DxP and DxP+

- Mark Nabel, Silviculturist, Coconino National Forest
- Jessi Ouzts, Silviculturist, Kaibab National Forest
- Steve Fugate, Forest Restoration GIS Data Coordinator, The Nature Conservancy

What does this work respond to?

- Present day forest conditions of densely growing, smaller trees has led to increased wildfire activity, decreased water yield, reduced biodiversity, degraded ecosystem services, and loss of habitat.

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What does this work respond to?

- There has been an alarming increase in the size and severity of wildfire since 1985
  - The average size of wildfires have quadrupled
  - The number of acres burned annually in United States has increased from 3 million to 10 million
  - The annual suppression costs have increased from $240 million to $3.1 billion

What does this work respond to?

- There is a need for wildfire mitigation through landscape forest restoration using mechanical thinning and prescribed fire
  - Prep 50K acres/year to stimulate investment by the timber industry

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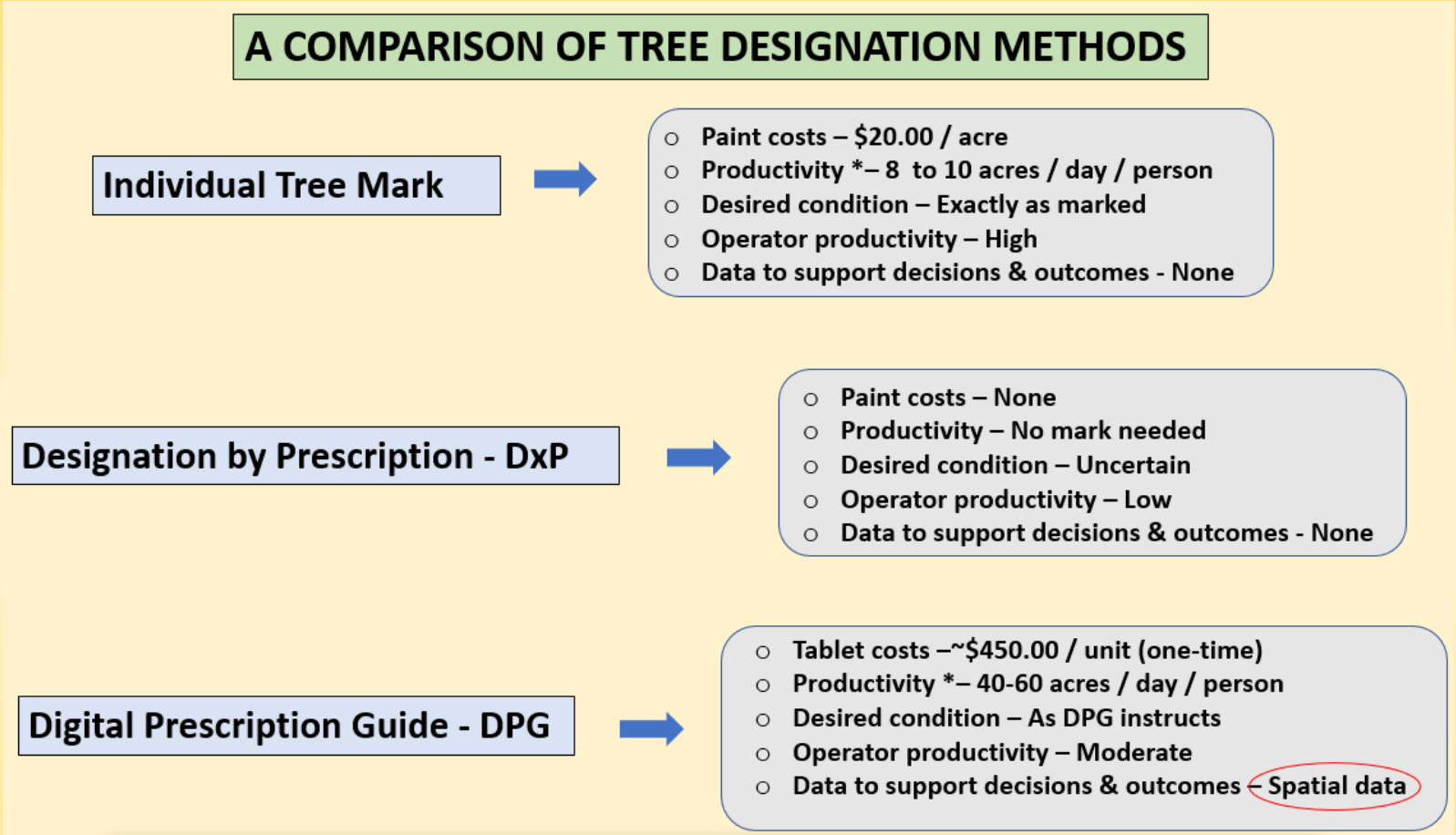
What was done?

