remote rural broadband systems (RRBS): Fixed systems that provide wireless Internet access for subscriber-based broadband Internet applications, authorized to operate on a licensed basis on the same frequency bands as WSDs.

Separation distance: The minimum distance between a WSD and a station's protected contour (for broadcasting, RRBS, etc.) at which a WSD may operate.

Terrain elevation profile: Terrain elevations along a particular radial, calculated at intervals of 100m or less. The terrain elevation is calculated based on the following datasets:

> **Canada:** the Canadian Digital Elevation Model at the highest available resolution
> **United States:** the United States Geological Survey National Elevation Dataset (USGS NED) 1 arc-second data for the continental U.S., and the 2 arc-second data for Alaska.

A WSDB may use any other methodology for the calculation of the terrain elevation profile that would result in larger protected contours than those calculated using the specified terrain elevation datasets. In this case, the WSDB will be required to demonstrate to ISED that the protected contours would always be larger.

TV receive site: A location where signals are received for retransmission or monitoring, including TV studio and transmitter locations, relay points and broadcasting distribution undertaking head-ends outside the edge of the protected contours of a TV station. This includes receive sites for a full power

TV station, a TV broadcaster or a low-power TV station (i.e. an LP or a very low power (VLP) transmitter, translator or booster transmitter) where signals are received over the air.

White space (WS): Part of the spectrum that is, or has become, available for radiocommunication by radio systems at a specific time period and in a given geographical area.

White space database (WSDB): An ISED-recognized third party database that maintains records of all licensed services and systems approved to operate within WS frequency bands. The WSDB determines available channels at a specific time and geographic location, and provides lists of available channels to WSDs.

White space database administrator (WSDBA): A third party service provider designated by ISED to administer a WSDB within Canada.

White space device (WSD): A radio apparatus that operates in the WS frequency bands using dynamic spectrum access techniques.

8. Related documents

The current issues of the following documents are applicable and available on the Spectrum management and telecommunications website.

BPR-4	*Application Procedures and Rules for Television Broadcasting Undertakings*
BPR-10	*Application Procedures and Rules for Digital Television (DTV) Undertakings*
BPR-11	*Broadcasting Television Application Procedures During the 600 MHz Transition*
CPC-2-1-28	*Voluntary Licensing for Licence-Exempt Wireless Microphones in the TV Bands*
CPC-4-1-01	*Application Procedures for White Space Database Administrators (WSDBAs)*
RSS-196	*Point-to-Multipoint Broadband Equipment Operating in the Bands 512-608 MHz for Rural Remote Broadband Systems (RRBS) (TV Channels 21 to 36)*
RSS-210	*Licence-Exempt Radio Apparatus: Category I Equipment*
RSS-222	*White Space Devices (WSDs)*
SMSE-12-12	*Framework for the Use of Certain Non-broadcasting Applications in the Television Broadcasting Bands Below 698 MHz*
SMSE-003-19	*Decision on the Technical and Policy Framework for White Space Devices*

SRSP-300.512 *Technical Requirements for Remote Rural Broadband Systems (RRBS) Operating in the Bands 512-608 MHz (TV Channels 21 to 36)*

Digital Television (DTV) Allotment Plan

Digital Television (DTV) Transition Schedule

9. White space frequency bands/channels

The frequency bands/channels authorized for use by WSDs are shown in table 1. A WSDB shall only provide available channels to a WSD from among those listed in table 1 and as per the requirements of this standard.

Table 1: Overview of authorized white space frequency bands/channels

Frequency bands (MHz)	Channel name	Incumbent services	Personal/ Portable WSD	Fixed WSD	Mobile WSD
54-60	TV Channel 2	TV Broadcasting, LPA	Not permitted	✓ **	✓
60-72	TV Channels 3-4	TV Broadcasting, LPA	Not permitted	✓ **	Not permitted
76-88	TV Channels 5-6	TV Broadcasting, LPA	Not permitted	✓ **	✓
174-216	TV Channels 7-13	TV Broadcasting, LPA	Not permitted	✓ **	✓
470-512	TV Channels 14-20	TV Broadcasting, LPA	✓ **	✓ **	✓
512-602	TV Channels 21-35	TV Broadcasting, LPA, RRBS	✓ **	✓ **	✓
602-608	TV Channel 36	TV Broadcasting, LPA, RRBS	✓	✓	Not permitted
608-614	TV Channel 37*	Medical telemetry and	Not permitted		

		radio astronomy	
614-617	600 MHz guard band	LPA	Not permitted
617-652	600 MHz mobile downlink	Mobile services	Not permitted
652-657	600 MHz duplex gap	LPA	Not permitted
657-663	600 MHz duplex gap	LPA	✓ Not permitted
663-698	600 MHz mobile uplink	Mobile services	Not permitted

*****Channel 37 (608-614 MHz) has been excluded to protect the operation of radio astronomy and wireless medical telemetry.

**A WSDB may provide available channels below 602 MHz to a narrowband WSD. Narrowband WSDs are permitted to operate on 100 kHz sub-channels within the central 5.5 MHz portion of a 6 MHz channel. The sub-channel(s) shall be on integral multiples of 100 kHz starting at a 250 kHz offset from the 6 MHz channel edge. The remaining 250 kHz portions of the lower and upper edges of the 6 MHz channel may be used by narrowband WSDs if two adjacent 6 MHz channels are both indicated by a WSDB as being available. In this case, the combined 500 kHz of spectrum (i.e. two 250 kHz portions) from two adjacent 6 MHz channels may be used for a total of 5 sub-channels. These 5 sub-channels shall be located on integral multiples of 100 kHz, with the 3rd channel centered at the channel edge between the two adjacent 6 MHz channels. Narrowband WSDs shall operate with a 1% maximum duty cycle. The maximum duty cycle applies to each 100 kHz sub-channel being used by a narrowband WSD.

10. WSDB access to ISED's database

The ISED database information shall be accessed from the white space data extract section of the Spectrum Management System Data webpage.

10.1 WSDB licensing information update from ISED database

The WSDB shall retrieve updated licensing information from the ISED database at least once every 24 hours.

10.2 WSDB failure to access ISED database

Should the ISED database not be available, additional attempts to retrieve information from the ISED database shall be made at least once every 4 hours. If more than 12 hours has elapsed without the WSDBA being able to retrieve this information, the WSDBA shall contact ISED regarding the unsuccessful access to the ISED database.

