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"TV Repack: Post Auction Procedures"

for

3rd Annual AFCCE Symposium
Association of Federal Communications Consulting Engineers
Washington, DC
October 30, 2015

Brief Digital TV History

Mar 1998	First DTV station goes on-air (27 total in 1998)

DTV Construction Deadlines

May 1999	Top 10 Markets, 4 network affiliates
Nov 1999	Markets 11-30, 4 network affiliates
May 2002	All Commercial Stations
May 2003	All Noncommercial Stations

Many stations initially built reduced facilities and "maximized" later

July 2005	"Use it or Lose it" deadline – Commercial stations
July 2006	"Use it or Lose it" deadline – Noncommercial stations
2005-2006	Channel Elections for Post-Transition Election conflict resolution
2009	Analog operations terminate DTV operations on final channel

Revisiting TV Spectrum Reallocation

2009 +/-	Rumblings of a "Repacking" to move more spectrum from TV broadcasting to wireless carriers
Mar 2010	FCC Releases "The National Broadband Plan"
Feb 2012	"The Middle Class Tax Relief and Job Creation Act of 2012" a.k.a. "Spectrum Act"
Oct 2012	FCC NPRM, Docket No. 12-268 "Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions"
June 2014	FCC Incentive Auction 1st Report & Order
Aug 2015	"Procedures" Public Notice
March 2016	Planned Incentive Auction

Post Auction Band Plan
"All Paired, Down from 51"

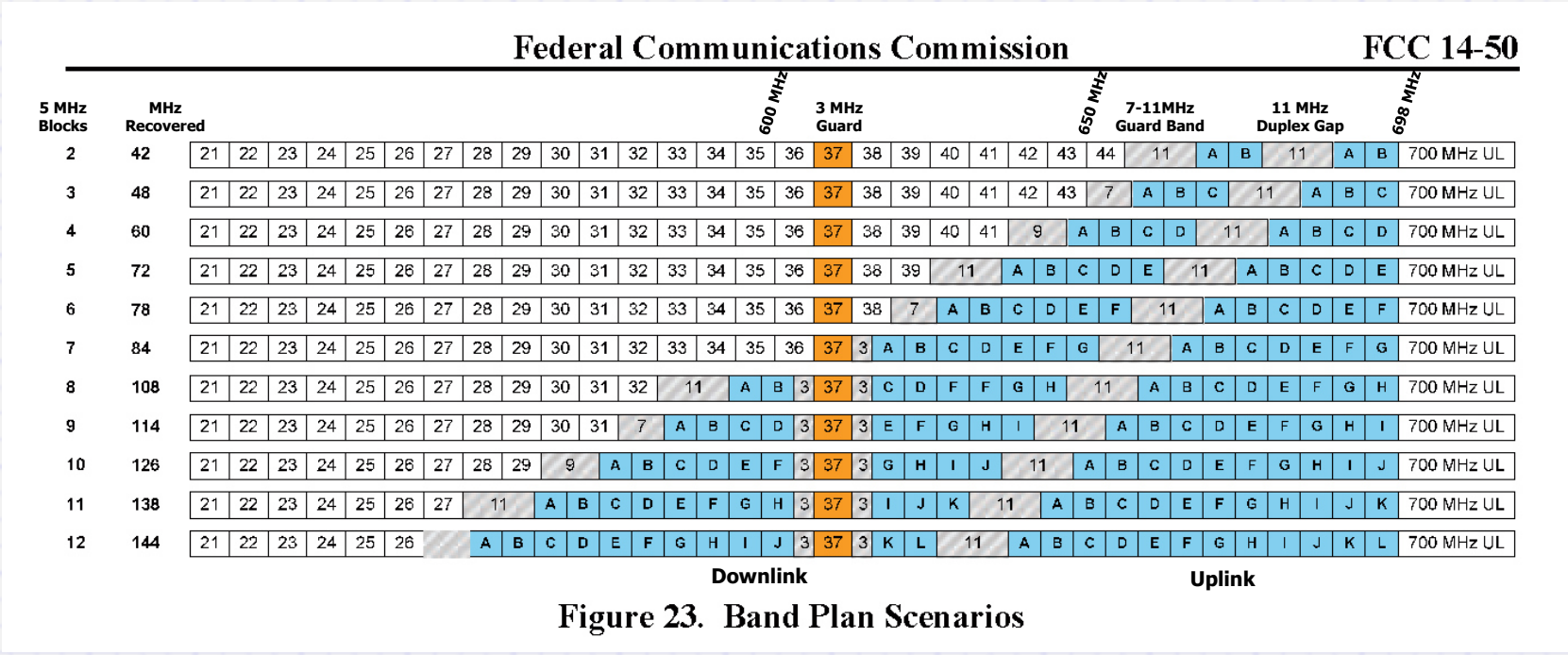


Figure 23. Band Plan Scenarios

Auction outcome to dictate final "TV Band" and Wireless "600 MHz Band"
Most markets - uniform band
Constrained markets – less spectrum recovered – impaired wireless blocks
Possible issues with inter-service interference ("ISIX" OET Bulletin 74)

Broadcaster Auction Options

Auction participation is not mandatory. Participation is confidential.

Bid options for participating stations:

1. License relinquishment
2. Change bands (U to Hi-V, U to Lo-V, Hi-V to Lo-V)
3. Share channel with another station

Post-Auction: Repacking

Non-participating stations may have to change to a new channel within the same band. Existing coverage area is replicated to new channel.

Participating stations who exit the auction may have to change channel within the same band.

Replication to New Channel

New channel assignment based on licensed antenna location and height

No change to directional pattern

UHF Power changes with dipole factor

Normalized to 615 MHz (Ch. 38)

-2.31 dB on Ch. 14

+1.03 dB on Ch. 51

1000 kW on Ch. 50 = 546 kW on Ch. 20

1000 kW on Ch. 18 = 1256 kW on Ch. 28 (cap at 1000 kW)

Table 2

Field Strengths Defining the Area subject to Calculation for DTV Stations

Channels	Defining Field Strength, dBu, to be predicted for 50% of locations, 90% of time
2 - 6	28
7 - 13	36
14 - 69	41 - 20 log[615/(channel mid-frequency in MHz)]

Timelines and Milestones

Incentive Auction (FCC Auction #1001 – reverse #1002 – forward)
Participating stations must submit application (Dec 1 – 18, 2015)
Reverse and Forward Auctions (begins March 29, 2016)
Auction closes when "Final Stage Rule" is satisfied

ASAP After Auction Concludes

Forward auction licenses are granted, disbursement of auction proceeds are made to broadcasters that are relinquishing spectrum

Relinquishing and channel sharing stations must vacate pre-auction channels within 3 months (Update 10/2015: 6 months for channel sharees with possible extensions up to 6 months more)

Channel Reassignment Public Notice

Final TV channel assignments and parameters announced
Post-Auction period begins
t = 0 Ready Set GO!

Timelines and Milestones

Deadline at "t + 3" Months

- Repacked stations must file Construction Permit applications and estimated channel relocation costs
- Crunch time – to plan new facility and transition

After "t + 3" Months, 36 month "Broadcast Construction Period" begins

- CP's are issued ASAP
- FCC establishes construction deadlines for new channel implementation
- Deadlines to vary by region, complexity, and other factors
  - Some stations will have less than the full 36 month period

Timelines and Milestones

Meeting Construction Deadline

- 6-month extension of **construction deadline** upon suitable request
- Subsequent extensions via much stricter criteria

- At "t + 39" months, all operations on pre-auction channels must cease
- Must go dark if not ready at "t + 39"
- 12 months silent = automatic license expiration
  - FCC can reinstate with waiver – if involuntarily dark and if "equity and fairness" apply

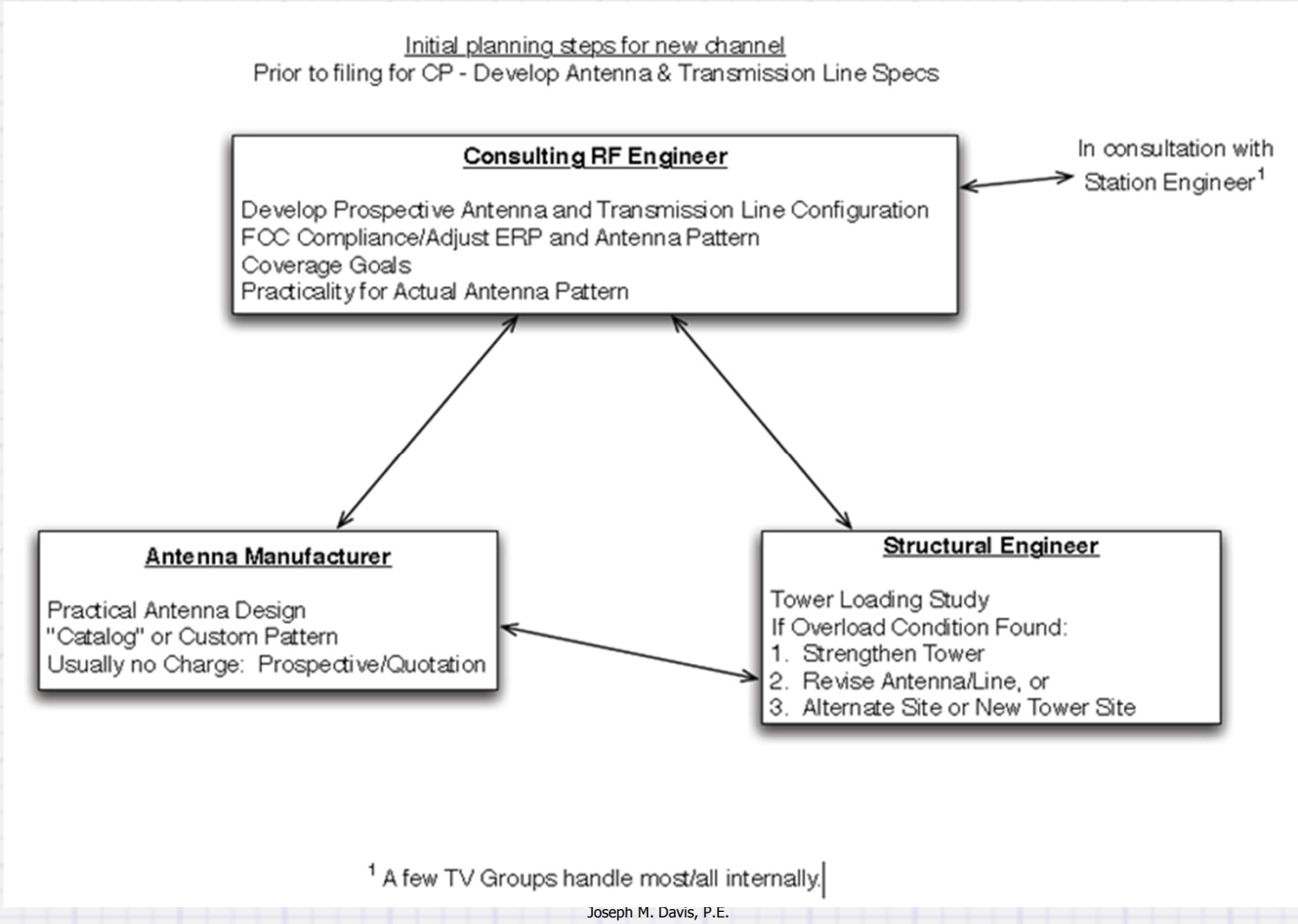
Interim operations will be necessary for many stations

- Existing or new auxiliary transmitter/antenna
- Temporary installation
- On pre-auction and/or post-auction channel
- Reduced facilities
- Alternate site
- Temporary channel

Facility Planning

Limited opportunity for pre-planning until repack results are available

By t = 3 months must apply for Construction Permit



Facility Planning

1. Pre-planning (t = 0)
2. RF Engineering
3. Structural Engineering
4. Negotiate with tower owners
5. Permitting
6. Estimated Costs to FCC for Reimbursement (negotiation?)

------ t = 3 months ------

7. Acquire equipment/manufacturing
8. Tower Work
9. Field Engineering

Timelines and Milestones

Careful of "Premature Construction"

Need Construction Permit first:

"Installation of an antenna, transmitter, transmission line, and related inside wiring linking these facilities" (FCC 14-50 FN 1594)

OK without a Construction Permit:

Construction planning, installation of a new power line, equipment purchases, and onsite storage of equipment; actions "generally having no intrinsic radio communications use related to a proposed facility" do not constitute construction (FCC 14-50 FN 1595)

OK to perform "site clearance, pouring of concrete footings for a tower, installation of a tower base and anchors, installation of a new power line, purchase and on-site storage (but not installation) of radio equipment and other preliminary steps having no intrinsic broadcast use" (DA 14-1099)

Planning and Application Procedures

Construction Permit Applications:
Repacked stations - three filing deadlines depending on nature of proposal

1. "Initial Applications" – generally conforming – file by t=3 months

   Comply with new parameters, no contour expansion
   Interference study not required, serve > 95% reference population
   Expedited grant by FCC

   Slight contour extension up to 1 percent OK if needed to achieve the new assignment or to address a loss area on the new channel
   Interference is <0.5% to any other station
   Antenna pattern must closely conform to new assignment

   1 percent contour extension limit not applicable to winning bidders going from UHF to VHF due to pattern matching issues

Planning and Application Procedures

Last two filing deadlines follow FCC processing of first set of applications

2. "Priority" Expanded Facilities (Maximization) and Alternate Channels
   Applicable if new assignment can't be constructed for reasons beyond station's control. MB to describe standards for priority.
   Contour extension over 1 percent
   New interference <0.5% to any other station

What is a Priority Station?

"Specifically, we will provide a priority to any station that demonstrates that it is unable to construct facilities that meet the technical parameters specified in the *Channel Reassignment PN*, or the permissible contour coverage variance discussed above, for reasons beyond its control."