- Investment to increase the scope and scale of forest thinning by reducing costs associated with timber sale prep tasks
  - Implement timber sales using DxP instead of ITM
- Concerns expressed by stakeholders
  - Will desired conditions be met without paint?
  - Will DxP decrease operator productivity?
  - How to assess outcomes, compliance, and accountability?
  - Will cost savings in sale prep result in additional costs elsewhere?

What was done?

- TNC offered a Digital Restoration Guide (DRG) as a solution and DxP+ (DxP accompanied by Digital Prescription Guide) is born to bridge the gap between ITM and DxP



Timeline

- 2012 –
  - TNC works with USFS to layout meadow restoration boundary on USFS land adjacent to HPP and learns of the high cost of paint and the desire to use more DxP on future projects instead of ITM
  - TNC begins developing a Digital Restoration Guide (DRG) and works with USFS to cultivate the idea a digital guide to accompany DxP
- 2013 –
  - TNC installs TimberGuide in-cab mapping solutions with HDI and Perkins Timber Harvesting to test and implement DxP+

Timeline

- 2014 – TNC, 4FRI team, and Flagstaff RD develop early DxP+ data models and collect data using ESRI Arc Collector
- 2015 – TNC and Flagstaff RD implement DxP+ at Clarks and Bob's
- 2016 –
  - TNC uploads map packages onto TimberNavi in-cab mapping solution for Perkins Timber Harvesting
  - Flagstaff RD commits to 10K acres of DxP+ with a TEAMS crew at Chimney Springs, Johnny's, Pinegrove, and Marshall timber sales
  - City of Flagstaff uses DxP+ concepts to harvest on Observatory Mesa
  - DxP+ units harvested on Bob's
  - TNC signs a challenge cost-share SPA with the Kaibab National Forest

