

Yuma 230 kV Ring Circuit

Conceptual Projects in the Yuma Area

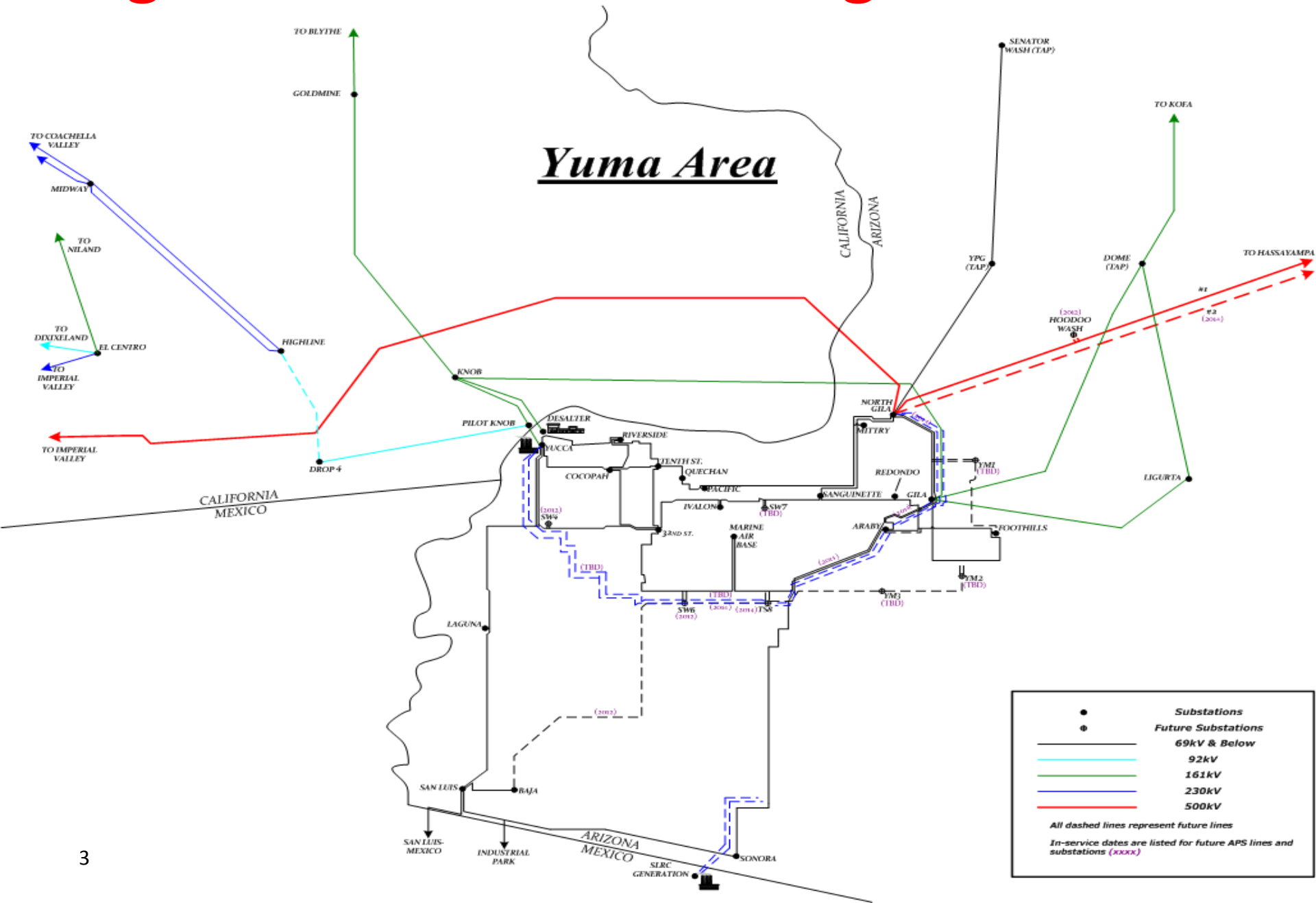
APS Transmission Planning
February 9, 2011



Introduction

- **Develop a conceptual 230kV ring circuit for Yuma**
 - **Build a Double circuit 230kV line from N.Gila to TS8 230kV**
 - A 500/230kV transformer at the North Gila substation
 - A 230kV TS8 substation located inside of the Yuma load pocket
 - A 230/69kV transformer at TS8 substation
 - **Build a Double circuit 230kV line from TS8 to Yucca**
 - A Yucca 230kV substation at/near the existing Yucca substation
 - A 230/69kV transformer at the Yucca 230kV substation