Thereafter, a WSDB may continue to operate for 7 days from the last successful access, unless otherwise indicated by ISED. After those 7 days, the WSDBA shall only operate in accordance with instructions provided by ISED. It is anticipated that the latter approach (i.e. contacting ISED for further instructions) would only occur in rare circumstances.

Following unsuccessful access to the ISED database, and thereafter obtaining a successful connection, the WSDB shall notify ISED of the successful access.

10.3 Geographical reference datum

If the geographical reference datum for coordinates of stations provided in ISED's database differs from the datum used by the WSDB's internal calculations and/or the datum used to obtain geolocation coordinates of WSDs, the WSDB shall ensure that the appropriate conversion calculations are incorporated.

10.4 Information required for TV broadcasting stations

A WSDB shall obtain the following information from ISED's database for TV broadcasting stations to be protected from WSDs:

- Transmitter coordinates – latitude
- Transmitter coordinates – longitude
- Effective radiated power (ERP)
- Antenna height above ground level (AGL) of the radiating centre of the transmitting antenna
- Ground elevation above mean sea level (AMSL)
- Horizontal transmit antenna pattern
- Centre frequency
- Station call sign
- Nature of the station (i.e. analog station or digital station)

10.5 Information required for remote rural broadband systems (RRBS) base stations

A WSDB shall obtain the following information from ISED's database for RRBS base stations to be protected from WSDs:

- Transmitter coordinates – latitude
- Transmitter coordinates – longitude
- ERP
- Antenna height AGL of the radiating centre of the transmitting antenna
- Site elevation AMSL
- Centre frequency (both downstream (base station transmit) and upstream (remote station transmit) frequencies)
- Station call sign

10.6 Information required for licensed low-power apparatus (LPA)

A WSDB shall obtain the following information from ISED's database for licensed LPA to be protected from WSDs:

- Transmitter coordinates – latitude
- Transmitter coordinates – longitude
- Authorization number (licence number)
- Radius of operation, if specified

11 Systems and services registration

A WSDB shall allow for the collection of the information listed in the sub-sections below for systems and services that are not included in the ISED databases.

11.1 Fixed and mobile WSD registration

A WSDB shall have a registration process for fixed and for mobile WSD users. Relevant information is collected from users to help with investigations of harmful interference.

A WSDB shall obtain the following information from fixed or mobile WSD users:

- Name of the individual or business that owns the device (e.g. the Internet Service Provider (ISP) providing the service not the ISP's customers)
- Name of a contact person responsible for resolving interference issues related to the device's operation
- Mailing address for the contact person
- Email address for the contact person
- Phone number for the contact person
- Antenna height AGL

Once registered, information shall be considered public.

Prior to registering a WSD for the first time, a WSDB shall verify that the above-mentioned registration information is complete and that a verified email address has been provided by the fixed or mobile WSD user.

11.2 TV receive site registration and cable TV head-ends

A WSDB shall provide a registration process for TV receive sites that qualify for protection under section 13.2.1. WSDBs are not obliged to provide protection to TV receive sites that are not registered under this process.

A WSDB shall obtain the following registration information from TV receive site users wishing to be protected from WSDs:

- Names of the individuals or businesses responsible for each TV receive site
- Mailing address for the contact person
- Email address for the contact person
- Phone number for the contact person
- Coordinates of the location of the TV receive site
- Call sign of the TV receive site
- Call sign of the transmitter associated with the TV receive site

Once registered, information shall be considered public.

A WSDB shall confirm that the TV receive site being registered is associated with an ISED-authorized call sign.

A WSDB shall confirm that the TV receive site or cable TV head-end being registered resides no farther than 80 km outside the nearest edge of a the protected contour of the TV transmitter site associated with that call sign.

If the registration information cannot be validated, the WSDB shall reject the registration and return a message to the user to contact ISED for authorization.

11.3 Licensed LPA registration information

A WSDB shall allow licensed LPA users to log information about scheduling and location to obtain protection from WSDs. WSDBs are not obliged to provide protection to licensed LPA except at times and locations that have been so registered.

A WSDB shall obtain the following information from any licensed LPA wishing to be protected from WSDs:

- Name of the individual or business responsible for an licensed LPA
- Mailing address for the contact person
- Email address for the contact person
- Phone number for the contact person
- Geographical coordinates of the location or area(s) of operation where the licensed LPA will be used
- Centre frequency (MHz) of the channel(s) used by the licensed LPA at the indicated site
- Period of operation (i.e. period of use) of the channels: specific hours, days, weeks and/or months when the licensed LPA will be used
- The licensed LPA's authorization number (licence number)

A WSDB shall confirm that an licensed LPA user that wishes to register its time-of-use scheduling information in the database has a valid licence according to the ISED database. If none exists, the WSDB shall reject the registration of the licensed LPA, and return a message to the user to contact ISED for a licence as detailed in CPC-2-1-28.

A WSDB shall only allow the registration of licensed LPA operations within geographical areas and frequencies specified on the licence. The period of registration shall be limited to less than 1 year.

A WSDB shall allow a registration to establish a recurring event. For the protection of the future occurrences of the event, the WSDB shall ensure that the licensed LPA user still has a valid licence based on the information from ISED's database at that time.

Once registered, information shall be considered public.

11.3.1 Area of operation of licensed LPA

In the case of an licensed LPA at a fixed location with no radius of operation, the maximum area of operation registered with the WSDB will be within a radius of 500 m around a fixed location.

In the case of an licensed LPA with a specified radius of operation larger than 500 m, an licensed LPA's area of operation shall be defined as a point and radius area or as a quadrilateral area, as chosen by the user. The registration shall allow up to the maximum number of points prescribed below, as applicable for the given option.

- Point and radius option: The operational location(s) of the licensed LPA may be defined using a maximum of 25 geographical points at any one time. Each geographical point shall have a maximum radius of operation of 500 m around the particular point; or

- Quadrilateral option: The operational location(s) of the licensed LPA shall be defined based on the edges of straight lines connecting the vertices (geographic points) of the quadrilateral.

    1. Each quadrilateral must be specified with four geographic points and the distance between any two adjacent points shall be limited to 3 km.
    2. In cases where an licensed LPA occupies a larger area, up to four non-contiguous quadrilaterals may be registered.

- ISED may consider allowing other options to define the licensed LPA area of operation on a case-by-case basis at the request of a WSDBA.