"In addition, we delegate authority to the Media Bureau to define other categories of stations that may be eligible for a filing priority due to extraordinary circumstances beyond a station's control."

Footnote – an example of priority:

"We anticipate that such stations would include those that cannot submit a construction permit application for their assigned channel because they are unable to construct at their current tower site due to technical or legal issues."

What is a Priority Station?

Oct 17, 2014 Second R&O

Stations experiencing more than one percent new interference

"…if a station is predicted to receive new interference above one percent on the final channel assigned to it following the repacking process, we will provide it with the opportunity to file an application proposing an alternate channel or expanded facilities in a priority filing window, along with a limited number of other stations that have been assigned the same priority…"

==========

Oct 26, 2015 Third R&O

More than one percent population loss from terrain and/or interference

"…stations predicted to experience a loss in population served in excess of one percent as a result of the repacking process – either because of new station-to-station interference or terrain loss resulting from a new channel assignment (or a combination of both) - may file an application proposing an alternate channel or expanded facilities in a priority filing window…"

Terrain Loss from Channel Change

More than one percent population loss???

TVStudy detail: OET Bulletin 69 Terrain Blockage Comparison: WCBS-TV

	Ch. 33 385 kW 519 m		Ch. 22 303 kW 519 m	
Digital Television Coverage	Population (2010 Census)	Area (sq. km)	Population (2010 Census)	Area (sq. km)
Within noise limited contour	21,713,751	36,527.9	21,713,751	36,527.9
Not affected by terrain losses	21,185,661	34,222.5	21,277,494	34,472.2
Terrain Losses	528,090	2,305	436,257	2,056

	Population	Area
New Terrain Loss	-91,833	-250
	-0.43%	-0.73%

TVStudy detail: OET Bulletin 69 Terrain Blockage Comparison: KYW-TV

	Ch. 26 790 kW 375 m		Ch. 36 974 kW 375 m	
Digital Television Coverage	Population (2010 Census)	Area (sq. km)	Population (2010 Census)	Area (sq. km)
Within noise limited contour	11,061,110	33,837.7	11,061,110	33,837.7
Not affected by terrain losses	10,873,780	32,642.8	10,841,587	32,542.8
Terrain Losses	187,330	1,195	219,523	1,295

	Population	Area
New Terrain Loss	32,193	100
	0.30%	0.31%

Terrain Loss from Channel Change

More than one percent population loss???

Station:	Base Terr-Ltd Population	New Terrain Loss Population	Percent
WCVB-TV Boston Ch. 20 625 kW to Ch. 30 781 kW	7,606,759	11,121	0.15%
WATL Atlanta Ch. 25 500 kW to Ch. 30 557 kW	5,819,640	3,530	0.06%
WCNC-TV Charlotte Ch. 22 791 kW to Ch. 30 943 kW	3,749,644	8,596	0.23%
KNXV-TV Phoenix Ch. 15 458 kW to Ch. 30 646 kW	4,173,097	1,563	0.04%
KASW Phoenix Ch. 49 531 kW to Ch. 25 331 kW	4,152,148	-10,036	-0.24%
WJLA-TV Washington DC Ch. 7 52 kW to Ch. 12 52 kW	8,627,814	31,122	0.36%
WSAZ-TV Huntington WV Ch. 23 595 kW to Ch. 33 738 kW	1,120,741	3,925	0.35%

Planning and Application Procedures

Last two filing deadlines follow FCC processing of first set of applications

2. "Priority" Expanded Facilities (Maximization) and Alternate Channels
   Applicable if new assignment can't be constructed for reasons beyond station's control. MB to describe standards for priority.
   Also: Service loss over one percent population
   Contour extension over 1 percent
   New interference <0.5% to any other station

3. "Non-Priority" Expanded Facilities and Alternate Channels
   Contour extension over 1 percent
   New interference <0.5% to any other station

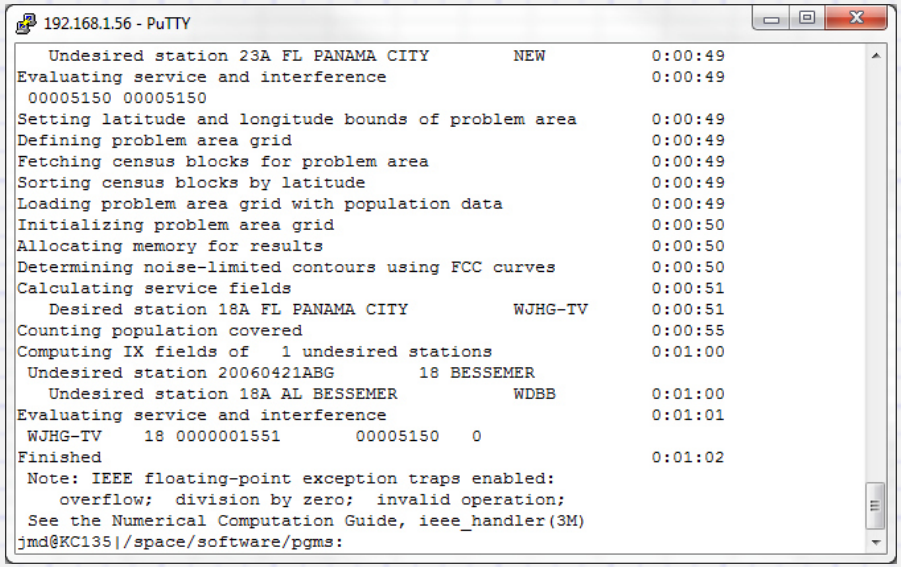
   After processing initial CP applications in "1", MB to issue PN's with deadlines for "2" and "3", processing guidelines, cut-off and MX resolution

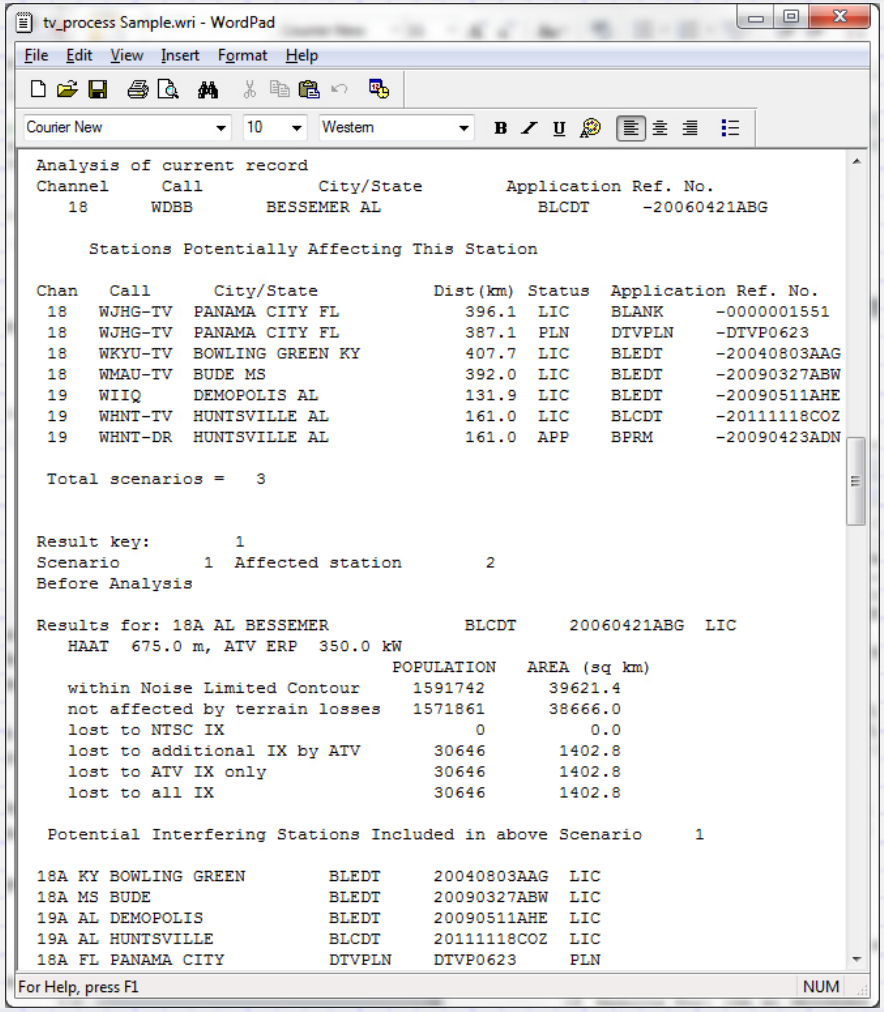
4. Stations that are not repacked ("Stays")
   Contour extension and channel substitution freezes lifted

Application Software: Interference

Goodbye old friend "tv_process"

Long-standing implementation of OET Bulletin 69

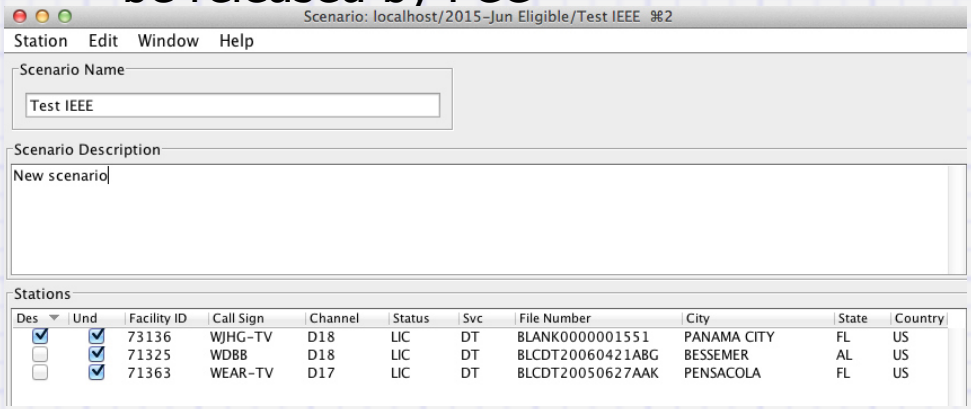


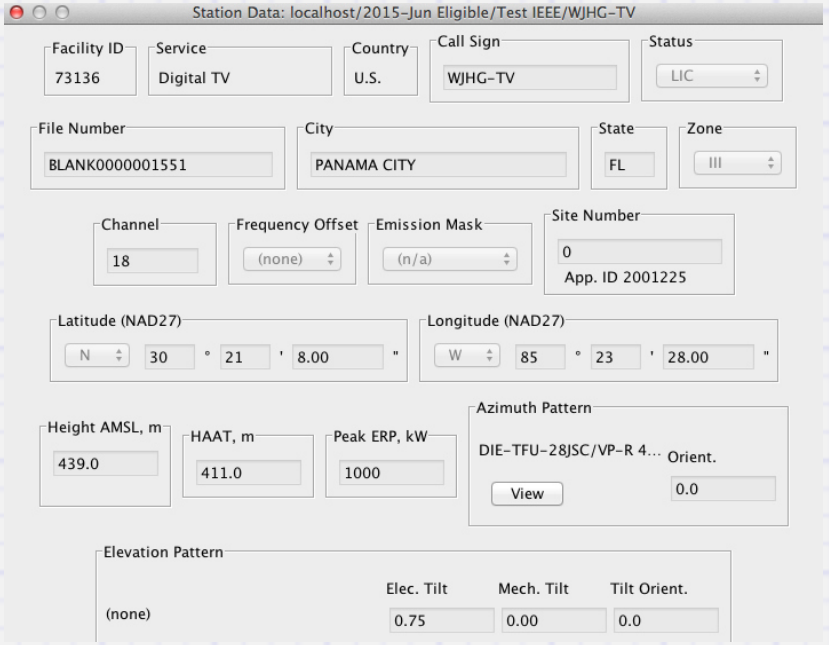


Application Software: Interference

Hello to "TVStudy"

Application processing version to be released by FCC





Interference analysis for station expansion proposals in TV band

Contour extension NOT LIKELY for stations in Wireless "600 MHz Band"

```
tvstudy v1.3.2

Database: localhost
    CDBS: 06/12/2015 (4)  2015 June Eligible List
   Study: 2015-Jun Eligible
Scenario: Test IEEE

Comment:

Start: 2015.09.22 14:46:55

Desired station                              Noise-limited       Terrain-limited     Interference-free

     Undesired station                       Total interference  Unique interference

WJHG-TV D18 LIC PANAMA CITY, FL        36322.1     856,886   36270.3     852,588   36266.3     852,574  (in U.S.)

     WDBB D18 LIC BESSEMER, AL                4.0          14       4.0          14
```

Expansion of Stations in 600 MHz Band

Can't extend contour towards wireless licensee area if potential interference to wireless licensee is increased