Figure 1: Yuma 230kV Ring Circuit



Project Needs/Benefits

- **Increase load serving capability to Yuma**
- **Increase scheduling capability**
- **Provide Yuma with a reliable Transmission system network**
- **Access to renewable resources**
- **Support the underlying 69kV system**

Project Coordination

- **APS initiated the 230kV Ring Circuit study effort in an open forum at the February 2010 CRT meeting**
- **APS solicited and formed a technical review group reporting to the CRT**
- **Technical Review Group Members**
 - APS – Arizona Public Service
 - IID – Imperial Valley Irrigation District
 - PDS – PDS Consulting, PLC (PDS)
 - WMIDD- Welton-Mohawk Irrigation and Drainage District
 - WAPA – Western Area Power Administration
 - WSES – Western States Energy Solutions, LLC
 - BOR – Bureau of Reclamation
- **Technical Review Group Function**
 - Case Development
 - Study Review
 - Technical Support

Pre-Project Basecase

- A 2014 case from the APS 2010 ten year plan was used
 - Developed from coordinated seed cases
 - Has a detailed representation of Arizona
- APS's Projects in Yuma modeled in the basecase
 - A new North Gila –TS8 230kV line (2014)
 - 500/230kV transformer at North Gila
 - 230/69kV transformer at TS8
 - A new TS8-SW6-Baja-San Luis 69kV lines (2012)
 - Upgrade the North Gila - Foothills, Gila - Araby, Yucca - Riverside 69kV lines to 795 ACSS conductor (2010-2014)
 - A new North Gila-Sanguinetti 69kV line (2010)
- Hoodoo Wash/Agua Caliente: 290MW solar generator that ties into the Hassayampa – North Gila 500kV #1 line w/new 500kV switchyard (Generator Interconnection Project)

Projects Included in the Study

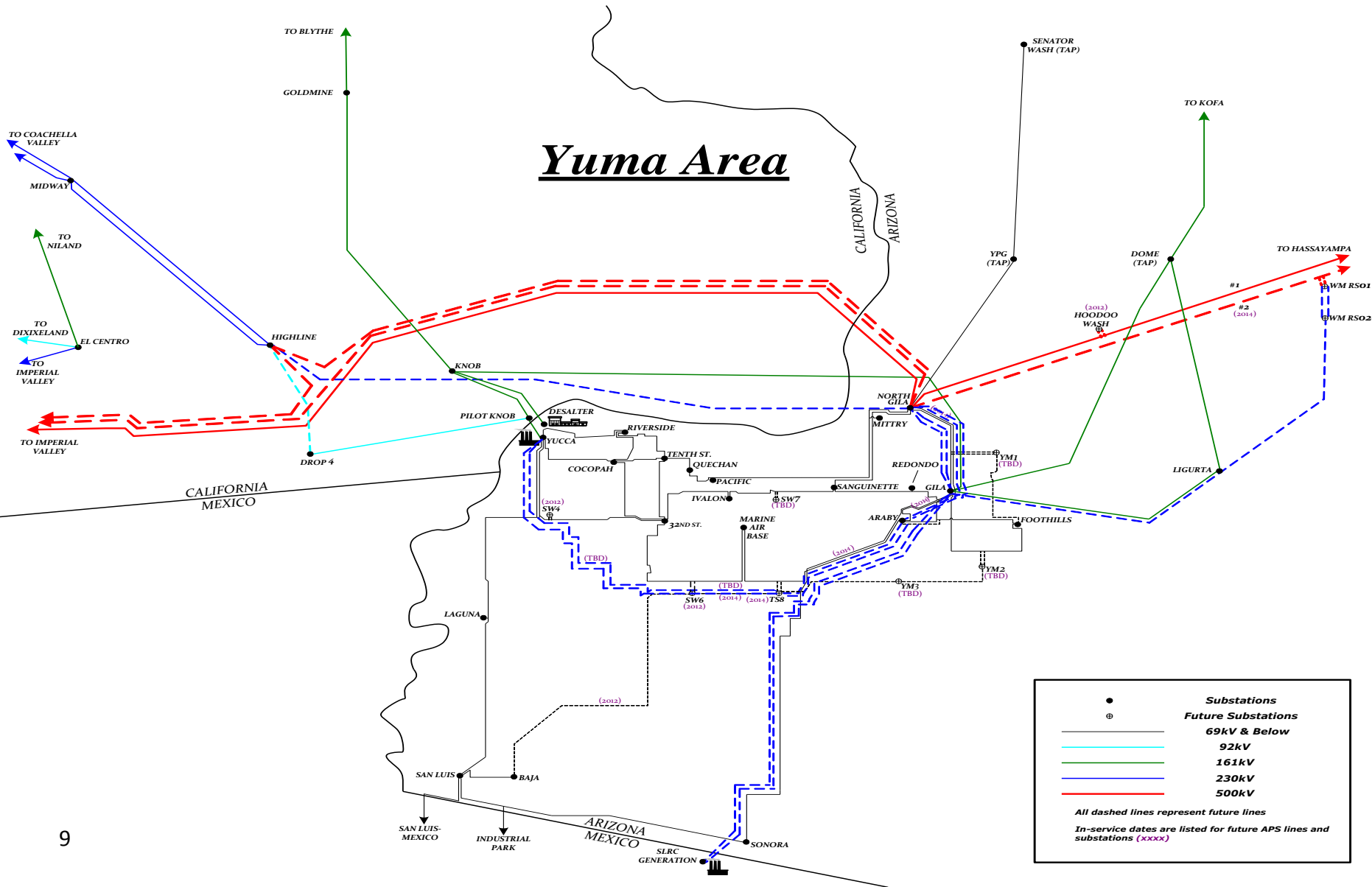
- **APS's Projects**
 - Double Circuited North Gila –TS8 230kV lines (2014)
 - Double Circuited TS8 – Yucca 230kV lines (2014)
- **WAPA/North Branch's Project**
 - SLRC Project
 - Double Circuit 230kV from North Branch Generation Project to Gila and double circuit 230kV from Gila to North Gila (2014)
 - Two 500/230kV transformers at North Gila
 - 230/161kV transformer at Gila
- **IID Project**
 - Single circuit 230kV from North Gila to Highline
- **PDS's Projects**
 - North Gila – Imperial Valley #2 500kV line
 - A double circuit Imperial Valley – Highline 500kV line
 - A North Gila – Highline – Imperial Valley 500kV line
 - A 500/230kV transformer at Highline