12 Denied list

A WSDB shall maintain a list of devices that are not authorized to operate with WSDBs. These devices shall not be permitted to gain access to WS channels. A WSDB shall enable devices on the denied list to be identified by any combination of the following parameters:

- Manufacturer's serial number
- ISED certification number (IC ID)

If the WSDB has also implemented other additional parameters to identify devices operating with it, ISED may also identify devices to be placed on the denied list using these additional parameters. Devices will be added to or removed from the denied list only after receiving formal direction from

ISED. It is anticipated that the denied list will be rarely used and there is no requirement for an external interface or automated update of this list.

13 WSD power, height limits, and available channels

A WSDB shall only return available channels according to the criteria set out in this section and its sub-sections. The implementation of less congested areas , support for mobile WSDs, and EHAAT of 700 m provisions are optional for WSDBs (see section 5). A WSDB may avoid the need to calculate less congested areas if they limit all WSDs to an e.i.r.p. level of 4 W or less.

13.1 WSD power limits

A WSDB shall not provide any available channels to a fixed WSD operating with an equivalent isotropically radiated power (e.i.r.p.) level greater than 16 W (42 dBm) per 6 MHz channel. Furthermore, in areas other than less congested areas, a WSDB shall not provide any available channels to a fixed WSD operating with an e.i.r.p. level greater than 4 W (36 dBm) per 6 MHz channel.

A WSDB shall not provide a list of available channels to a mobile WSD operating in a less congested area with an e.i.r.p. level greater than 16 W (42 dBm) per 6 MHz channel. A WSDB shall not provide a list of available channels to a mobile WSD operating outside of a less congested area.

A WSDB shall not provide a list of available channels to a personal/portable WSD operating with an e.i.r.p. level greater than 100 mW (20 dBm) per 6 MHz channel.

A WSDB shall not provide any available channels to a narrowband WSD operating with an e.i.r.p. level greater than 72.45 mW (18.6 dBm) per 100 kHz sub-channel.

13.2 Maximum height for fixed and mobile WSDs

A WSDB may choose to implement a maximum effective height above average terrain (EHAAT) of 500 m or optionally 700 m. A WSDB shall not provide any channels to a fixed or mobile WSD if its EHAAT exceeds the limit implemented (e.g. 500 m or 700 m).

In the case of a fixed or mobile WSD requesting available channels for a mode I personal/portable WSD, a WSDB shall not provide any available channels for the mode I device if the fixed or mobile WSD's EHAAT exceeds 106 m.

If a fixed WSD reports height as AMSL, the WSDB shall convert AMSL to antenna height AGL as follows:

- determine the site elevation for the reported fixed WSD geographic coordinates, using the same method used to determine elevation for HAAT calculations

- subtract the site elevation from the reported AMSL, which will produce an antenna height AGL value (if the resulting antenna height AGL is less than 1.5 m, set the antenna height AGL value to 1.5 m)

14 Protection criteria for TV broadcasting stations

A WSDB shall only return available channels according to the protection criteria for TV broadcasting stations set out in this section and its sub-sections.

14.1 Protection criteria for over-the-air TV broadcasting stations

A WSDB shall protect active, over-the-air TV broadcasting stations, as indicated by the ISED database.

A WSDB shall protect all types of TV broadcasting stations, including active analog and digital TV stations. This includes full service TV stations, TV re-broadcasters and low-power TV stations (i.e. including LP TV translator and very low power (VLP) TV translators and booster stations).

14.2 Protection contours for TV broadcasting stations

To protect fixed TV services from white space devices, a WSDB shall calculate protected contours for TV broadcasting stations based on the propagation models and electromagnetic field strength levels specified in table 2. However, a WSDB may also use any other methodology that would result in larger protected contours for TV broadcasting stations than those calculated with the specifications contained in Table 2; in this case, the WSDB will be required to demonstrate to ISED that the protected contours would always be larger.

Table 2: Thresholds for the protected contours of TV broadcasting stations

Type of TV station	TV channel	Thresholds for TV broadcasting station-protected contour (dBµV/m)	Propagation curve*
Analog (full and low-power)	Low VHF (Ch. 2-6)	47	F(50,50)
	High VHF (Ch. 7-13)	56	F(50,50)
	UHF (Ch. 14-51)	64-20log(615/F**)	F(50,50)
Digital (full and low-power)	Low VHF (Ch. 2-6)	28	F(50,90)
	High VHF (Ch. 7-13)	36	F(50,90)
	UHF (Ch. 14-51)	41-20log(615/F**)	F(50,90)

*****See BPR-10, *Application Procedures and Rules for Digital Television (DTV) Undertakings*, annex F.
******F is the centre frequency of the TV channel in MHz.

14.2.1 Protection of registered TV receive sites

A WSDB shall protect TV receive sites outside the protected contour, where signals are received for retransmission or monitoring. This includes TV studio and transmitter locations, relay points and broadcasting distribution undertaking head-ends, provided that such sites are no farther than 80 km outside the nearest edge of the protected contours of the station. In order to receive protection, a TV receive site must be registered with a WSDB as described in section 10.2.

The protection area of the receive-sites from WSDs shall encompass an arc of ± 30 degrees from a line between a registered receive-site and the associated TV transmitter station. This contour extends to a distance of 80 km for co-channel protection and 20 km for adjacent-channel protection, or to the edge of the associated TV station, whichever distance is less.. Outside of this ± 30-degree arc:

- WSDs operating at 4 watts e.i.r.p. or less may not operate within 8 km from the receive site for co-channel operation and within 2 km from the receive site for adjacent channel operation.
- WSDs operating with more than 4 watts e.i.r.p. and up to 10 watts e.i.r.p. may not operate within 10.2 km from the receive site for co-channel operation and within 2.5 km from the receive site for adjacent channel operation.
- WSDs operating with more than 10 watts e.i.r.p. may not operate within 16.6 km from the receive site for co-channel operation and within 3.5 km from the receive site for adjacent channel operation.

For the purpose of this section, a TV station whose signals are received over the air may include a full power TV station, a TV re-broadcaster or a low-power TV station (i.e. LP or VLP transmitter, translator or booster transmitter). The distance of the TV transmitter to its protected contour shall be determined using the calculation procedure detailed in annex B.

14.3 Minimum separation distance between a WSD and a TV broadcasting station protected contour

A WSDB shall only return available channels according to the criteria set out in this section and its sub-sections. ISED would consider any methodology used that differs from that described in annex B, which would result in a larger minimum separation distances than those outlined below.