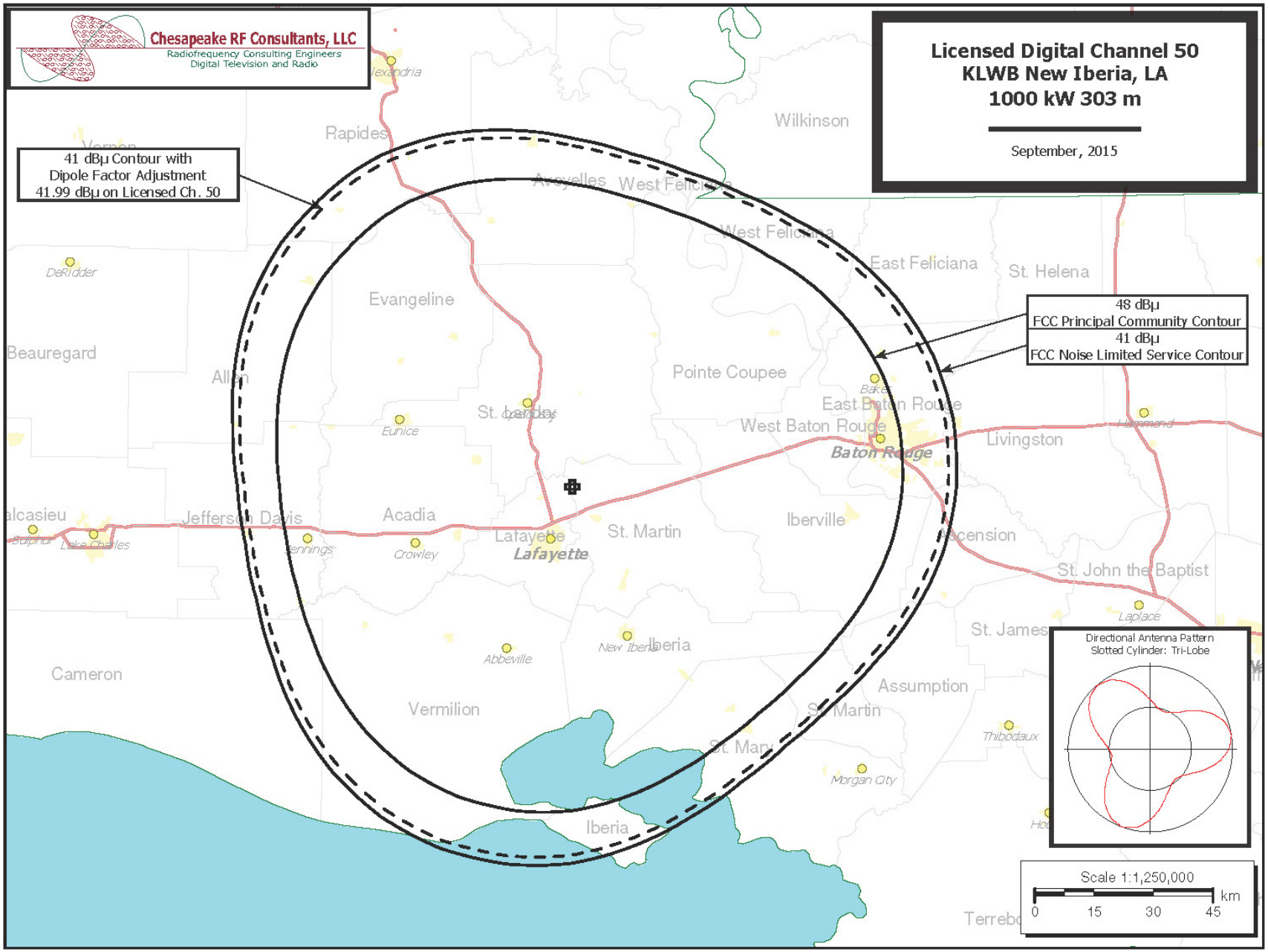
OK if wireless licensee consents

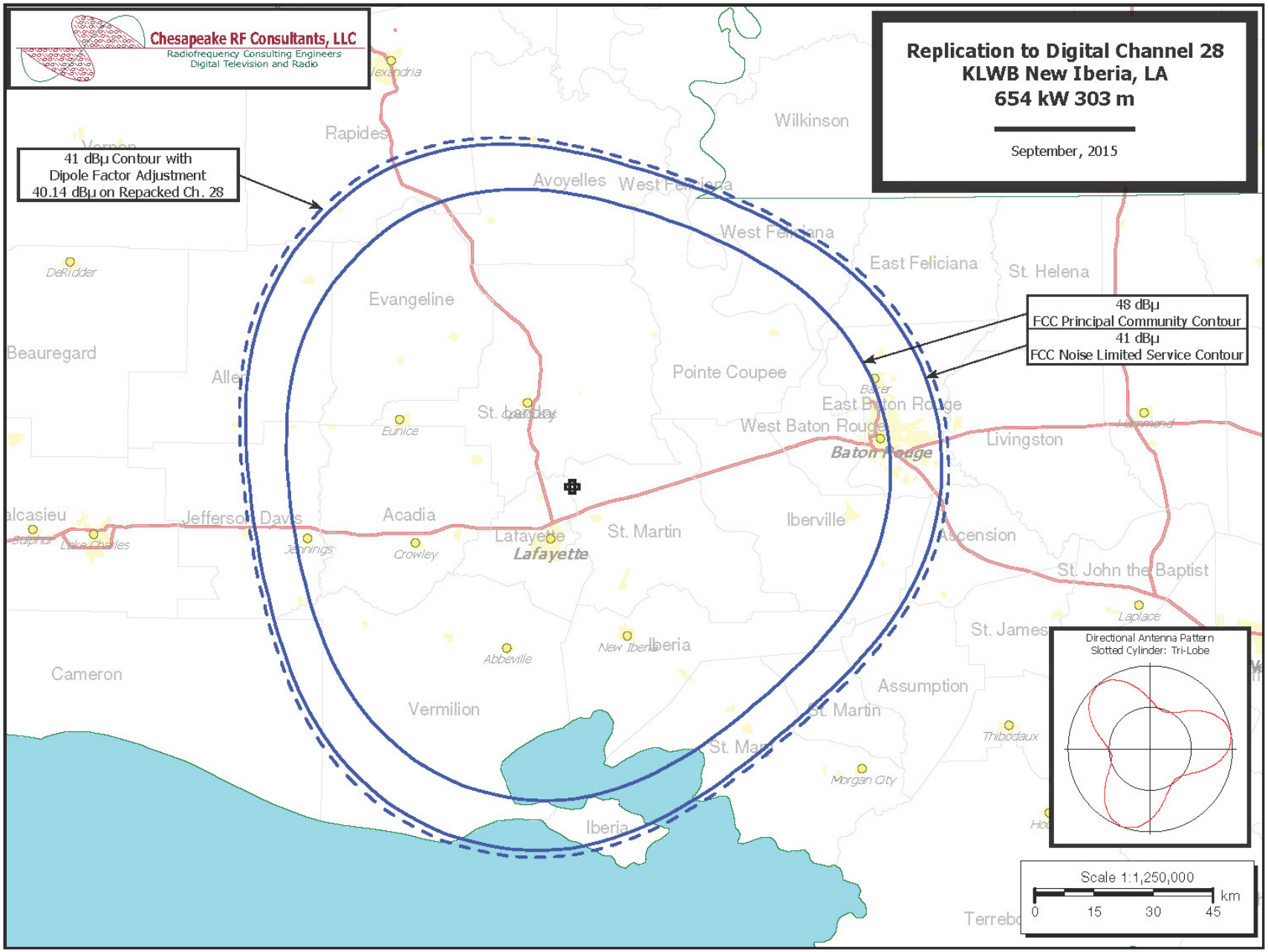
Waiver on a case-by-case basis

Interference analysis must consider co-channel and adjacent-channel wireless operations within 500 km of DTV's expanded NLSC

"For purposes of this limitation, a television station's baseline contours are those set forth in its initial post-auction construction permit application." (FCC 15-141)

Initial application – Can expand by one percent (distance) without regard to wireless, if necessary to achieve the reassignment contour or to address a loss of coverage area


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
Licensed Digital Channel 50
KLWB New Iberia, LA
1000 kW 303 m
September, 2015
41 dBμ Contour with
Dipole Factor Adjustment
41.99 dBμ on Licensed Ch. 50
48 dBμ
FCC Principal Community Contour
41 dBμ
FCC Noise Limited Service Contour
Directional Antenna Pattern
Slotted Cylinder: Tri-Lobe
Scale 1:1,250,000
0 15 30 45 km
Rapides
Wilkinson
Avoyelles
West Feliciana
East Feliciana
St. Helena
Evangeline
Beauregard
Allen
Pointe Coupee
East Baton Rouge
West Baton Rouge
Baton Rouge
Livingston
Jefferson Davis
Acadia
Lafayette
St. Martin
Iberville
Ascension
St. John the Baptist
St. James
Cameron
Vermilion
Iberia
Assumption
St. Mary
Thibodaux
Morgan City
Eunice
Crowley
Abbeville
New Iberia
Laplace
DeRidder
Lake Charles
Terrebo


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
Replication to Digital Channel 28
KLWB New Iberia, LA
654 kW 303 m
September, 2015
41 dBµ Contour with
Dipole Factor Adjustment
40.14 dBµ on Repacked Ch. 28
48 dBµ
FCC Principal Community Contour
41 dBµ
FCC Noise Limited Service Contour
Directional Antenna Pattern
Slotted Cylinder: Tri-Lobe
Scale 1:1,250,000
0 15 30 45 km
Rapides
Wilkinson
Avoyelles
West Feliciana
East Feliciana
St. Helena
Evangeline
Beauregard
Pointe Coupee
East Baton Rouge
West Baton Rouge
Baton Rouge
Livingston
Jefferson Davis
Acadia
St. Martin
Iberville
Ascension
Lafayette
St. John the Baptist
Iberia
St. James
Cameron
Vermilion
Assumption
Thibodaux
Morgan City
DeRidder
Eunice
Jennings
Crowley
Abbeville
New Iberia
Laplace

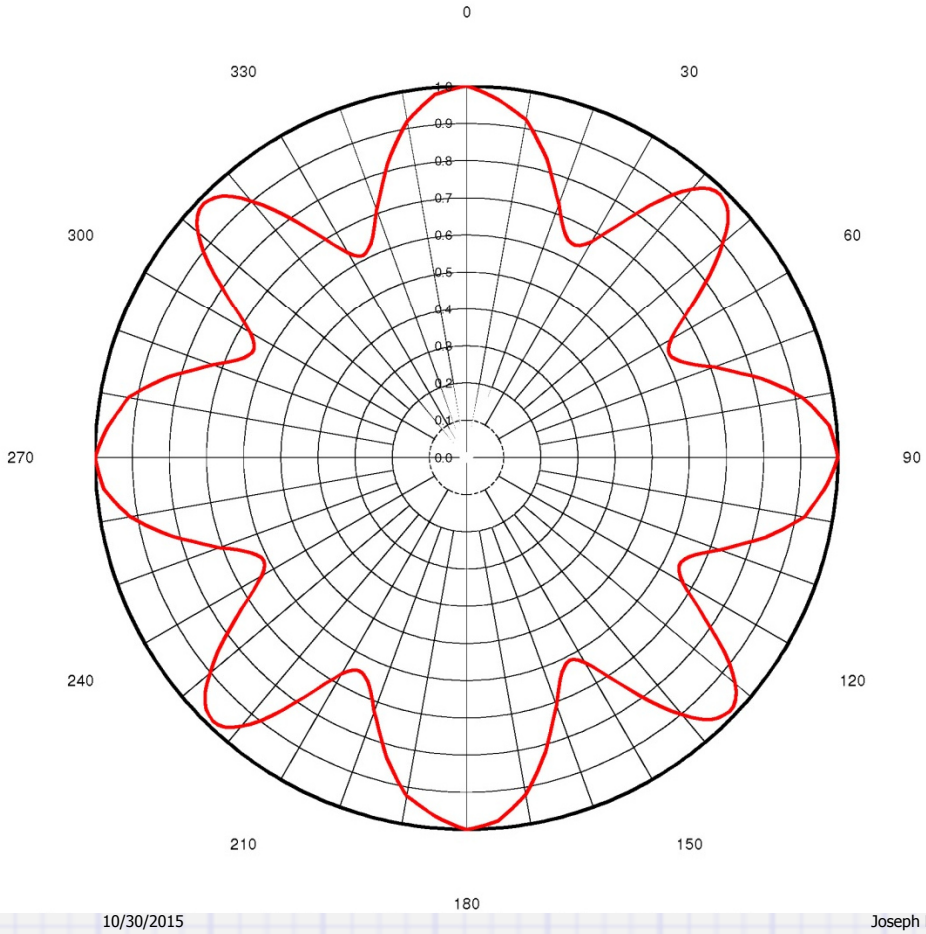
UHF Panel Antenna Azimuthal Patterns: Nondirectional

Dielectric

Serial Number:	TUA6-R001
Channel	42
Antenna Type	TUA-O4-2/8U-1-S

AZIMUTH PATTERN

Gain	1.45 (1.61 dB)	Frequency	641.00 MHz
Calculated / Measured	Calculated	Drawing #	TUA-O4-6410

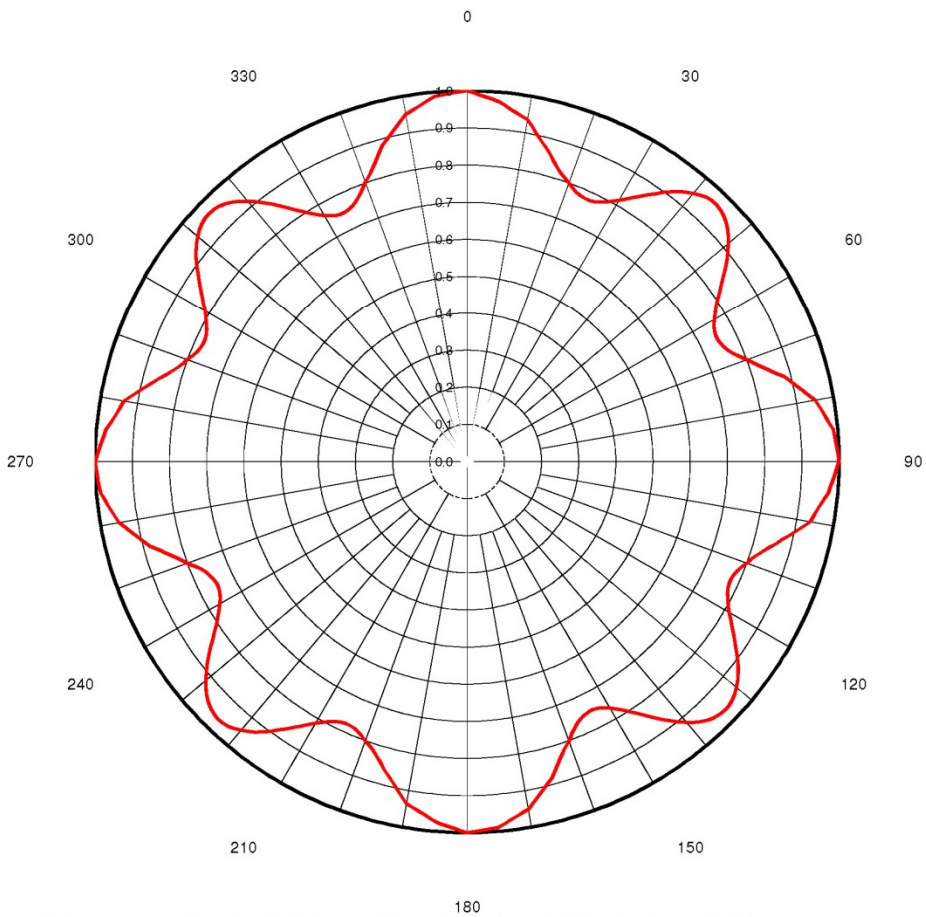


Dielectric

Serial Number:	TUA6-R001
Channel	23
Antenna Type	TUA-O4-2/8U-1-S

AZIMUTH PATTERN

Gain	1.30 (1.14 dB)	Frequency	527.00 MHz
Calculated / Measured	Calculated	Drawing #	TUA-O4-5270