Projects Included in the Study (cont.)

- **WMIDD's Projects**

- 500/230kV Station (WM RS01)
- 230kV switchyard (WM RS02)
- Double Circuited 230kV WM RS01 to WM RS02
- Single Circuit 230kV from Gila 230kV substation to WM RS02 using the Ligurta to Gila 161kV right-of-way for a portion of the routing
- Rebuild the Ligurta to Gila 161kV line to double circuit 230kV from Gila to N. Gila (2014) with the WMRSO2 to Gila circuit energized at 230kV and the Ligurta to Gila initially energized at 161kV

Figure 2: Projects in the Yuma Area



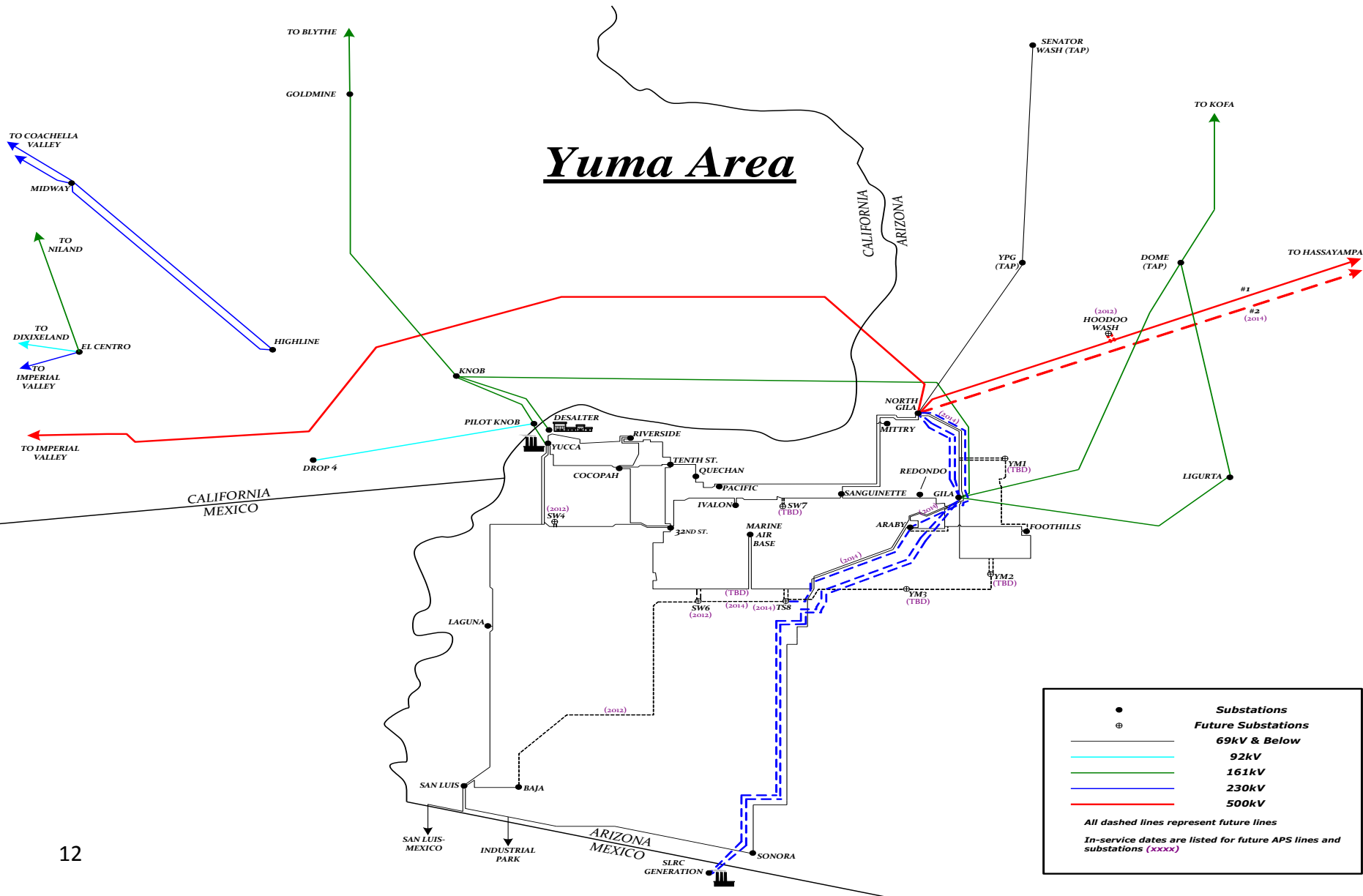
Five Cases Developed and Evaluated

- **Five Cases were developed and evaluated**
 - Case A: Pre-Project case
 - Used as the benchmark for the study
 - Case B: Post-Project Case
 - Included projects from APS, IID & WMIDD
 - Case C: APS/IID Sensitivity case
 - Case D: WMIDD Sensitivity case
 - Case E: PDS Sensitivity case

Pre-Project Case (Case A)

- **Pre-Project case used**
 - **APS 2010 Ten Year Planning case**
 - **An Arizona Detailed 2014 case**
 - Hassayampa - North Gila #2 500kV line
 - North Gila – TS8 230kV line
 - 500/230kV transformer at North Gila
 - 230/69kV transformer at TS8
 - Upgrade North Gila - Foothills, Gila - Araby, Yucca - Riverside 69kV lines to 795 ACSS conductor.
 - North Gila-Sanguinetti 69kV line (2010)
 - Hoodoo Wash/Agua Caliente: A 290MW solar generator that's interconnected to the Hassayampa – North Gila 500kV #1 line.
 - **Used as the benchmarking case**

Figure 3: Pre-Project Diagram



Post-Project Case (Case B)