14.3.1 Minimum separation distance from WSD to protected contour of TV broadcasting station

When a fixed, mobile or mode II personal/portable WSD contacts a WSDB and provides its geographic coordinates, the WSDB shall provide a list of available channels to the WSD based upon the criteria below. These criteria provide minimum separation distances from the protected contours of the TV stations based upon all of the following:

- the e.i.r.p. level of the WSD
- the type of WSD (fixed, mobile or personal/portable)

- the frequency band of operation of the TV station (low VHF, high VHF, or UHF)

A WSDB shall apply the minimum separation distances provided in tables C1, C2, C5, and C6 of annex C for fixed and mobile WSDs from the protected contours for both digital and analog TV stations. Table C1 applies to all co-channel cases in the UHF frequency band; Table C2 applies to all adjacent channel cases in the UHF frequency band; Table C5 applies to all co-channel cases in the low and high VHF frequency bands; and Table C6 applies to all adjacent channel cases in the low and high VHF frequency bands. The adjacent channel case separation distances are only required to be implemented for channels within the same TV band (i.e. low VHF, high VHF, or UHF) for which the TV station is operating.

Narrowband WSDs (both fixed and personal/portable) shall comply with the minimum separation distances for fixed WSDs operating at e.i.r.p. level of 4 W (36 dBm) per 6 MHz channel.

A WSDB shall also apply the minimum separation distances provided in tables C3 and C4 of annex C for personal/portable WSDs from the near side of the protected contours for both digital and analog TV stations.

If a personal/portable WSD is operating with an e.i.r.p. level of 40 mW or less, a WSDB shall not apply the adjacent channel separation distances in table C4 and shall list all adjacent channels as available within the broadcast TV-protected contours.

If a fixed or mobile WSD is operating with an e.i.r.p. level of 40 mW or less, as well as with an antenna height above ground not exceeding 10 m, a WSDB shall not apply the adjacent channel separation distances in table C2 and shall list all adjacent channels as available within the broadcast TV-protected contours.

In determining these minimum separations, the WSDB shall increase the minimum separation distances by the amount that the location accuracy uncertainty of a WSD exceeds ±50 m.

When applying tables C1, C2, C5 and C6 of annex C, where a database is capable of calculating the directional height above average terrain (dirHAAT) of the affected TV station, this value may optionally be used instead of the EHAAT.

15 Protection criteria of remote rural broadband systems (RRBSs)

A WSDB shall protect the RRBS base station (downstream) transmitted protected contour, which corresponds to a field strength of 30.8 dBμV/m at a receive antenna height of 9 m. The RRBS protected contour is calculated using the licensed base station power. The RRBS downstream operation is protected with a minimum separation distance from the protected contour, as specified in sections 15.1 and 15.3 below.

A WSDB shall also protect the RRBS base station (upstream) received signal at the RRBS base station location. The RRBS upstream operation is protected with a minimum separation distance from the base station location, as specified in sections 15.2 and 15.4 below.

In determining these minimum separations, the WSDB shall increase the minimum separation distances by the amount that the location accuracy uncertainty of a WSD exceeds ±50 m. ISED would consider any alternative methodology resulting in larger minimum separation distances than those outlined below.

For the cases when the WSD's power level falls in between any two power levels referenced in tables 3 and 4 below, the higher power level requirements shall apply. Where a WSDB is capable of calculating the directional height above average terrain (dirHAAT) of the affected TV station, this value may be used instead of the EHAAT.

15.1 Fixed and mobile WSD minimum separation distance to the RRBS base station protected contour on the RRBS base station transmit channel (Downstream)

A WSDB shall ensure that fixed and mobile WSDs protect the transmit channel of the RRBS base station by operating outside the protected contours of the transmit co-channel of RRBS stations, at or greater than the minimum separation distances specified in table 3, based upon the WSD e.i.r.p. level. Narrowband WSDs (both fixed and personal/portable) shall comply with the minimum separation distances between a fixed WSDs operating at e.i.r.p. level of 4 W (36 dBm) per 6 MHz channel and the protected contour of the RRBS transmit channel base station (downstream).

Table 3: Fixed and mobile WSD minimum separation distance to RRBS base station protected contour on the RRBS base station transmit channel (Downstream)

EHAAT of fixed or mobile WSD (or dirHAAT, if applicable), m	Minimum separation distance (km) to the protected contour of the RRBS transmit channel base station		
	Co-channel		
	Fixed or mobile WSD e.i.r.p.		
	4 W	10 W	16 W
EHAAT ≤ 3	2.5	3.2	3.6
3 < EHAAT ≤ 10	4.6	5.8	6.5
10 < EHAAT ≤ 30	8.0	10.0	11.3
30 < EHAAT ≤ 50	10.3	12.9	14.5
50 < EHAAT ≤ 75	12.6	16.3	18.3
75 < EHAAT ≤ 100	15.1	18.9	21.3
100 < EHAAT ≤ 150	18.5	23.3	26.1
150 < EHAAT ≤ 200	21.2	26.8	30.1
200 < EHAAT ≤ 250	23.7	29.8	32.7
250 < EHAAT ≤ 300	25.9	32.0	35.1
300 < EHAAT ≤ 350	27.9	34.1	37.5
350 < EHAAT ≤ 400	29.9	36.1	39.8
400 < EHAAT ≤ 450	31.4	38.0	41.7

450 < EHAAT ≤ 500	32.8	39.8	43.5
500 < EHAAT ≤ 700 (optional)	37.5	45.4	49.9

15.2 Fixed and mobile WSD minimum separation distance to the RRBS base station on the RRBS base station receive channel (Upstream)

A WSDB shall ensure that fixed and mobile WSDs protect the RRBS base station receive channel by operating at least at the minimum co-channel separation distances to the RRBS base station coordinates specified in table 4. Narrowband WSDs (both fixed and personal/portable) shall comply with the minimum separation distances between a fixed WSDs operating at e.i.r.p. level of 4 W (36 dBm) per 6 MHz channel and the RRBS receive channel base station coordinates (upstream).