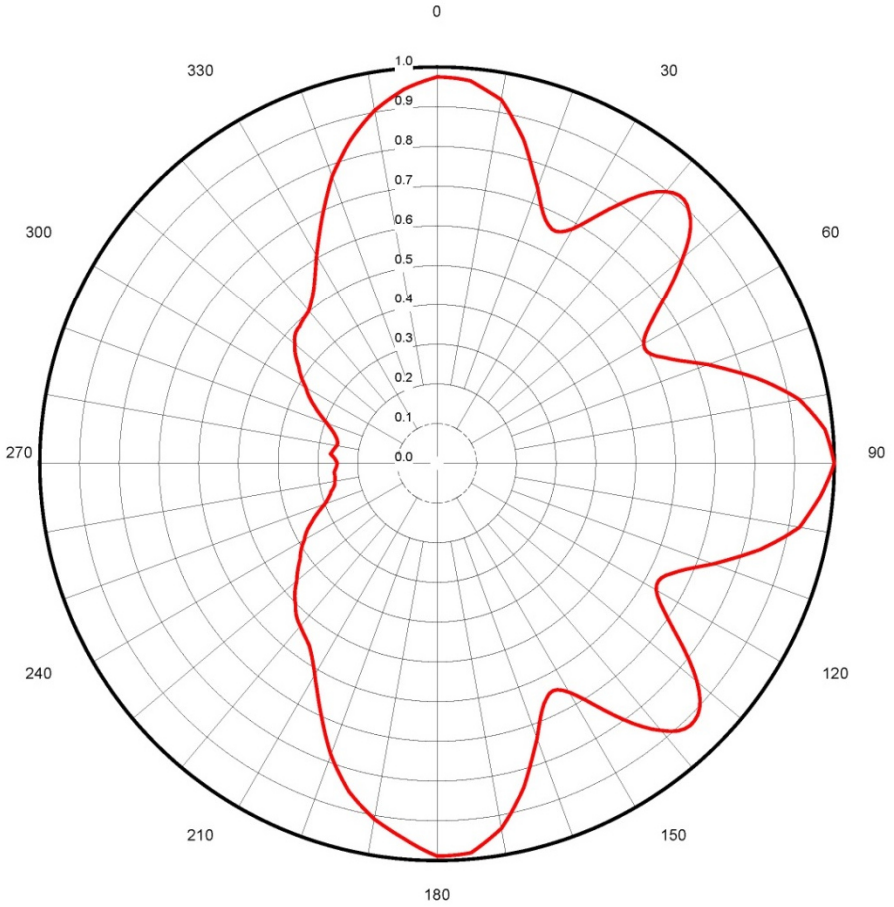
UHF Panel Antenna Azimuthal Patterns: Directional

Dielectric

Proposal Number	C		
Date	8-Mar-07		
Call Letters	K----DT	Channel	44
Location			
Customer			
Antenna Type	TUA-C4SP-12/40U-1-S		

AZIMUTH PATTERN

Gain	2.00 (3.01 dB)	Frequency	653.00 MHz
Calculated / Measured	Calculated	Drawing #	TUA-C4SP-6530

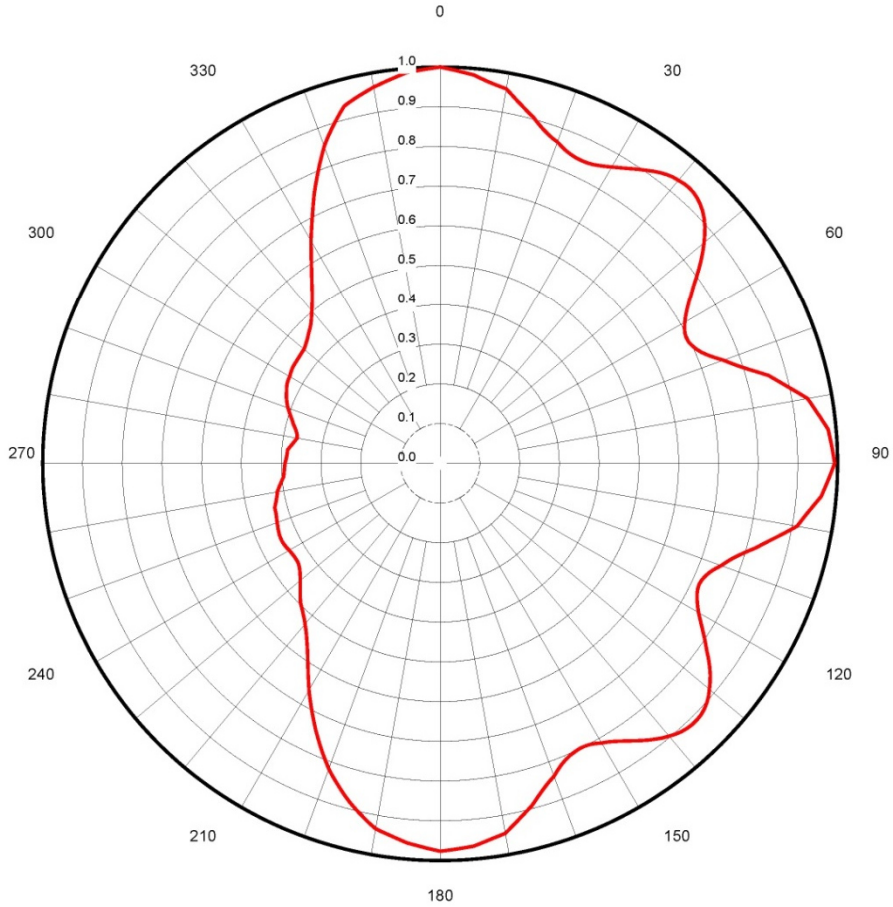


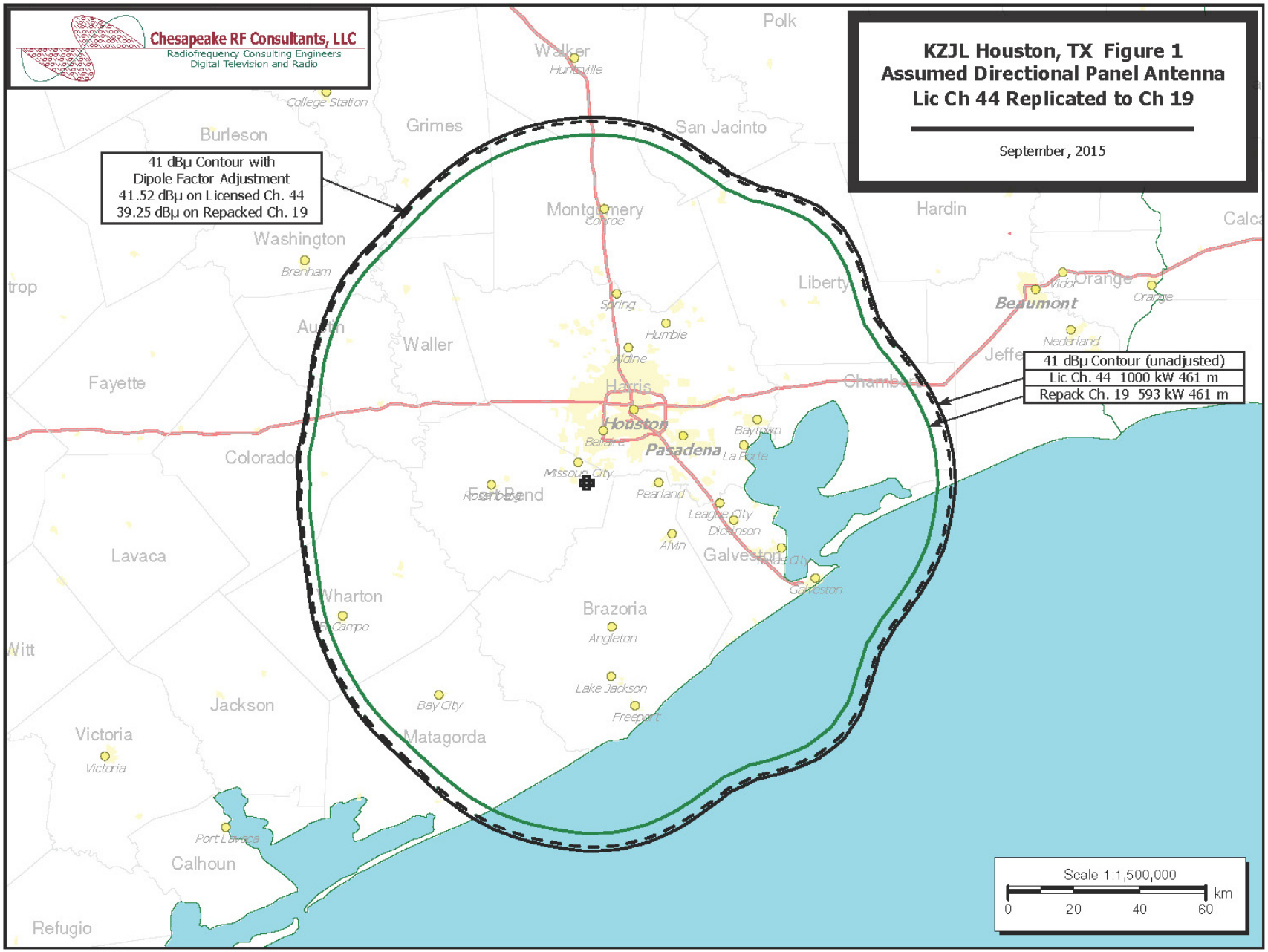
Dielectric

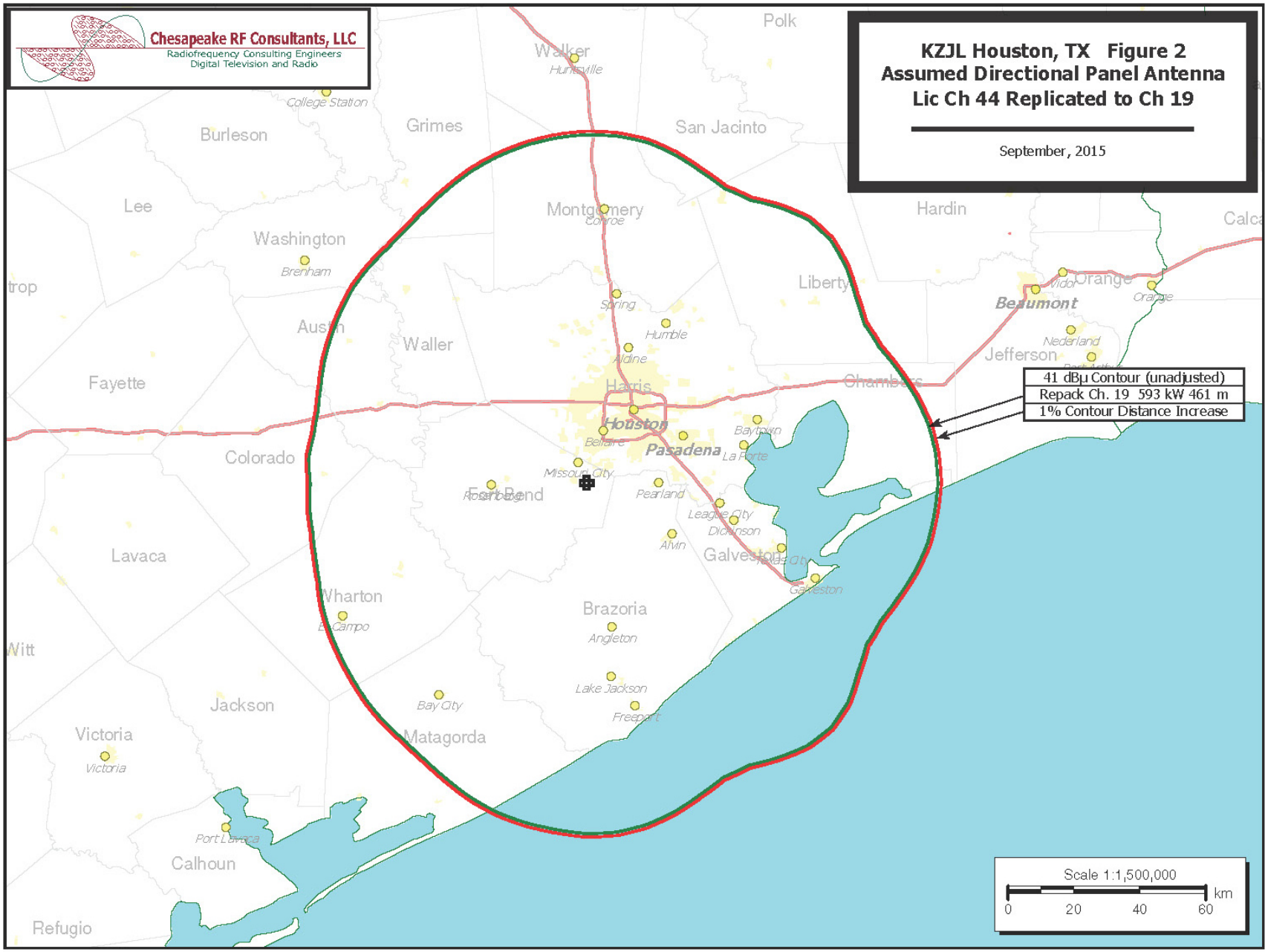
Proposal Number	C		
Date	8-Mar-07		
Call Letters	K-----DT	Channel	19
Location			
Customer			
Antenna Type	TUA-C4SP-12/40U-1-S		