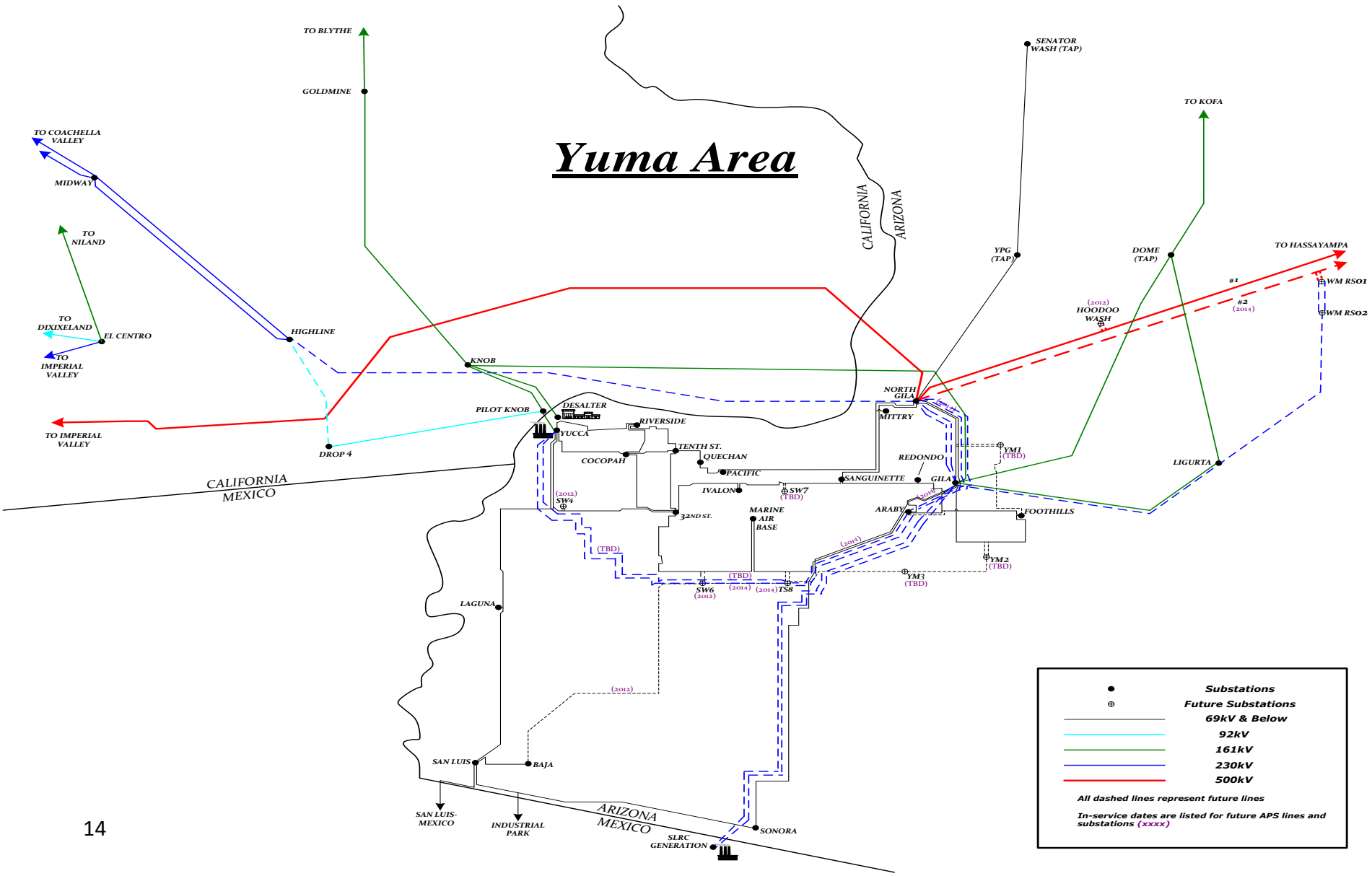
- **Projects Modeled**

- APS's Projects
- WAPA/North Branch's Project
- IID's Project
- WMIDD's Projects
- PDS's Projects...Not in-service

- **Benefit of Projects Modeled**

- Provides access to renewable energy
- Provides an increase in import capability for Yuma
- Provides a stronger transmission Network for the area.

Figure 4: Post-Project Diagram



●	Substations
⊕	Future Substations
— (black)	69kV & Below
— (cyan)	92kV
— (green)	161kV
— (blue)	230kV
— (red)	500kV
All dashed lines represent future lines	
In-service dates are listed for future APS lines and substations (xxxx)	

APS/IID Sensitivity Case (Case C)