Table 4: Fixed and mobile WSD minimum separation distance to the RRBS base station coordinates on the RRBS base station receive channel (Upstream)

EHAAT of Fixed or mobile WSD (or dirHAAT, if applicable), m	Minimum separation distance (km) to the RRBS base station coordinates		
	Co-channel to RRBS base station receive frequency		
	Fixed or mobile WSD e.i.r.p.		
	4 W	10 W	16 W
EHAAT ≤ 3	11.4	14.3	16.1
3 < EHAAT ≤ 10	20.7	26.1	29.3
10 < EHAAT ≤ 30	39.8	51.2	58.0
30 < EHAAT ≤ 50	47.3	57.8	64.2
50 < EHAAT ≤ 75	53.8	64.1	70.3
75 < EHAAT ≤ 100	58.9	69.3	75.5
100 < EHAAT ≤ 150	66.0	76.3	82.8
150 < EHAAT ≤ 200	70.8	82.0	89.3
200 < EHAAT ≤ 250	76.3	89.0	96.9
250 < EHAAT ≤ 300	81.2	94.9	102.9
300 < EHAAT ≤ 350	86.5	101.0	109.5
350 < EHAAT ≤ 400	91.3	106.5	115.7
400 < EHAAT ≤ 450	95.6	111.8	121.2
450 < EHAAT ≤ 500	99.7	116.5	126.2
500 < EHAAT ≤ 700 (optional)	113.4	132.8	143.7

15.3 Mode II personal/portable WSD minimum separation distance to the RRBS base station protected contour on the RRBS base station transmit channel (Downstream)

A WSDB shall ensure that mode II personal/portable WSDs operate at or greater than the minimum separation distance of 8.2 km from the transmit RRBS base station protected contour.

15.4 Mode II personal/portable WSD minimum separation distance to the RRBS base station coordinates on the RRBS base station receive channel (Upstream)

A WSDB shall ensure that mode II personal/portable WSDs operate at or greater than the minimum separation distance of 37.8 km from the RRBS receive channel's base station coordinates.

15.5 Communication with Mode I personal/portable WSDs and protection criteria for RRBS

A WSDB shall ensure that when a fixed or mobile WSD communicates with a mode I personal/portable WSD, the minimum separation distances in table 3 and table 4 are increased by:

- 1.3 km when the mode I personal/portable device operates at an e.i.r.p. less than or equal to 40 mW.
- 1.7 km when the mode I personal/portable device operates at an e.i.r.p. greater than 40 mW.

A WSDB shall also ensure that when a mode II personal/portable WSD communicates with a mode I personal/portable WSD, the minimum separation distances outlined in section 15.3 and 15.4 are increased by:

- 1.3 km when the mode I personal/portable device operates at an e.i.r.p. less than or equal to 40 mW.
- 1.7 km when the mode I personal/portable WSD operates at an e.i.r.p. less than or equal to 40 mW.

16 Protection criteria to registered licensed LPA

Registered licensed LPA scheduling information will be included within the WSDB. A WSDB shall only provide channels to WSDs located at or greater than the minimum separation distance from the edge of the registered area of operation of the protected licensed LPA. For fixed and mobile WSDs, the minimum separation distance shall be 1 km if the device e.i.r.p. is less than or equal to 4 W, and 1.6 km if the device e.i.r.p. is greater than 4 W. For personal/portable WSDs, the minimum separation distance shall be 0.4 km. For narrowband WSDs (both fixed and personal/portable), the minimum separation distance shall be 1 km.

In determining the minimum separations, the WSDB shall increase the minimum separation distances by the amount that the location accuracy uncertainty of a WSD exceeds ±50 m, if any.

17 Protection of radio astronomy observatories

In order to protect radio astronomy observatories, a WSDB shall not permit the use of WSDs on any channel within a distance of 2.4 km from the following two coordinates:

- Dominion Radio Astrophysical Observatory, located near Penticton, British Colombia (latitude 49° 19´ 12¨ N, longitude 119° 37´ 12¨ W)
- Algonquin Provincial Park, located in Ontario (latitude 45° 57´ 19.8¨ N, longitude 78°4´ 22.95¨ W)

18 WSDB requirements for mobile WSDs operating in geo-fenced areas

A WSDB may choose whether or not to implement the capability of providing available channels to mobile WSDs. If it does choose to implement this capability, the requirements described in this section must be met. A WSDB shall not provide any available channels to a mobile WSD if these requirements are not implemented.

18.1 Available channels over a geo-fenced areas

A WSDB shall provide a list of available channels and the corresponding maximum permitted power levels to a mobile WSD for operation within a defined geo-fenced area. A WSDB shall not provide any list of available channels to a mobile WSD operating outside of a less congested area.

The WSDB must take into consideration the mobile device's antenna height above ground level and geolocation uncertainty in determining the list of available channels. The WSDB must take into consideration any variation in mobile device EHAAT throughout the geo-fenced area and must use the highest EHAAT within the geo-fenced area in determining channel availability.

18.2 Mobile WSD minimum separation distance

A WSDB shall ensure that mobile WSDs operate at or greater than the minimum separation distances from protected services that apply for fixed WSDs, as specified in sections 14, 15, 16 and 17, at all points within the geo-fenced area in which the mobile WSD will operate.

18.3 Boundaries of geo-fenced areas

A WSDB shall obtain from a mobile WSD the boundaries that define the geo-fenced area in which the mobile WSD will operate. Alternatively, the WSDB may provide the mobile WSD with the boundaries of a geo-fenced area in which it can operate. The area boundaries used by the WSDB to determine channel availability must be the same as the boundaries stored within the mobile device.

19 Security

A WSDB shall incorporate reasonable and reliable security measures to ensure that WSDs will not operate on occupied channels or cause interference to licensed services or systems.

A WSDB shall employ both of the following measures to protect the security of operational and/or client data:

- Implementation of reasonably secure methods for data transmission and authentication that are designed to prevent corruption or unauthorized modification of data when communicated between the WSDB and WSDs
- Implementation of reasonable controls designed to protect data from unauthorized access, input, manipulation or the deliberate extraction of operational and/or client data

20 Database access initialization and reverification procedures

A WSDB shall provide fixed, mobile and mode II personal/portable WSDs with channel availability information and shall include any scheduled changes in channel availability within the coming 48 hours, upon initialization and reverification of WSD contact.

A WSDB may provide available channel information to mode II personal/portable WSDs for locations beyond their current position. The mode II personal/portable WSDs can use that information to define a geographic area within which they could operate on the same available channels at all locations.

21 Synchronization

A WSDB shall ensure that the registration information of the fixed and mobile WSD sites, TV receive sites, cable TV head-ends, and scheduling information of licensed LPA sites is synchronized at least every 15 minutes with the other designated Canadian WSDBs.

Any designated WSDBA and a new entrant WSDBAs seeking designation shall develop a successful synchronization process within two months from the application date of the new entrant WSDB. If the process is unsuccessful, ISED will specify the synchronization process which both WSDBAs must implement as well as the time frame under which it must be completed.