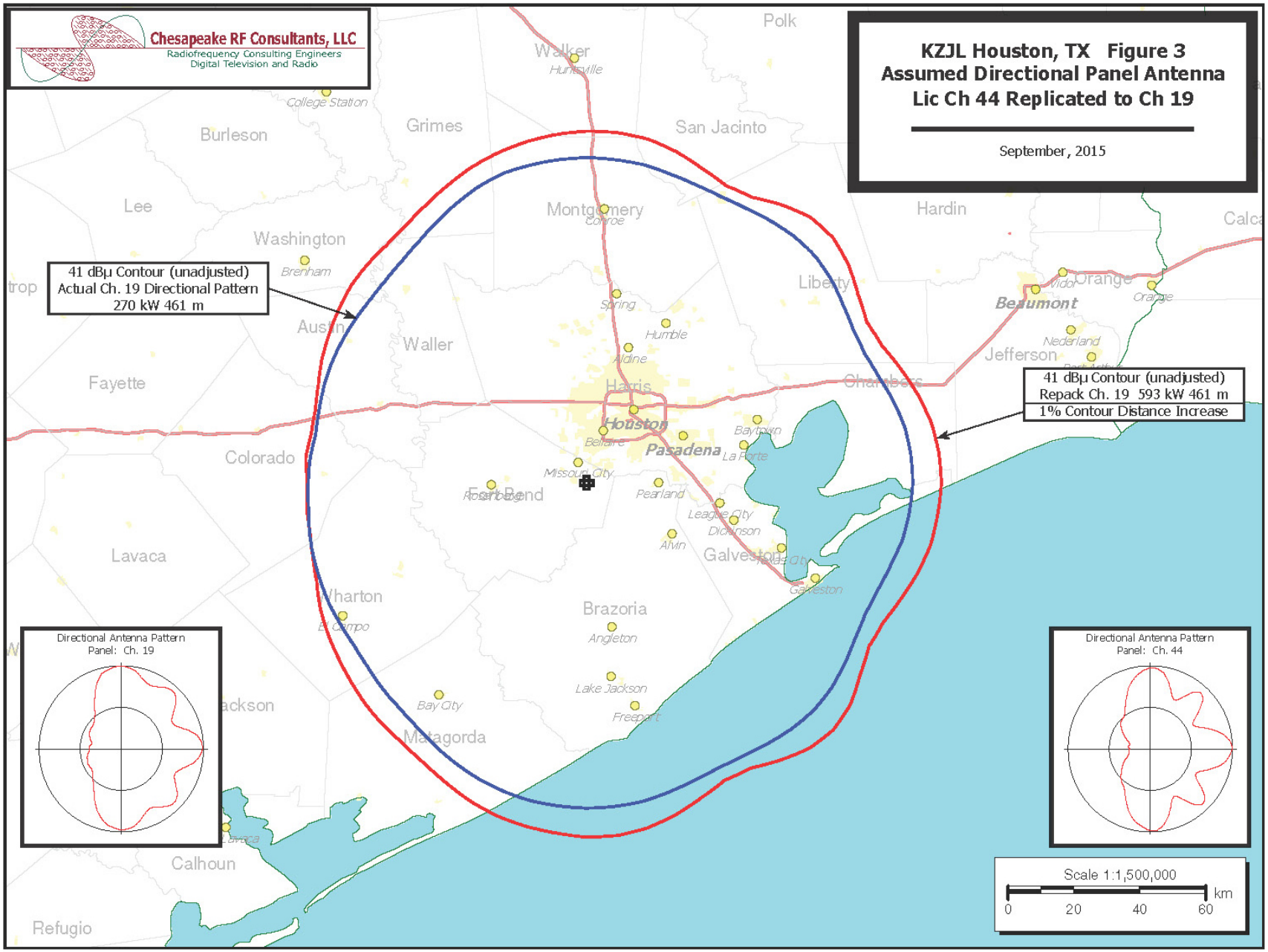
AZIMUTH PATTERN

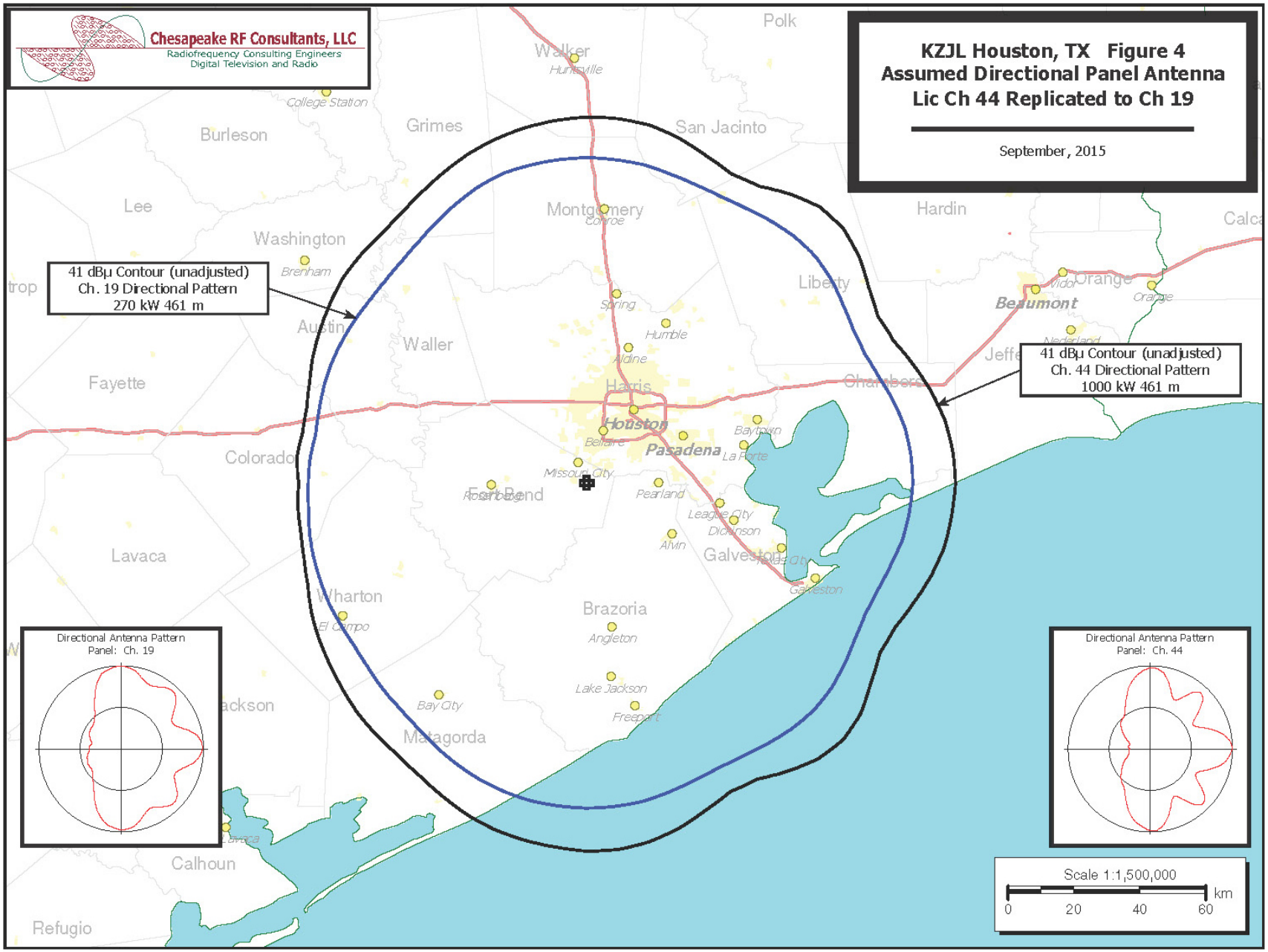
Gain	1.70 (2.30 dB)	Frequency	503.00 MHz
Calculated / Measured	Calculated	Drawing #	TUA-C4SP-5030