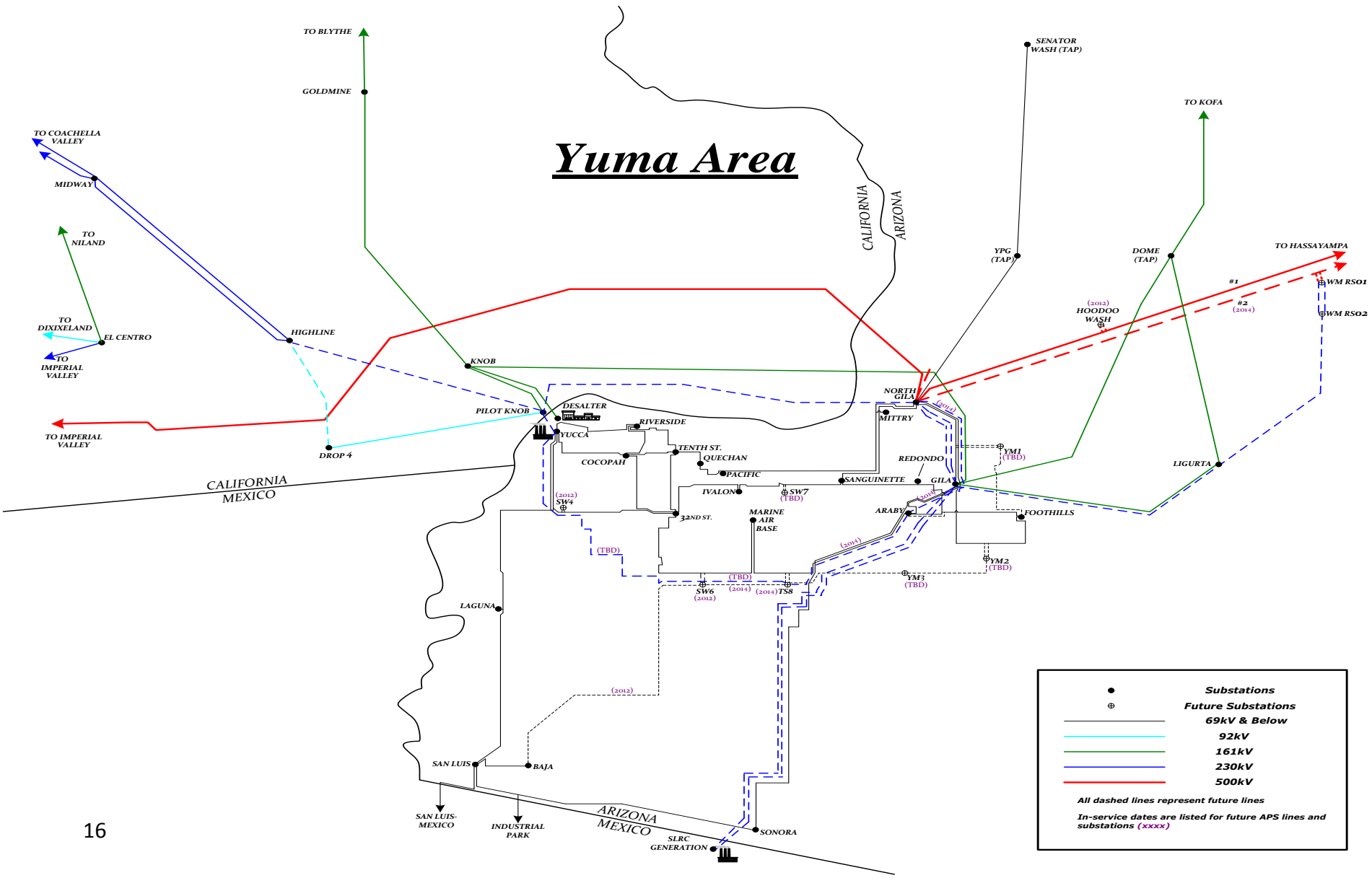
- **Sensitivity Description**

- IID's North Gila – Highline 230kV line
 - Modeled from North Gila – Pilot Knob – Highline 230kV line
 - Upgrade Yucca – Pilot Knob 161kV to 230kV
- APS's 230kV Ring Circuit
 - Modeled as a single 230kV Circuit from North Gila – TS8 – Yucca

- **Benefit of Sensitivity**

- Provides an alternative for increased reliability for the North Gila-Highline 230kV line
- Additional source for the Yuma Ring Circuit project.

Figure 5: APS/IID Sensitivity Diagram



WMIDD Sensitivity Case (Case D)