22 Detailed log files

For the purpose of resolving potentially harmful radio interference, WSDBAs must maintain a log of all active WSD registration, client contact and related operational information, for a minimum period of sixty (60) calendar days, and must make all such information available to ISED upon request.

A WSDBA shall also provide ISED with access, upon request, to the detailed log files of WSD queries and responses (including those that are personally identifiable) contained in its database, for the purposes of evaluation and enforcement.

23 Operation near the Canada-U.S. border

Operating U.S. broadcasting stations are to be protected according to the same criteria specified for Canadian stations above, with the exception that protected contours will be assumed to stop at the Canada-U.S. border. The required separation distances extend within Canada.

24 Interference response

Interference response stemming from WSD queries remains ISED's responsibility and information shall be provided to ISED following a formal request. In order to facilitate the request, a WSDB shall:

- retain logs of WSD queries and responses for sixty (60) days to allow for audits in case of interference reports.

- indicate whether channels are available when queried by a specific WSD or type of WSD. This feature shall allow for a type of WSD, or all WSDs, to be denied to channels on the basis of a geographic area defined by a point and radius, or by a quadrilateral area defined by straight lines connecting four geographic points.

Annex A: White space database (WSDB) interface evaluation tests

A.1 WSDB interface test to connect with a fixed or mobile white space device (WSD)

A WSDB shall validate all the following information provided by a fixed or mobile WSD before initializing it:

a. The certification number for the device reflects a valid certification under RSS-222 as a fixed or mobile WSD (i.e. IC ID). ISED maintains a list of certified WSDs on the white space data extract section of the Spectrum Management System Data webpage.
b. Manufacturer's serial number or certification number (i.e. IC ID) for the device is not on the denied list
c. Geographic coordinates are within Canada
d. Antenna height above mean sea level (AMSL) or antenna height above ground level (AGL) is provided
e. Geographic coordinates' uncertainty with 95% confidence level

A.2 WSDB interface with a mode II personal/portable WSD initialization

A WSDB shall validate all the following information provided by a mode II personal/portable WSD before initializing it:

a. The certification number for the device reflects a valid certification under RSS-222 as a mode II personal/portable device. ISED maintains a list of certified WSDs on the white space data extract section of the Spectrum Management System Data webpage.
b. Manufacturer's serial number or certification number (i.e. IC ID) for the device is not on the denied list
c. Geographic coordinates are within Canada
d. Geographic coordinates' uncertainty with 95% confidence level

A.3 WSDB mode I personal/portable WSD validation

A WSDB shall validate all the following information provided by a mode I personal/portable WSD through an intermediate fixed WSD, mobile WSD, or mode II WSD before initializing it:

a. The certification number for the device reflects a valid certification under RSS-222 as a mode I personal/portable device. ISED maintains a list of certified WSDs on the white space data extract section of the Spectrum Management System Data webpage.
b. Fixed or mobile WSD has an effective height above average terrain (EHAAT) of less than or equal to 106 m (if the validation request comes from a fixed or mobile WSD)

A.4 White space channel availability

A WSDB shall confirm the available channels that can be assigned to fixed, mobile or personal/portable WSD under test.

Annex B: Determination of the TV broadcast contour and the RRBS protected contour

a. The position of the protected contour of each TV station is determined using the height above average terrain (HAAT, as defined in section 6) measurement on each of 360 equally spaced radials, starting from True North and moving clockwise.

b. The effective radiated power (ERP) is determined in the direction of each radial, using the directional antenna tabulations for the broadcast station. Since the HAAT values are to be computed for 1 degree intervals and the antenna tabulation will typically be at much larger intervals, the white space database (WSDB) should interpolate dB units between provided antenna data points using linear interpolation. Where the broadcast antenna pattern data does not exist for a directional station, the maximum ERP value is applied in all directions. In calculating the HAAT value, the ground elevation above sea level at the station location provided in the ISED database should be used instead of the ground elevation predicted by the terrain elevation data files.

c. The ERP and HAAT, in conjunction with the criteria in section 14.2, are used to calculate the distance from the broadcast station to the protected contour along the radial. For interpolating a value between available data points on the F propagation curves, interpolation shall be used and all units shall be converted to the decibel scale during the interpolation process (i.e. field strength remains in dBu, height is converted to dB referenced to 1 m, and distance is converted to dB referenced to 1 km). As a minimum, linear interpolation shall be implemented, but more accurate interpolation techniques will also be permitted. Data tables for the F propagation curves are available on ISED's website under the figure descriptions for the curves provided in Annex F of BPR-10. The use of these data tables is recommended, but other sources of data tables may be accepted by ISED if they accurately cover the same propagation curves. The F propagation curves have a limited range of data points for input and output parameters for which to provide propagation results. If a terrain profile or station antenna height leads to a height value above or below the curve limits, the value at the limit should be used (i.e. 30 and 1600 m for lower/upper limits respectively). If the transmitter power is sufficiently low such that a distance below the curve limits is obtained, the free space propagation model should be used as an alternate.

d. Analogously to the determination of the TV broadcast contour discussed above, the position of the protected contour of the RRBS base station transmit channel is found using its licensed ERP value and its calculated HAAT value for each radial, until the 30.8 dBuV/m field strength level is reached at a 9 m receive antenna height. The F(50,90) propagation curves should be applied in all directions for this calculation. Furthermore, the same guidance specified above should be used for the determination of HAAT and the use of the propagation curves.

Annex C: Minimum separation distances

This annex prescribes the minimum separation distance of white space devices (WSDs) operating at a given height (i.e. effective height above average terrain (EHAAT)), channel range, and power level. The white space database (WSDB) shall provide the list of available channels based on the prescribed minimum separation distances and the WSDs location, in accordance with the requirements of section 14.3.1 (Minimum separation distance from WSD to protected contour of TV broadcasting station). As indicated in section 14.3.1, the directional HAAT (dirHAAT) can be used instead of EHAAT. For the cases when the WSD's power level falls in between any of the two power levels referenced in the tables C1-C6 below, the higher power level requirements shall apply.