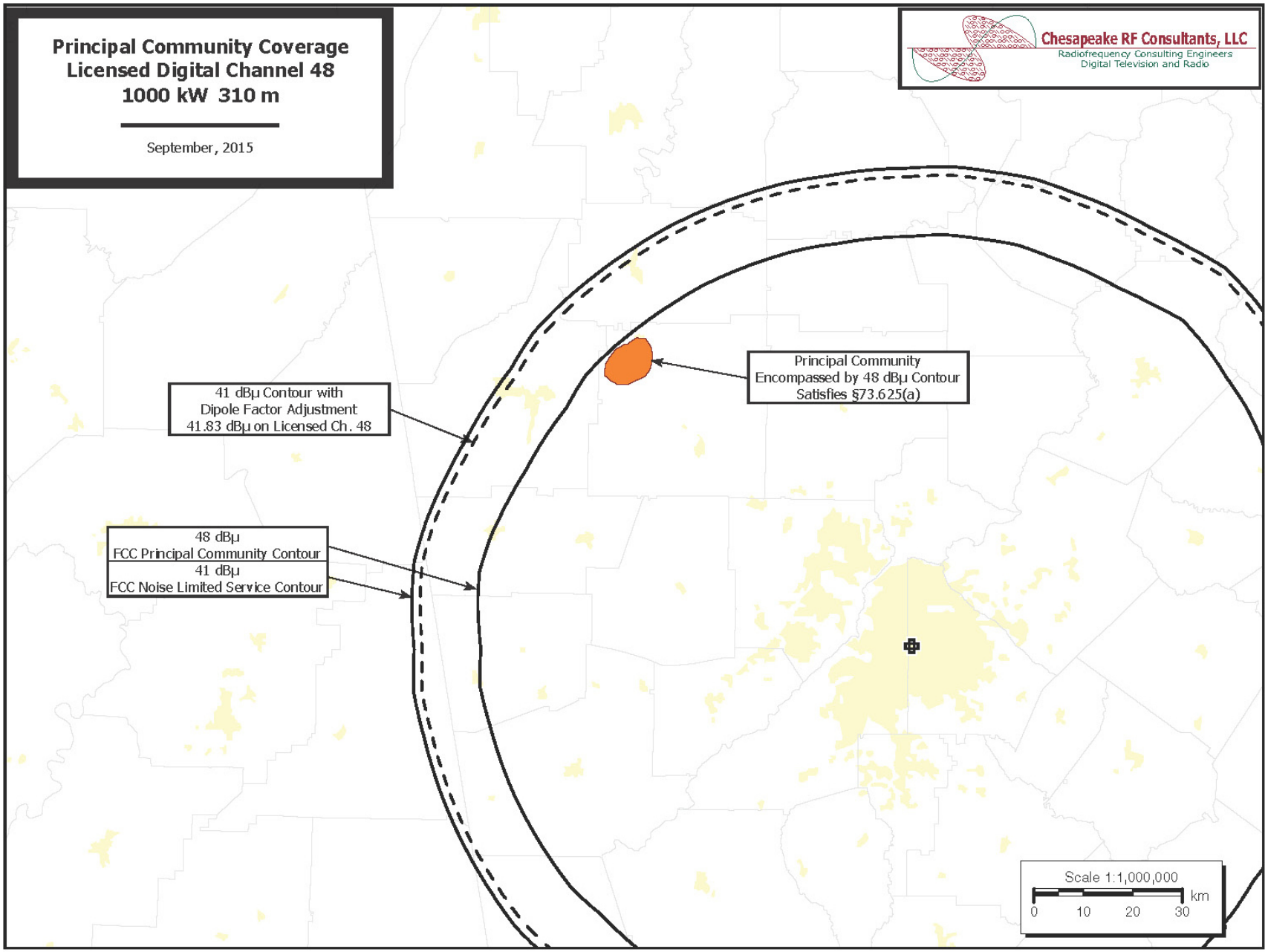


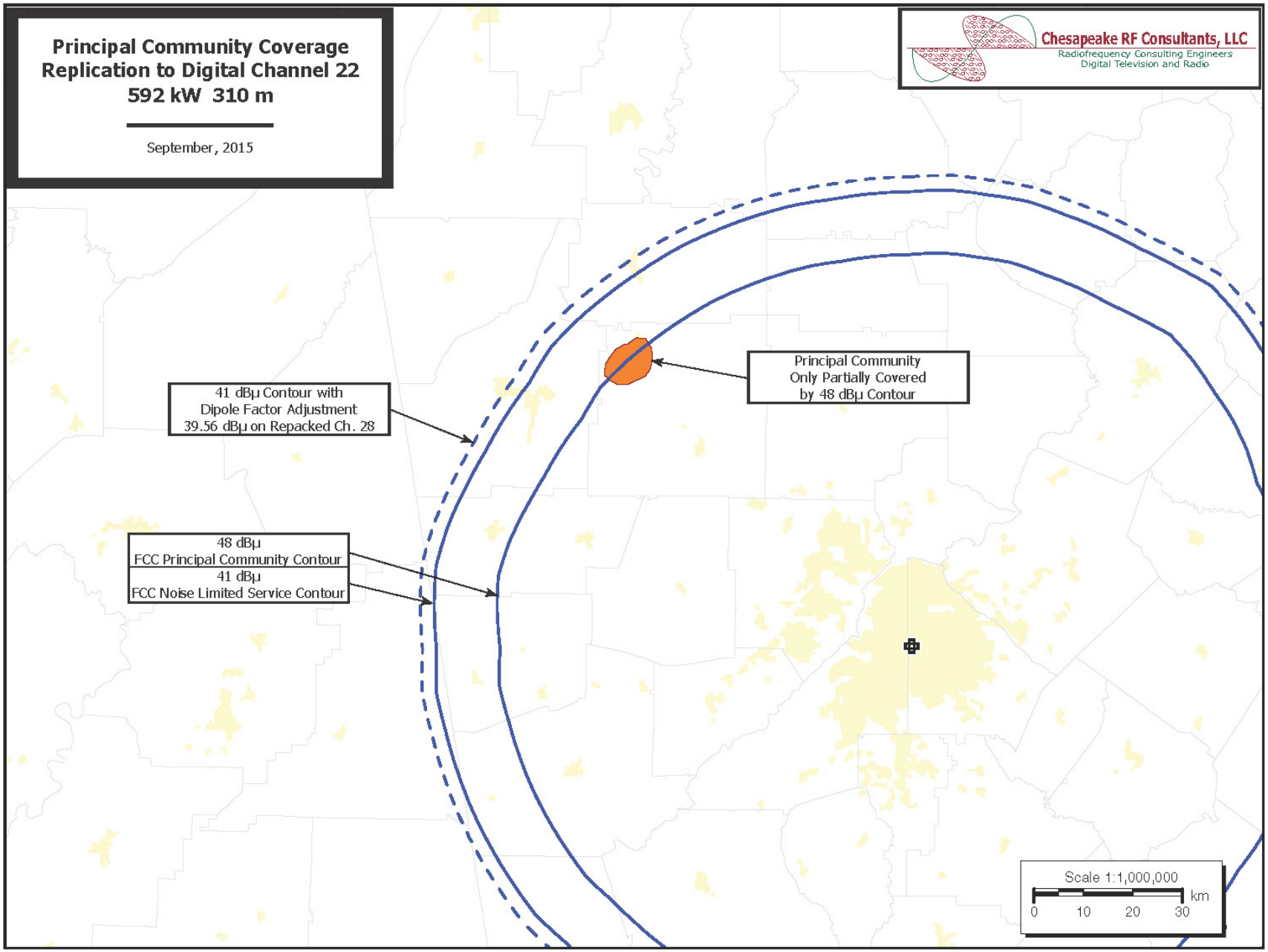

Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
KZJL Houston, TX Figure 1
Assumed Directional Panel Antenna
Lic Ch 44 Replicated to Ch 19
September, 2015
41 dBμ Contour with
Dipole Factor Adjustment
41.52 dBμ on Licensed Ch. 44
39.25 dBμ on Repacked Ch. 19
41 dBμ Contour (unadjusted)
Lic Ch. 44 1000 kW 461 m
Repack Ch. 19 593 kW 461 m
Scale 1:1,500,000
0 20 40 60 km
Polk
Walker
Huntsville
College Station
Grimes
San Jacinto
Burleson
Montgomery
Conroe
Hardin
Washington
Brenham
Liberty
Orange
Beaumont
Vidor
Orange
Nederland
Spring
Humble
Aldine
Austin
Waller
Fayette
Harris
Chambers
Houston
Pasadena
Baytown
La Porte
Bellaire
Missouri City
Colorado
Fort Bend
Pearland
League City
Dickinson
Alvin
Galveston
Texas City
Galveston
Lavaca
Wharton
El Campo
Brazoria
Angleton
Lake Jackson
Freeport
Bay City
Jackson
Matagorda
Victoria
Victoria
Port Lavaca
Calhoun
Refugio


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
KZJL Houston, TX Figure 2
Assumed Directional Panel Antenna
Lic Ch 44 Replicated to Ch 19
September, 2015
41 dBµ Contour (unadjusted)
Repack Ch. 19 593 kW 461 m
1% Contour Distance Increase
Scale 1:1,500,000
0 20 40 60 km
Polk
Walker
Huntsville
College Station
Burleson
Grimes
San Jacinto
Lee
Washington
Brenham
Montgomery
Conroe
Hardin
Liberty
Beaumont
Orange
Nederland
Jefferson
Chambers
Austin
Waller
Spring
Humble
Aldine
Harris
Houston
Bellaire
Pasadena
Baytown
La Porte
Missouri City
Fort Bend
Rosenberg
Pearland
League City
Dickinson
Alvin
Galveston
Texas City
Fayette
Colorado
Lavaca
Wharton
El Campo
Brazoria
Angleton
Lake Jackson
Freeport
Bay City
Matagorda
Jackson
Victoria
Victoria
Port Lavaca
Calhoun
Refugio
Witt


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
KZJL Houston, TX Figure 3
Assumed Directional Panel Antenna
Lic Ch 44 Replicated to Ch 19
September, 2015
41 dBµ Contour (unadjusted)
Actual Ch. 19 Directional Pattern
270 kW 461 m
41 dBµ Contour (unadjusted)
Repack Ch. 19 593 kW 461 m
1% Contour Distance Increase
Directional Antenna Pattern
Panel: Ch. 19
Directional Antenna Pattern
Panel: Ch. 44
Scale 1:1,500,000
0 20 40 60 km
Polk
Walker
Huntsville
College Station
Burleson
Grimes
San Jacinto
Lee
Montgomery
Conroe
Hardin
Washington
Brenham
Liberty
Orange
Beaumont
Austin
Waller
Spring
Humble
Aldine
Jefferson
Nederland
Fayette
Harris
Chambers
Houston
Baytown
Bellaire
Pasadena
La Porte
Colorado
Missouri City
Fort Bend
Pearland
League City
Dickinson
Alvin
Galveston
Lavaca
Wharton
El Campo
Brazoria
Angleton
Lake Jackson
Bay City
Freeport
Matagorda
Calhoun
Refugio


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
KZJL Houston, TX Figure 4
Assumed Directional Panel Antenna
Lic Ch 44 Replicated to Ch 19
September, 2015
41 dBµ Contour (unadjusted)
Ch. 19 Directional Pattern
270 kW 461 m
41 dBµ Contour (unadjusted)
Ch. 44 Directional Pattern
1000 kW 461 m
Directional Antenna Pattern
Panel: Ch. 19
Directional Antenna Pattern
Panel: Ch. 44
Scale 1:1,500,000
0 20 40 60 km
Polk
Walker
Huntsville
College Station
Burleson
Grimes
San Jacinto
Lee
Washington
Brenham
Montgomery
Conroe
Hardin
Liberty
Orange
Beaumont
Austin
Waller
Spring
Humble
Aldine
Harris
Houston
Pasadena
Baytown
La Porte
Bellaire
Missouri City
Fort Bend
Rosenberg
Pearland
League City
Dickinson
Alvin
Galveston
Texas City
Fayette
Colorado
Lavaca
Wharton
El Campo
Brazoria
Angleton
Lake Jackson
Freeport
Bay City
Matagorda
Calhoun
Refugio


Principal Community Coverage
Licensed Digital Channel 48
1000 kW 310 m
September, 2015
Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
Principal Community
Encompassed by 48 dBµ Contour
Satisfies §73.625(a)
41 dBµ Contour with
Dipole Factor Adjustment
41.83 dBµ on Licensed Ch. 48
48 dBµ
FCC Principal Community Contour
41 dBµ
FCC Noise Limited Service Contour
Scale 1:1,000,000
km
0
10
20
30


Principal Community Coverage
Replication to Digital Channel 22
592 kW 310 m
September, 2015
Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio
Principal Community
Only Partially Covered
by 48 dBµ Contour
41 dBµ Contour with
Dipole Factor Adjustment
39.56 dBµ on Repacked Ch. 28
48 dBµ
FCC Principal Community Contour
41 dBµ
FCC Noise Limited Service Contour
Scale 1:1,000,000
km
0
10
20
30

Replication: Band Change

New channel assignment based on licensed antenna location and height

No change to directional pattern

Pre-Auction UHF channel: apply dipole factor to set area to be replicated
Post-Auction VHF channel: dipole factor not used

Sample replication parameters:

Pre-Auction UHF				Post-Auction Hi-VHF
Ch. 15	295 m	non-d	75 kW	1.82 kW
Ch. 34	291 m	non-d	1000 kW	17.4 kW
Ch. 44	415 m	non-d	335 kW	5.85 kW
Ch. 49	279 m	DA	860 kW	9.06 kW

Replication: Band Change

Maximum DTV ERP's
Hi-VHF (Ch 7-13)

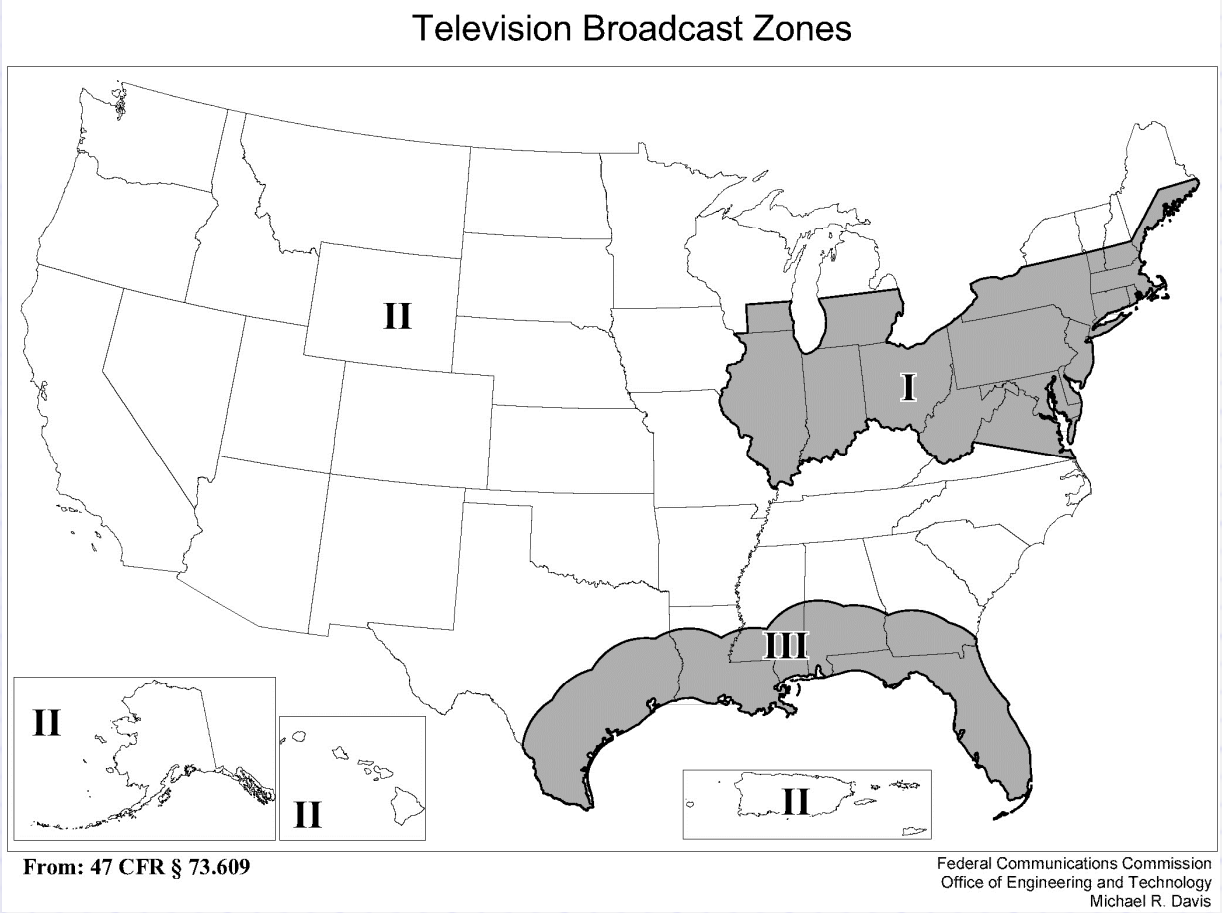
HAAT up to 305 m

Zone I:
30 kW

Zone II and III
160 kW

Equivalent ERP's when
HAAT is above 305 m

§73.622(f)



Replication: Band Change

Greenhill Report excerpt:

Overview of the UHF to VHF Band Change

Unique Opportunity to Receive Portion of Auction Proceeds, Remain on the Air and Maintain Current Coverage Standards

- Under this option, a Broadcaster will bid to relinquish its UHF spectrum in the Reverse Auction and be assigned a **full 6 MHz channel in the VHF spectrum – enabling delivery of the same services as on UHF**
  - UHF to VHF bidders have the flexibility to limit their bids to a high or low VHF channel
- Broadcasters will remain on the air and receive auction proceeds **with no change to licensee status**
- Pursuant to statute, **Broadcasters will retain must carry rights** at their new channel
  - Broadcasters could also utilize online delivery for programming for which they hold the applicable distribution rights
- The FCC will make all reasonable efforts to preserve a Broadcaster's population served and coverage area on its VHF channel, under the same standards applicable to repacking
- The FCC will work with winning UHF to VHF bidders seeking to modify their operations in order to mitigate any over-the-air reception issues
- For Broadcasters who rely largely on cable and satellite to reach their audience, there will be **little loss of viewership** from the switch to the VHF band
  - Likewise, Broadcasters in less dense locales may be able to generate significant payouts with little to no effect on existing coverage
- Allows Broadcasters to defer immediate taxation on a portion of the received auction proceeds
- Broadcasters can also elect to relinquish a high VHF channel in exchange for a low VHF channel

Replication: Band Change

FCC 14-50:

"In addition, we adopt the proposal to afford favorable consideration to post-incentive auction requests for waivers of the VHF power and height limits for winning UHF-to-VHF bidders that may be necessary to resolve coverage problems on their new channels. We decline, however, to establish a rebuttable presumption that such waivers are in the public interest."