Timeline

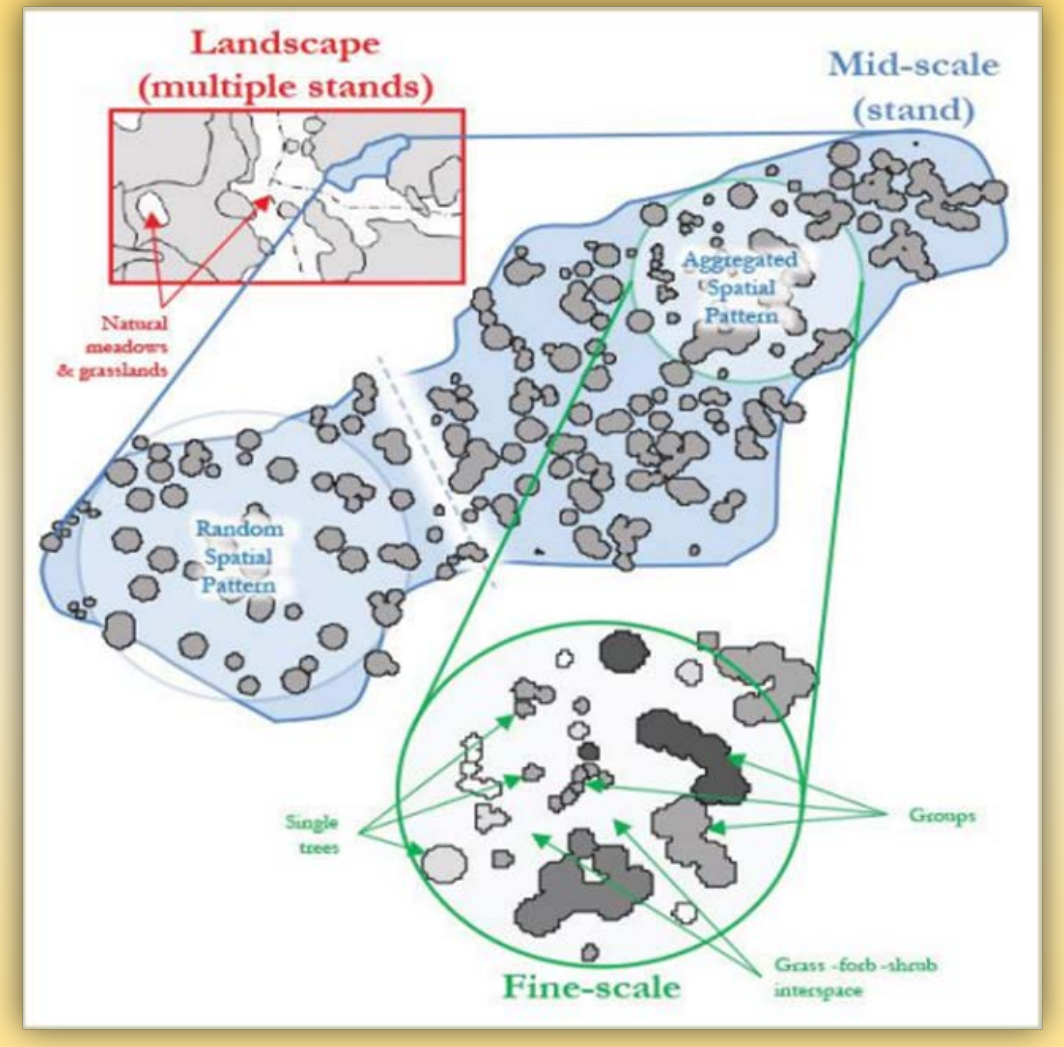
- 2017 –
  - Coconino County uses DxP+ concepts to treat Fort Tuthill
  - First 4FRI NEPA DxP+ units are treated at Chimney Springs Fort Valley by TNC, Flagstaff RD, Campbell Global, and HDI Forestry
  - TNC/Kaibab NF begin work under the 2016 challenge cost-share agreement to create DxP + polygons on 3589 acres (Clover, Junction, & Moonset)
  - Coconino creates DxP+ polygons on ~5,000 acres (Willard, Newman, A-1)
  - Apache Sitgreaves implements and mechanically harvests DxP + in mixed conifer
- 2018 –
  - TNC/Kaibab NF challenge cost-share “Prep SPA” initiates DxP+ at Parks West and Sitgreaves West. Small scale use of Heads-Up Digitizing.
  - In-cab technology and DxP+ used during harvest operations at Fort Tuthill
  - DxP+ operations continue at Chimney Springs by Suarez Forestry
  - Coconino creates DxP+ polygons on ~5,000 acres (Horse Park, Dutton Hill(s), LO Pocket(s)); experiments with DxP+ / Leave Tree mark hybrid
  - A-S implements DxP+ at Greens Peak and Burnt Mill.

Timeline

- 2019 –
  - TNC/Kaibab cost share implements DxP+ at Parks West and Sitgreaves West
  - DxP+ operations wrapping up at Chimney Springs
  - DxP/DxP+ operations starting in Clark and A-1 South
  - Today's presentation

What was the process?

- Use GTR-310 to define the landscape forest restoration goals
  - Restore the natural range of variability of historic conditions in terms of tree groups, grassy interspace, and individual trees



What was the process?

- Emphasize spatial targets in the Rx cut card to facilitate DxP+

Examples:

- Retain all yellow pine & old growth (>UDL), snags, logs and oak trees
- **Meet overall basal area target of 70-90 ft^2 BA/ac at the cut unit level**
- **Create groups of up to 1 acre averaging 0.1-0.5 ac in size**
- **Create interspace 60'-80' wide and comprising 40-55% of cut unit**
- **Create regeneration openings across 10% of cut unit**
- Strive to achieve desired trees per acre based on stocking guidelines

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What was the process?

- Implement DxP+
  - Create DxP+ data models

GroupType	UpperDBH	RegenDBH	AvgSpacing	ReserveTrees	Notes	SHAPE_Length	SHAPE_Area

GroupType	UpperDBH	RegenDBH	AvgSpacing	ReserveTre	Notes	TargetBA	TargetVSS_	Shape_Length	Shape_Area

Group Type	UpperDBH	Residual VSS	Current Basal Area	Residual Basal Area	ReserveTrees	Surveyor	Notes	Shape_Length	Shape_Area

Group Type *	Current Basal Area	Residual Basal Area	Number of Reserve Tree	DM Present	Advanced Regen	Surveyor	Notes *	SHAPE_Length	SHAPE_Area

  - Collect and sync data using AGOL, Collector, and iOS/Android tablets

    - Improve marking productivity compared to ITM

What was the process?