Table C1: Minimum separation distance of fixed (Ch. 14-36) and mobile (Ch. 14-35) WSDs operating at UHF frequency from the co-channel digital and analog television (TV)-protected contour

	Fixed or mobile WSD equivalent isotropically radiated power (e.i.r.p.)							
EHAAT of fixed or mobile WSD (or dirHAAT, if applicable), m	**40 mW**	**100 mW**	**250 mW**	**625 mW**	**1.6 W**	**4 W**	**10 W**	**16 W**
EHAAT ≤ 3	1.3	1.7	2.1	2.7	3.3	4.0	4.5	5.0
3 < EHAAT ≤ 10	2.4	3.1	3.8	4.8	6.1	7.3	8.5	9.4
10 < EHAAT ≤ 30	4.2	5.1	6.0	7.1	8.9	11.1	13.9	15.3
30 < EHAAT ≤ 50	5.4	6.5	7.7	9.2	11.5	14.3	19.1	20.9
50 < EHAAT ≤ 75	6.6	7.9	9.4	11.1	13.9	18.0	23.8	26.2
75 < EHAAT ≤ 100	7.7	9.2	10.9	12.8	17.2	21.1	27.2	30.1
100 < EHAAT ≤ 150	9.4	11.1	13.2	16.5	21.4	25.3	32.3	35.5
150 < EHAAT ≤ 200	10.9	12.7	15.8	19.5	24.7	28.5	36.4	39.5
200 < EHAAT ≤ 250	12.1	14.3	18.2	22.0	27.3	31.2	39.5	42.5
250 < EHAAT ≤ 300	13.9	16.4	20.0	23.9	29.4	35.4	42.1	45.9
300 < EHAAT ≤ 350	15.3	17.9	21.7	25.7	31.4	37.6	44.5	48.4
350 < EHAAT ≤ 400	16.6	19.3	23.2	27.3	33.3	39.7	46.9	51.0
400 < EHAAT ≤ 450	17.6	20.4	24.4	28.7	35.1	41.9	49.4	53.8

450 < EHAAT ≤ 500	18.3	21.4	25.5	30.1	36.7	43.7	51.4	55.9
500 < EHAAT ≤ 550	18.9	21.8	26.3	31.0	37.9	45.3	53.3	57.5
550 < EHAAT ≤ 700 (optional)	21.1	23.3	29.9	37.4	46.1	55.3	64.4	69.5

When a fixed or mobile WSD communicates with a personal/portable mode I WSD operating at e.i.r.p. less than or equal to 40 mW, the minimum separation distances in table C1 shall be increased by 1.3 km. When a fixed or mobile WSD communicates with a personal/portable mode I WSD operating at e.i.r.p. greater than 40 mW, the minimum separation distances in table C1 shall be increased by 1.7 km.

Table C2: Minimum separation distance of fixed (Ch. 14-36) and mobile (Ch. 14-35) WSDs operating at UHF frequency from the adjacent channel digital and analog TV-protected contour

	Fixed or mobile WSD e.i.r.p.

EHAAT of fixed or mobile WSD (or dirHAAT, if applicable), m	100 mW	250 mW	625 mW	1.6 W	4 W	10 W	16 W
EHAAT ≤ 3	0.1	0.1	0.1	0.1	0.2	0.2	0.3
3 < EHAAT ≤ 10	0.1	0.2	0.2	0.2	0.3	0.4	0.5
10 < EHAAT ≤ 30	0.2	0.3	0.3	0.4	0.5	0.6	0.7
30 < EHAAT ≤ 50	0.3	0.3	0.4	0.5	0.7	0.8	1.0
50 < EHAAT ≤ 75	0.3	0.4	0.5	0.7	0.8	0.9	1.0
75 < EHAAT ≤ 100	0.4	0.5	0.6	0.8	1.0	1.1	1.3
100 < EHAAT ≤ 150	0.5	0.6	0.8	0.9	1.2	1.3	1.5
150 < EHAAT ≤ 200	0.5	0.7	0.9	1.1	1.4	1.5	1.7
200 < EHAAT ≤ 250	0.6	0.8	1.0	1.2	1.5	1.7	1.9
250 < EHAAT ≤ 300	0.7	0.8	1.0	1.3	1.6	2.1	2.3
300 < EHAAT ≤ 350	0.7	0.9	1.1	1.4	1.8	2.2	2.4
350 < EHAAT ≤ 400	0.8	1.0	1.2	1.5	1.9	2.4	2.7
400 < EHAAT ≤ 450	0.8	1.0	1.3	1.6	2.1	2.6	2.9
450 < EHAAT ≤ 500	0.8	1.1	1.4	1.7	2.1	2.7	2.9
500 < EHAAT ≤ 550	0.9	1.2	1.5	1.8	2.2	2.8	3.0
550 < EHAAT ≤ 700 (optional)	1.0	1.2	1.6	2.0	2.4	3.1	3.4

When a fixed or mobile WSD communicates with a personal/portable mode I WSD operating at e.i.r.p. greater than 40 mW, the minimum separation distances in table C2 shall be increased by 0.1 km.

Table C3: Minimum separation distance of personal/portable mode II WSD from the co-channel digital and analog TV-protected contour

	Personal/portable mode II WSD e.i.r.p.	
	40 mW	**100 mW**
Communicating with personal/portable mode II or fixed WSD	1.3	1.7
Communicating with personal/portable mode I WSD	2.6	3.4

Table C4: Minimum separation distance of personal/portable mode II WSD from the adjacent channel digital and analog TV-protected contour

	Personal/portable mode II WSD e.i.r.p.*
	100 mW
Communicating with personal/portable mode II or fixed WSD	0.1
Communicating with personal/portable mode I WSD	0.2

*Adjacent channel operation is permitted for personal/portable WSDs operating below 40 mW.

Table C5: Minimum separation distance of fixed (Ch. 2- 13) and mobile (Ch. 2 and 5-13) WSDs operating at VHF frequency from the co-channel digital and analog TV-protected contour

		Fixed or mobile WSD e.i.r.p.							
EHAAT of fixed or mobile WSD (or dirHAAT, if applicable), m	**VHF channel range**	**40 mW**	**100 mW**	**250 mW**	**625 mW**	**1.6 W**	**4 W**	**10 W**	**16 W**
EHAAT ≤ 3	2 to 6	3.4	4.2	5.3	6.6	8.4	10.5	13.2	14.9
	7 to 13	1.9	2.4	3	3.8	4.7	5.9	7.5	8.4
3 < EHAAT ≤ 10	2 to 6	6.1	7.7	9.6	12.1	15.3	19.2	24.1	27.1
	7 to 13	3.5	4.3	5.4	6.8	8.6	10.8	13.6	15.3