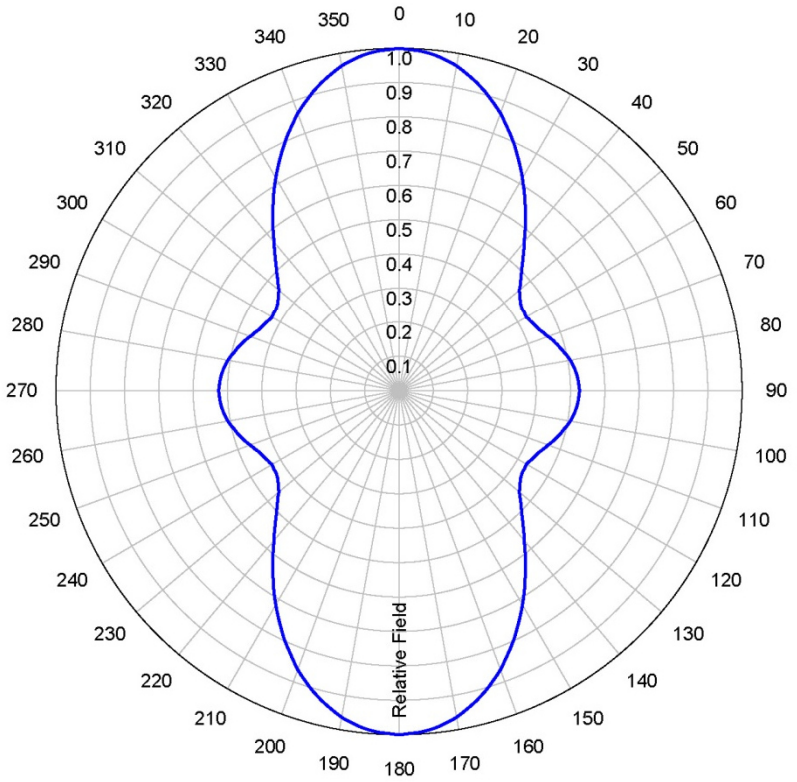
"Thus, we will consider such waiver requests on **a case-by case basis after the winning bidder has completed construction** of its VHF facilities and determined that **its viewers are experiencing reception problems.** We will afford such requests favorable consideration and grant them where possible."

Directional Patterns: UHF vs Hi-VHF

AZIMUTH PATTERN

Type:	ATW-P3		**Channel:**	32	
	Numeric	dBd	**Location:**		
Directivity:	2.24	3.50	**Polarization:**	Horizontal	
Peak(s) at:					

Note: Pattern shape and directivity may vary with channel and mouting configuration.



Preliminary, subject to final design and review.

ELECTRONICS RESEARCH, INC. ERI

Dielectric

Proposal Number	DCA-10190	Revision:	1
Date	7-Mar-03		
Call Letters	WGVU-DT	Channel	11
Location	Grand Rapids, MI		
Customer	Grand Valley St. Univ		
Antenna Type	TF-8HS-H P200		

AZIMUTH PATTERN

Gain	2.10	(3.22 dB)	
Calculated / Measured	Calculated		
Frequency	201.00 MHz		
Drawing #	TF-P4-2010		

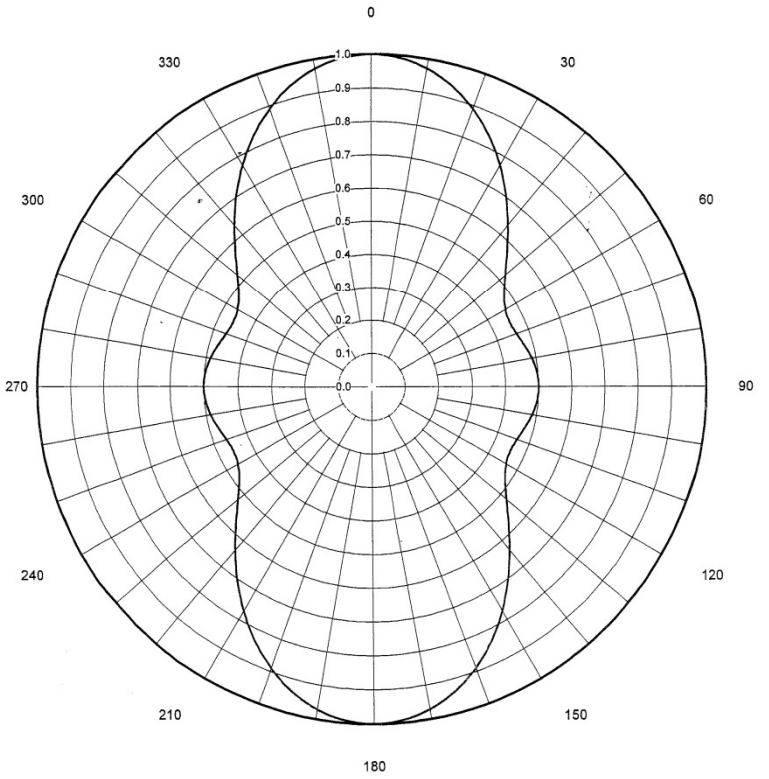


Exhibit 1a

Directional Patterns: UHF vs Hi-VHF

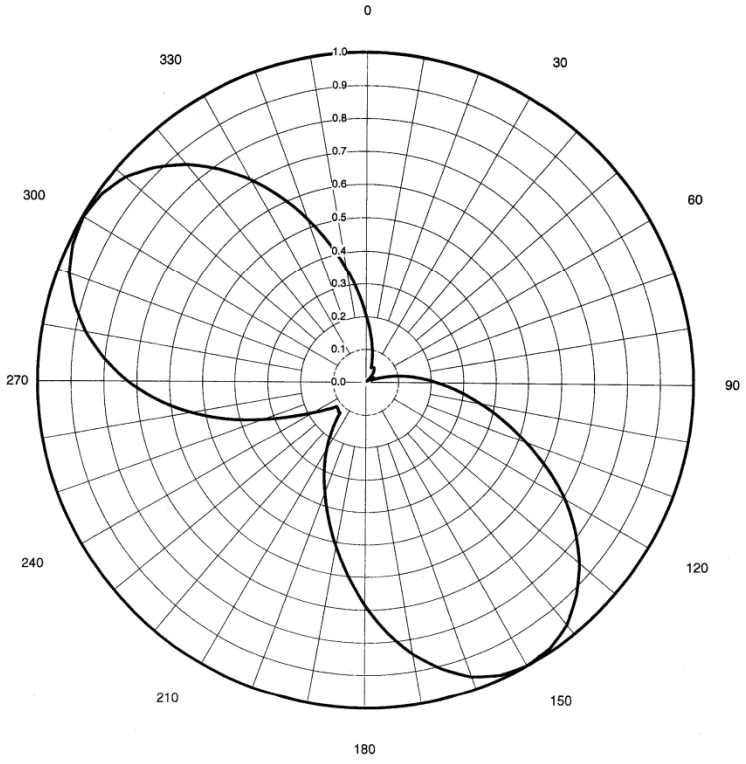
Figure 3
Sheet 1 of 2

Dielectric

Proposal Number	C-00446		
Date	28-Jun-06		
Call Letters	KOGG	Channel	16
Location	Haleakala, Maui, HI		
Customer	Maui LLC		
Antenna Type	TUA-P2SP-6/12H-1-T		

AZIMUTH PATTERN

Gain	2.90	(4.62 dB)	Frequency	485.00 MHz
Calculated / Measured	Calculated		Drawing #	TUA-P2SP-4850

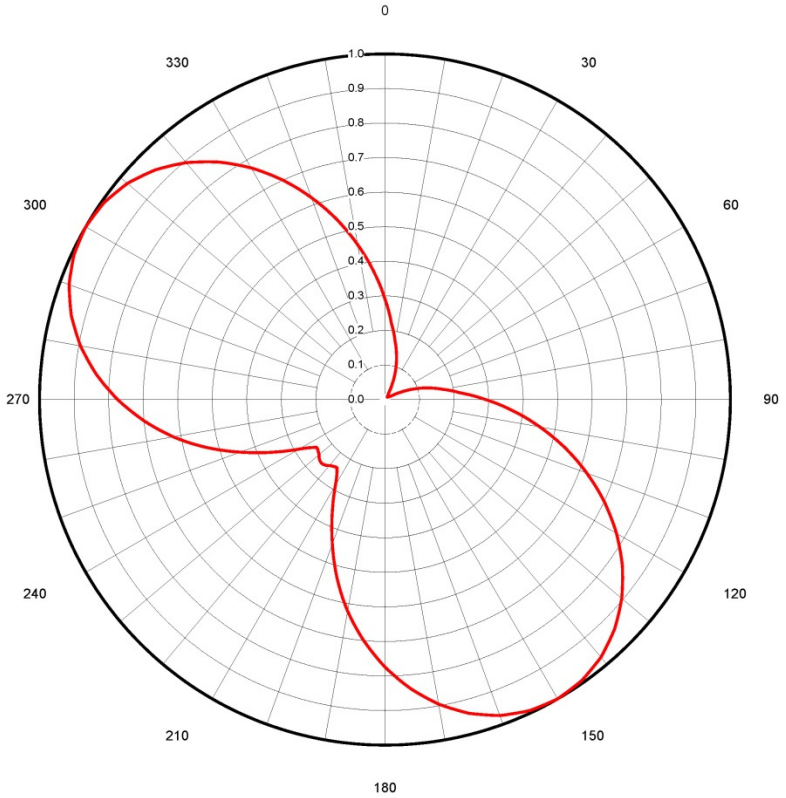


Dielectric

Proposal Number	C-00447		
Date	28-Jun-06		
Call Letters	KMAU	Channel	12
Location	Haleakala, Maui, HI		
Customer	Maui LLC		
Antenna Type	THA-P2SP-4H/8H-1-B		

AZIMUTH PATTERN

Gain	2.60	(3.98 dB)	Frequency	207.00 MHz
Calculated / Measured	Calculated		Drawing #	THA-P2SP-2070



Directional Patterns: UHF vs Hi-VHF

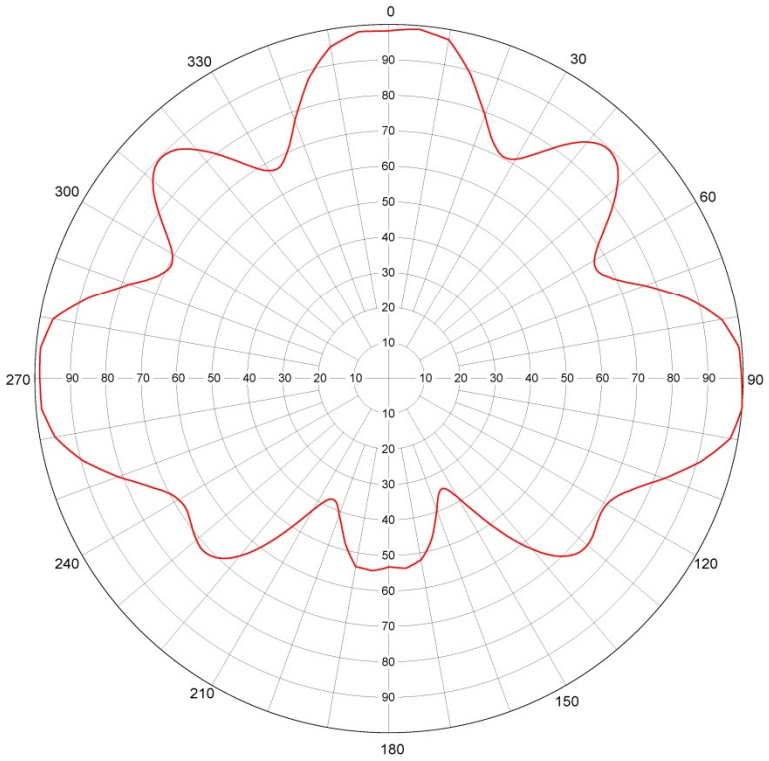
Exhibit No.

Dielectric

Date 29 Oct 2015
Call Letters
Location
Customer
Antenna Type
Channel 35

AZIMUTH PATTERN

Gain 1.70 (2.30 dB)
Calculated / Measured Calculated
Frequency 599 MHz
Drawing # TUA-C4



Remarks:

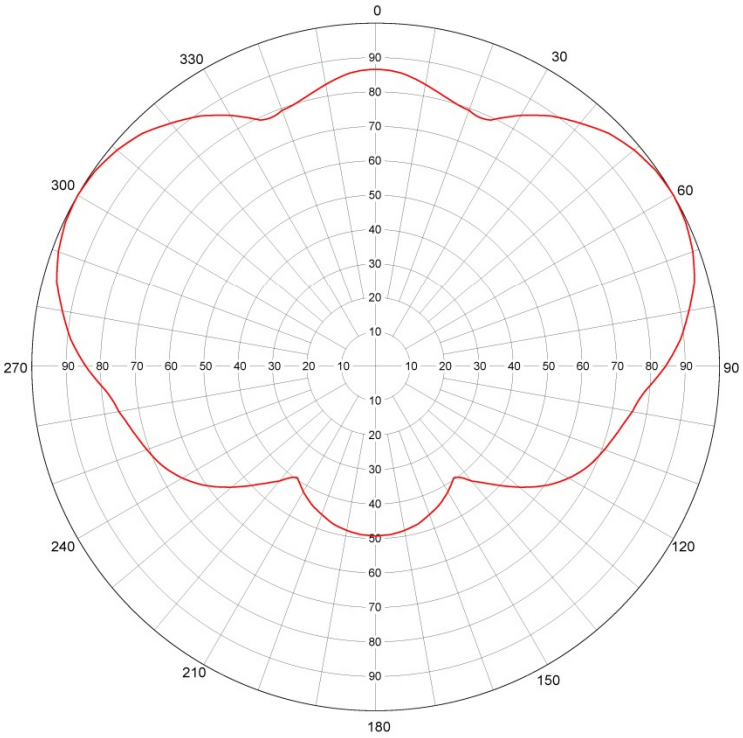
Exhibit No.