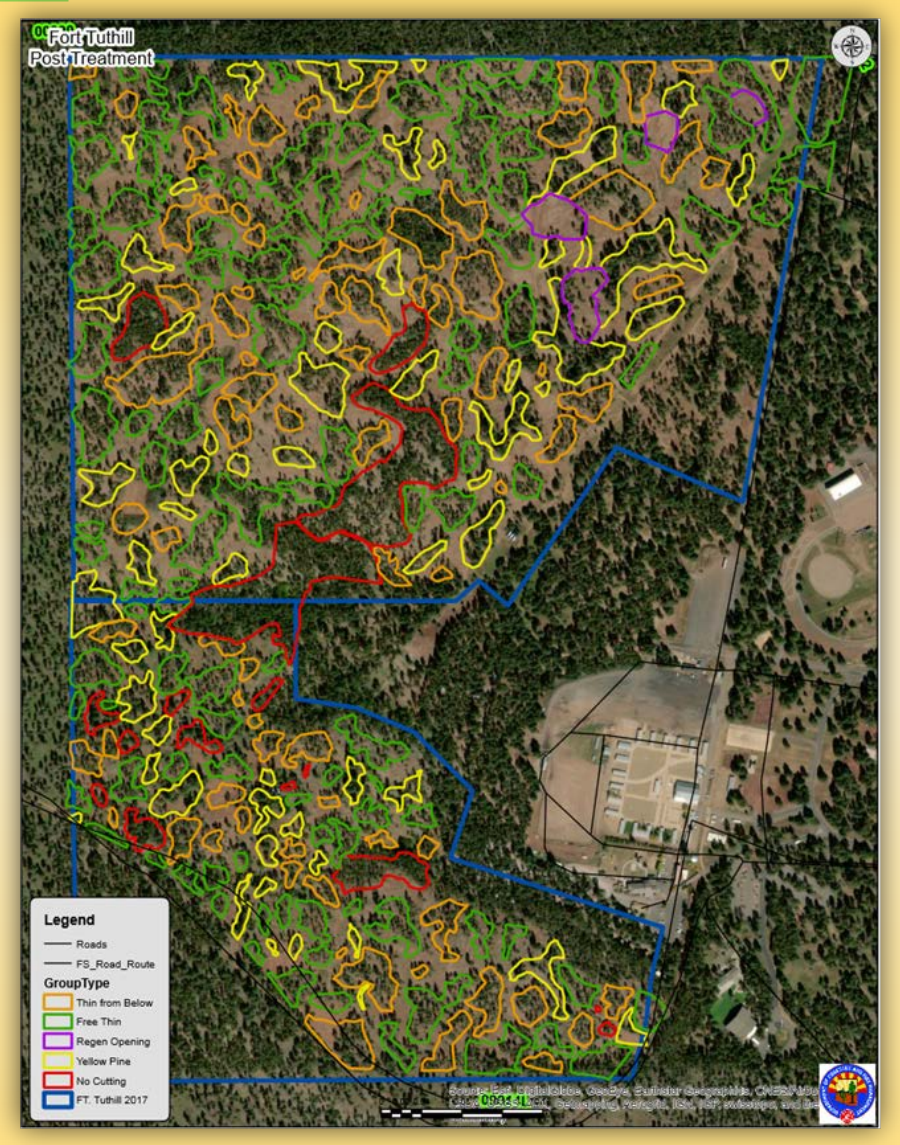
- Implement DxP+
  - Evaluate the quality of DxP+ digital product
    - QA/QC, field validation, summary metrics, and basal area calculator
    - Cross reference DxP+ summary metrics results with Rx targets in cut cards

Project Area	Unit	Group Acres Target	MIN/MEAN/MAX Group Acres	Interspace % Target	Interspace % Marked	Regen % Target	Regen %	BA Target (ft^2/acre)	Residual BA Marked (ft^2/acre)
Moonset	19	0.1-0.25	0.04/0.4/6.0*	40-55	50	20	20	50-70	74
Moonset	3	0.1-0.25	0.1/0.3/1.5*	55	60	15	11	50-70	71
Moonset	14	0.1-0.25	0.070.4//3.2*	40-55	48	0	0	70-90	86

  - Approve DxP+ for harvest operations

What was the process?