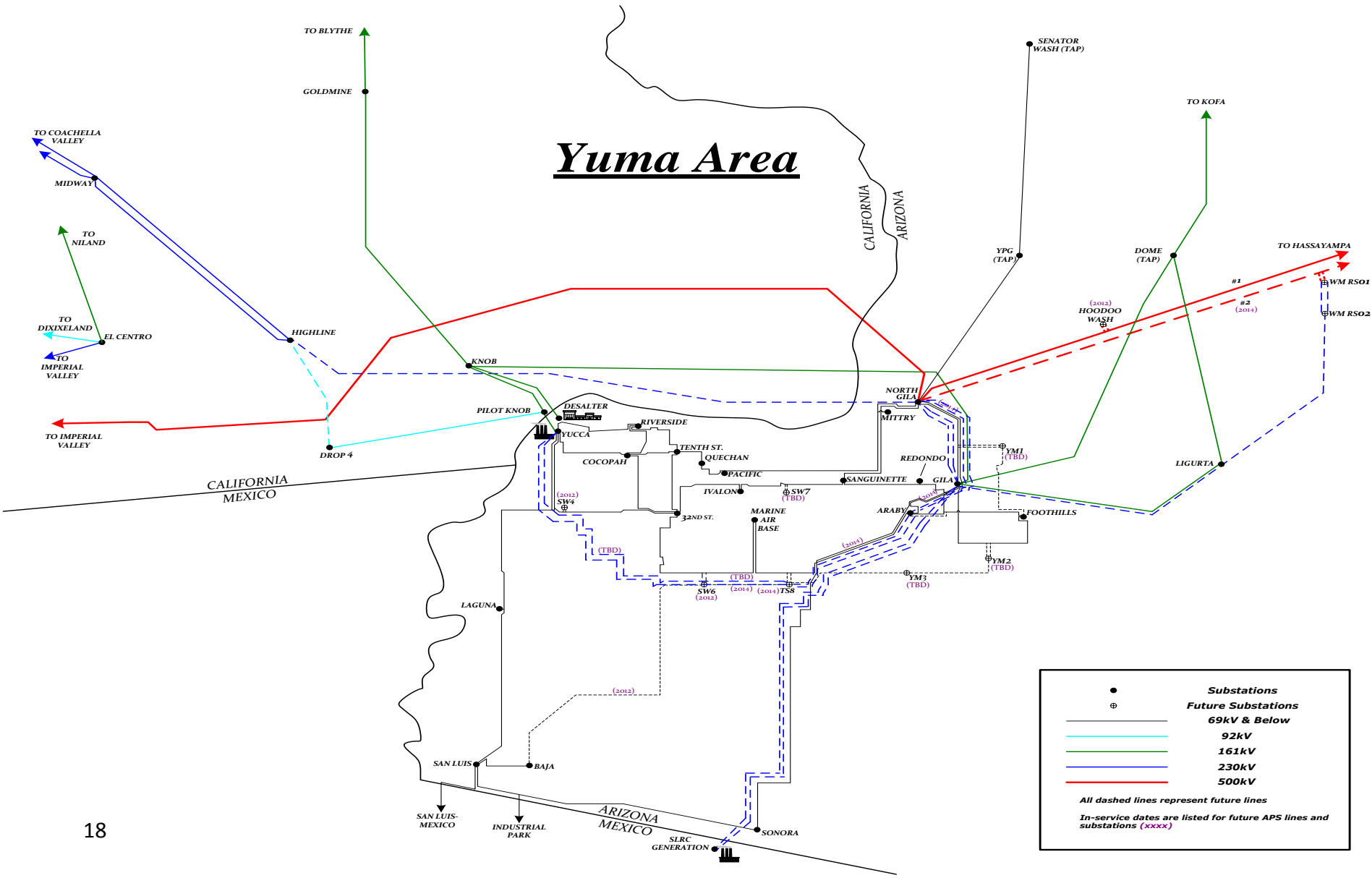
- **Sensitivity Description**

- Remove one of the 500/230kV transformer at WMRS01 substation
- Remove the WMRS2-Ligurta 230kV line
- Remove the Ligurta 230/161kV transformer

- **Benefit of Sensitivity**

- Provides WMIDD with the same service with less transmission elements

Figure 6: WMIDD Sensitivity Case



PDS Sensitivity Case (Case E)