10 < EHAAT ≤ 30	2 to 6	10.5	13.2	16.6	21.7	28.2	37	50.6	59.9
	7 to 13	5.9	7.5	9.4	11.8	18.2	23.4	30.1	34.4
30 < EHAAT ≤ 50	2 to 6	13.6	17.4	21.9	28.1	36.5	47.9	62.7	71.1
	7 to 13	7.7	9.6	12.1	18.6	23.7	30.2	38.8	44.3
50 < EHAAT ≤ 75	2 to 6	17	21.5	27.4	35	44.9	57.5	71.2	79.2
	7 to 13	9.4	11.8	18.3	23.1	29.3	37.2	47.2	53.1
75 < EHAAT ≤ 100	2 to 6	19.8	25.3	32	40.6	51.5	63.6	77.3	85
	7 to 13	10.8	16.9	21.3	26.9	34.2	42.9	53.6	59.5
100 < EHAAT ≤ 150	2 to 6	24.6	31.3	39.3	49.1	60.8	73.1	86.9	94.3
	7 to 13	13.2	20.6	26.1	32.8	41.5	51.7	62.7	68.6
150 < EHAAT ≤ 200	2 to 6	28.7	36.2	45	55.9	67.8	80.3	94.2	101.6
	7 to 13	18.7	23.6	29.8	37.6	47.3	58.3	69.2	74.7
200 < EHAAT ≤ 250	2 to 6	32.2	40.4	50.2	61.7	74	87	100.7	108.4
	7 to 13	20.9	26.5	33.5	42.1	52.7	63.5	74.3	79.9
250 < EHAAT ≤ 300	2 to 6	35.3	44.2	54.8	67.3	79.0	92.2	105.9	113.5
	7 to 13	23.0	29.1	36.8	46.1	57.3	67.9	78.7	83.9
300 < EHAAT ≤ 350	2 to 6	38.3	48.0	59.4	71.6	84.5	98.0	112.5	120.3
	7 to 13	25.2	32.5	40.8	50.6	61.7	72.5	83.3	89.0
350 < EHAAT ≤ 400	2 to 6	41.2	51.7	63.5	75.8	89.6	103.3	118.5	127.1
	7 to 13	27.7	35.7	44.4	54.8	66.0	76.7	87.7	93.7
400 < EHAAT ≤ 450	2 to 6	44.3	55.8	67.7	80.4	94.5	109.1	125.1	133.9
	7 to 13	30.1	38.7	48.3	59.1	70.3	81.2	92.9	99.5
450 < EHAAT ≤ 500	2 to 6	47.3	59.2	71.4	84.7	99.5	114.6	130.8	140.1
	7 to 13	32.8	41.9	52.1	62.9	74.1	85.4	98.2	105.0
500 < EHAAT ≤ 700 (optional)	2 to 6	57.0	69.6	83.1	97.4	112.8	128.7	145.2	153.3
	7 to 13	40.5	51.6	63	75.2	88.6	101.4	114.9	122.0

Table C6: Minimum separation distance of fixed (Ch. 2-13) and mobile (Ch. 2 and 5-13) WSDs operating at VHF frequency from the adjacent channel digital and analog TV-protected contour

		Fixed or mobile WSD e.i.r.p.						
EHAAT of fixed or mobile WSD (or dirHAAT, if applicable), m	**VHF channel range**	**100 mW**	**250 mW**	**625 mW**	**1.6 W**	**4 W**	**10 W**	**16 W**
EHAAT ≤ 3	2 to 6	0.2	0.3	0.3	0.4	0.5	0.6	0.6
	7 to 13	0.1	0.2	0.2	0.2	0.3	0.3	0.4
3 < EHAAT ≤ 10	2 to 6	0.4	0.4	0.5	0.7	0.8	1.0	1.1
	7 to 13	0.2	0.3	0.3	0.4	0.5	0.6	0.7
10 < EHAAT ≤ 30	2 to 6	0.6	0.7	0.9	1.1	1.4	1.7	1.9
	7 to 13	0.3	0.4	0.5	0.6	0.8	1.0	1.1
30 < EHAAT ≤ 50	2 to 6	0.7	0.9	1.1	1.4	1.8	2.2	2.5
	7 to 13	0.4	0.5	0.7	0.8	1.0	1.3	1.4
50 < EHAAT ≤ 75	2 to 6	0.9	1.1	1.4	1.7	2.1	2.7	3.0
	7 to 13	0.5	0.6	0.8	1.0	1.2	1.5	1.7
75 < EHAAT ≤ 100	2 to 6	1.0	1.3	1.6	2.0	2.5	3.1	3.5
	7 to 13	0.6	0.7	0.9	1.1	1.4	1.8	2.0
100 < EHAAT ≤ 150	2 to 6	1.2	1.5	1.9	2.4	3.0	3.8	4.2
	7 to 13	0.7	0.9	1.1	1.4	1.7	2.1	2.4
150 < EHAAT ≤ 200	2 to 6	1.4	1.8	2.2	2.8	3.5	4.3	4.9
	7 to 13	0.8	1.0	1.3	1.6	2.0	2.5	2.8
200 < EHAAT ≤ 250	2 to 6	1.6	2.0	2.4	3.1	3.9	4.8	5.4
	7 to 13	0.9	1.1	1.4	1.8	2.2	2.7	3.1
250 < EHAAT ≤ 300	2 to 6	1.7	2.1	2.7	3.4	4.2	5.3	6.0
	7 to 13	1.0	1.2	1.5	1.9	2.4	3.0	3.4
300 < EHAAT ≤ 350	2 to 6	1.8	2.3	2.9	3.6	4.6	5.7	6.4
	7 to 13	1.1	1.3	1.6	2.1	2.6	3.2	3.6
350 < EHAAT ≤ 400	2 to 6	2.0	2.5	3.1	3.9	4.9	6.1	6.9
	7 to 13	1.1	1.4	1.8	2.2	2.8	3.5	3.9
400 < EHAAT ≤ 450	2 to 6	2.1	2.6	3.3	4.1	5.2	6.5	7.3
	7 to 13	1.2	1.5	1.9	2.3	2.9	3.7	4.1

450 < EHAAT ≤ 500	2 to 6	2.2	2.7	3.4	4.3	5.4	6.8	7.7
	7 to 13	1.3	1.6	2.0	2.5	3.1	3.9	4.3
500 < EHAAT ≤ 700 (optional)	2 to 6	2.6	3.2	4.1	5.1	6.4	8.1	9.1
	7 to 13	1.5	1.8	2.3	2.9	3.6	4.6	5.1