Dielectric

Date 29 Oct 2015
Call Letters
Location
Customer
Antenna Type
Channel 12

AZIMUTH PATTERN

Gain 1.70 (2.30 dB)
Calculated / Measured Calculated
Frequency 207 MHz
Drawing # THB-C3



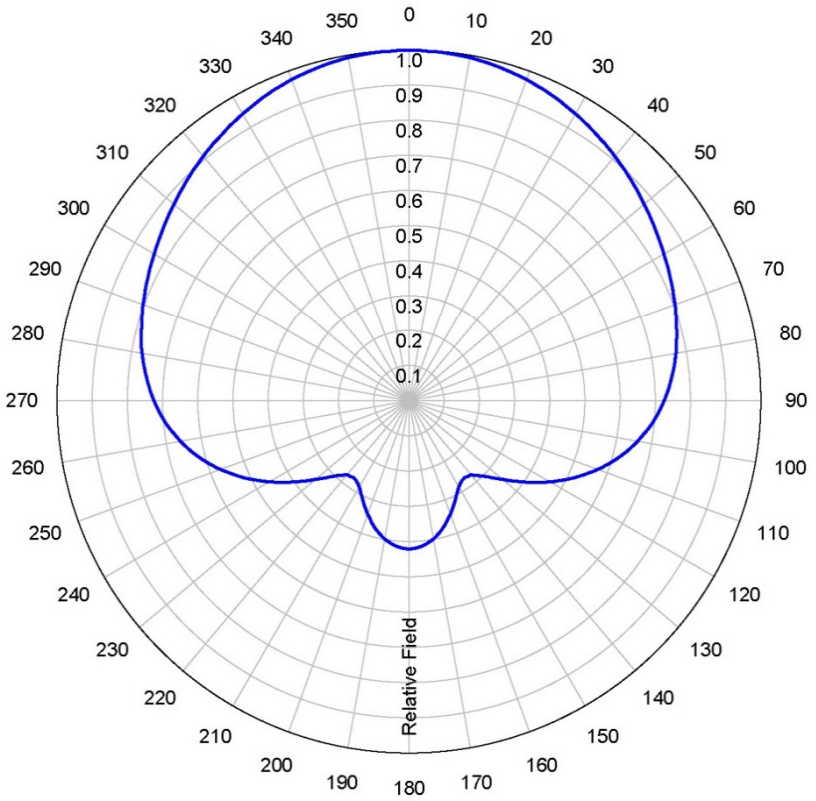
Remarks:

Directional Patterns: UHF vs Hi-VHF

AZIMUTH PATTERN

Type:	ATW-C3		**Channel:**	32	
	Numeric	dBd	**Location:**		
Directivity:	2.00	3.01	**Polarization:**	Horizontal	
Peak(s) at:					

Note: Pattern shape and directivity may vary with channel and mouting configuration.



Preliminary, subject to final design and review.

ELECTRONICS RESEARCH, INC. ERI

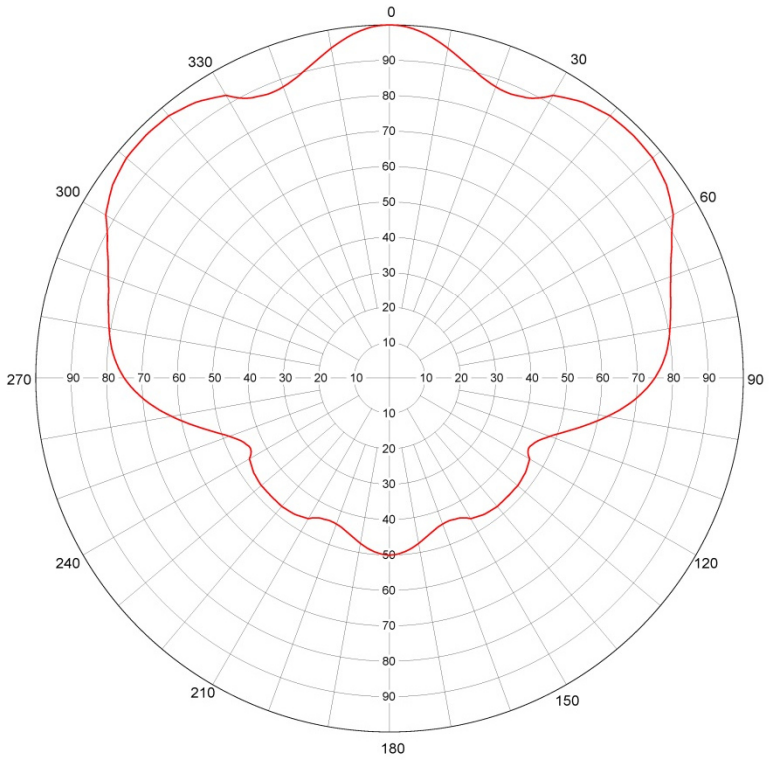
Exhibit No.

Dielectric

Date 29 Oct 2015
Call Letters Channel 10
Location
Customer
Antenna Type

AZIMUTH PATTERN

Gain 1.90 (2.79 dB) Frequency 195 MHz
Calculated / Measured Calculated Drawing # THA-S4



Remarks:

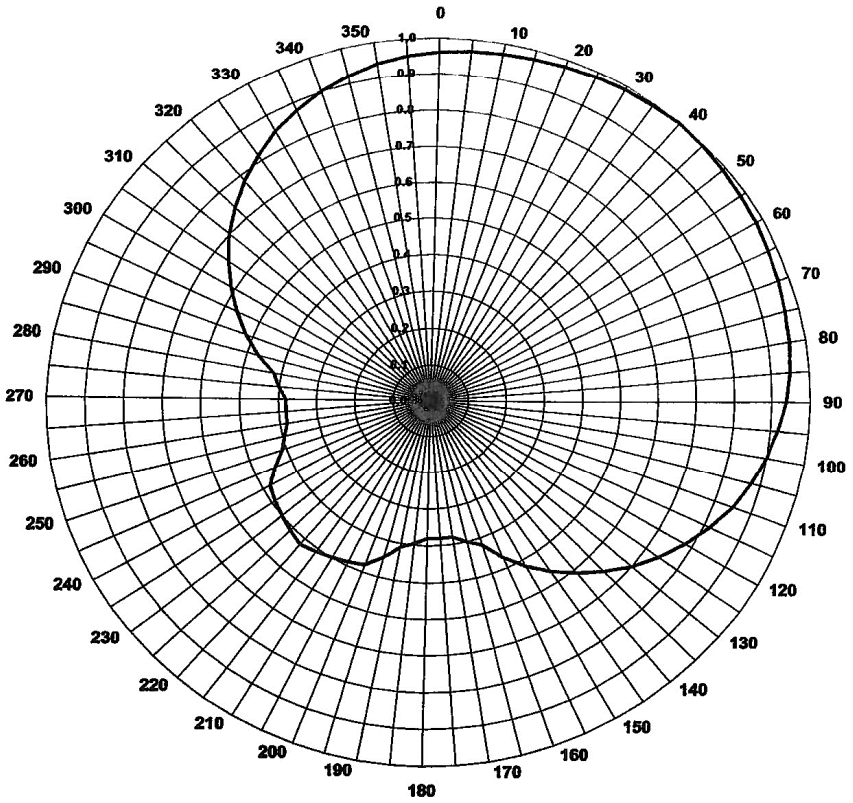
Directional Patterns: UHF vs Hi-VHF

ATW22H3-HTCX-26S KO022207-1672 Page 6

AZIMUTH PATTERN

TYPE:	CH26HAZ-CX	
	Numeric	dB
Directivity:	1.86	2.70
Peak(s) at:		

Frequency: 26 (DTV)
Location: Houston, TX
Polarization: Horizontal
Note: Pattern shape and directivity may vary with channel and mounting configuration.

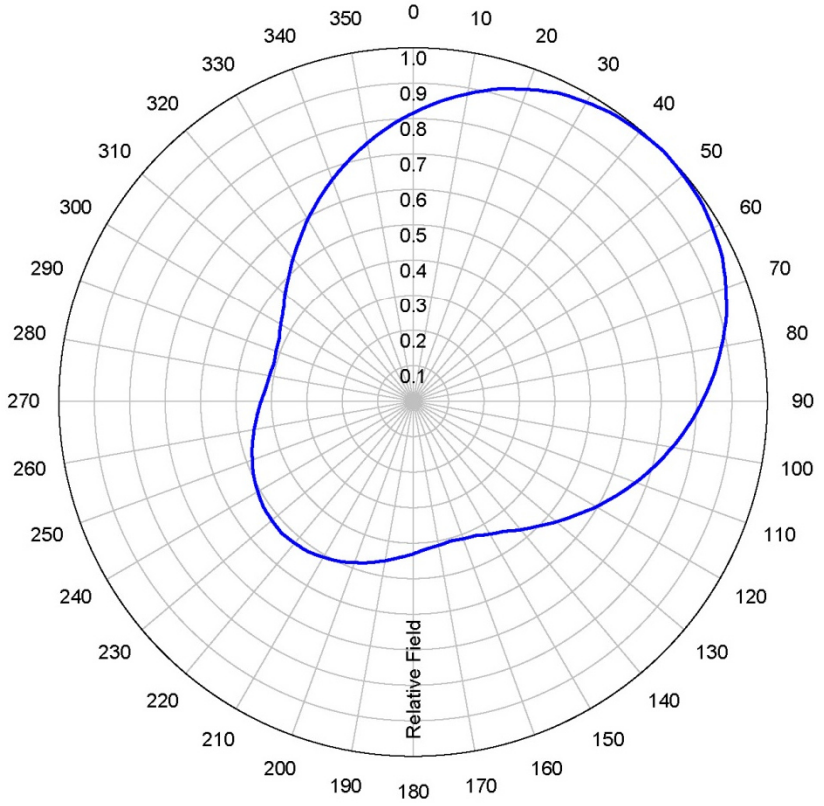


ELECTRONICS RESEARCH, INC. ERI

AZIMUTH PATTERN

Type:	ATW-VHF-NC	
	Numeric	dBd
Directivity:	2.30	3.62
Peak(s) at:		

Channel: 9
Location:
Polarization: Horizontal
Note: Pattern shape and directivity may vary with channel and mouting configuration.



Preliminary, subject to final design and review.

ELECTRONICS RESEARCH, INC. ERI

Vendor and Service Provider Capacity

Depressed marketplace for equipment, industry has contracted since 2009

Threat of repacking, FCC freezes, general economy

Severe domestic impact

High-power TV antenna manufacturers

Tower crews capable of working on tall and complicated towers

Vendor and Service Provider Capacity

Transmitter Manufacturers, high power

Supply of new transmitters vs support for existing or orphaned

Engineering Resources – Limited Capacity

Structural Engineers

Field Engineering – Transmitter installation & modification

RF Consulting Engineers

Plenty of Lawyers????

Impact to LPTV, Television Translator, DRT

Not protected through repack
Many expected to be displaced by spectrum reallocation or repacked station
No reimbursement for channel change

FCC Mitigation
Special filing window for displaced operating facilities
opens after t = 3 months and DTV expansion/alternate channel filing
MX apps – settlement window, DTDRT priority, then auction

Additional DTDRT's "digital-to-digital replacement translator"
(losses brought by repack)

Facilities in 600 MHz band may continue to operate until notified by new licensee (120 day notice); if on guard band must cease at t = 39 months

Work in Progress - Open NPRM to address further

Channel reservation for unlicensed use?

Collateral Damage

MVPD's receiving OTA signals must be ready

Advance notice required from TV stations of changes

- 30 days – ceasing operation
- 30 days – sharing channel
- 90 days – changing channel – coordination required for cutover

Other users of UHF TV Spectrum

Wireless Microphones

Whitespace Devices

BAS – Part 74 microwave operations in TV band

"Perfect Storm" of challenges and shortages

Stations involuntarily repacked

Winning full power bidders for band changes

Site consolidation / expansion opportunity for others

STA's and interim operations

LPTV and translator station displacement and digital buildout

All will draw from the same manufacturer and service provider resources

Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio

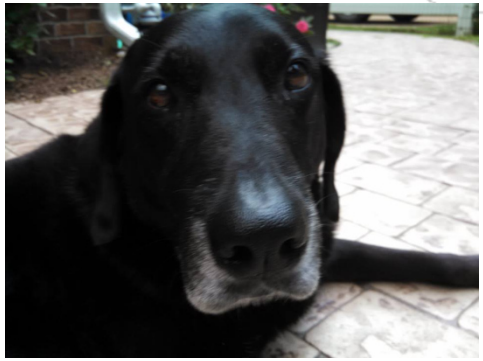
Download slides at:
www.rf-consultants.com/AFCCE

Comments, Questions?

Must be Miller Time…

Thank You!

Joseph M. Davis, P.E.



"RF Sniffer"

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