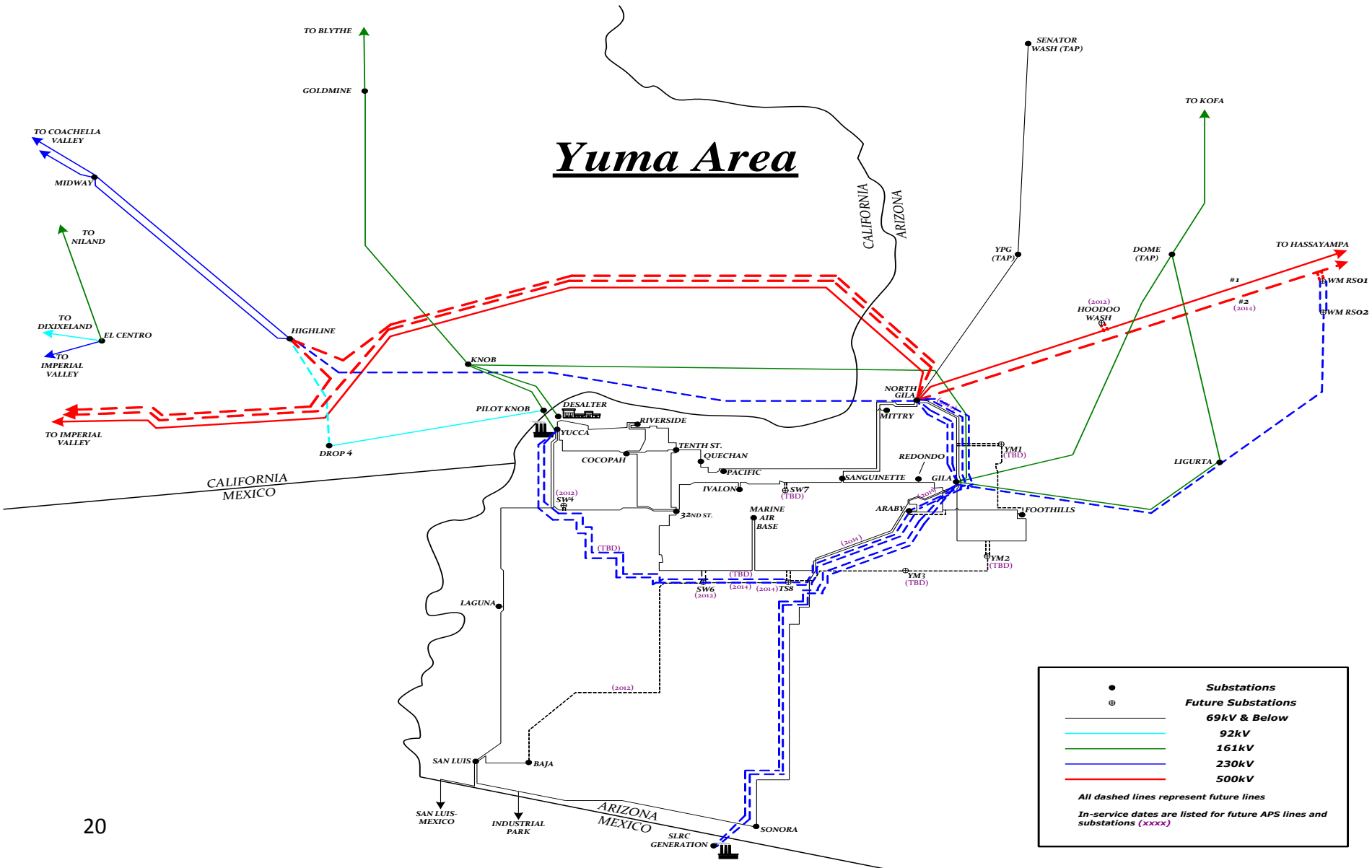
- **Sensitivity Description**

- A North Gila – Imperial Valley #2 500kV line
- A double circuit Imperial Valley – Highline 500kV line
- A North Gila – Highline – Imperial Valley 500kV line and a 500/230kV transformer at Highline

- **Benefit of Sensitivity**

- Provides reliability for an outage of the North Gila-Imperial Valley 500kV #1 line
- Increases capacity between AZ and CA
- Provides access to renewable energy

Figure 7: PDS Sensitivity Case



●	Substations
⊕	Future Substations
— (black)	69kV & Below
— (cyan)	92kV
— (green)	161kV
— (blue)	230kV
— (red)	500kV
All dashed lines represent future lines	
In-service dates are listed for future APS lines and substations (xxxx)	

Study Results

CASE		LSC	CRITICAL CONTINGENCY	LIMITING ELEMENT	THERMAL LIMITATION		EQUIP. RATING	UNIT
					NORMAL LOADING (%)	CONTINGE. LOADING (%)		
A	SIL	482	N.GILA-TS8 230kV Line	GILA 230/161kV XFMR	100	100	300	MVA
	MLSC	800	TS8 230/69kV XFMR	Gila 230/161kV XFMR	100	100	300	MVA
B	SIL	531	N.GILA-TS8 230kV DLO	YUCCA-PILOTKNOB 161kV LINE	100	100	486	AMPS
	MLSC	882	YUCCA-COCOPAH 69kV LINE	SW4-32STREET 69kV LINE	100	100	900	AMPS
C	SIL	534	YUCCA 230/69kV XFMR	PACIFIC-QUECHAN 69kV LINE	103	99	900	AMPS
	MLSC	928	YUCCA-COCOPAH 69kV LINE	SW4-32STREET 69kV LINE	100	100	900	AMPS
D	SIL	504	N.GILA-TS8 230kV DLO	YUCCA-PILOTKNOB 161kV LINE	100	100	486	AMPS
	MLSC	826	YUCCA-COCOPAH 69kV LINE	SW4-32STREET 69kV LINE	100	100	900	AMPS
E	SIL	492	N.GILA-TS8 230kV DLO	YUCCA-PILOTKNOB 161kV LINE	100	100	486	AMPS
	MLSC	862	YUCCA-COCOPAH 69kV LINE	SW4-32STREET 69kV LINE	100	100	900	AMPS

Status

- **Study Plan completed**
- **Case Development completed**
- **Draft Report distributed for review**
- **Finalize Study report finalized (End of February)**