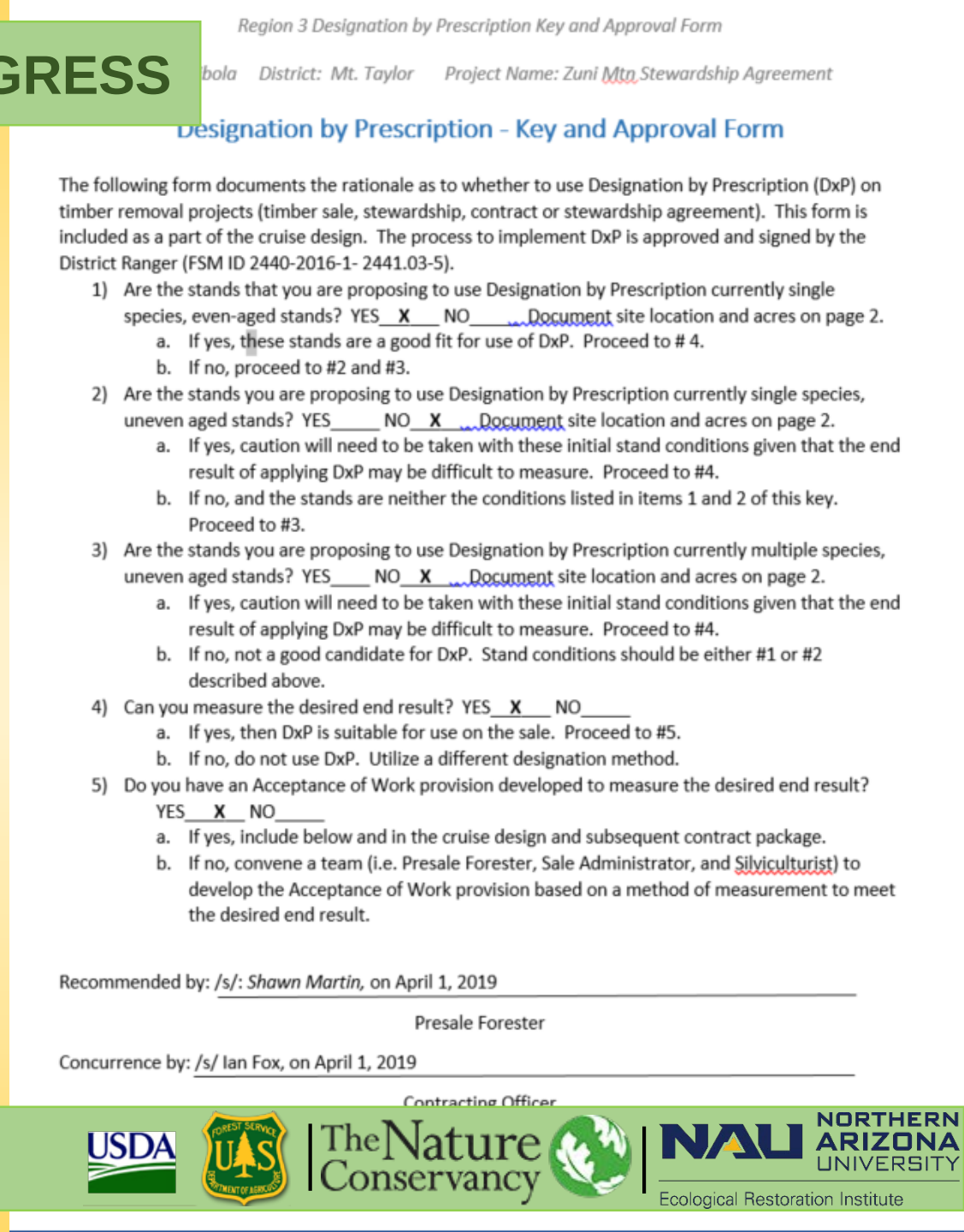
- Conduct harvest operations using DxP+
  - Improve operators' spatial awareness
  - Improve operators' ability to achieve Rx targets for tree group size, % interspace, % regeneration openings, and cut unit basal area
  - Improve operator productivity compared to DxP



The Formal Stuff

DxP Simplicity Checklist

- DxP units should only be those which meet specific criteria
  - Single-species, even-aged (BEST)
  - Single-species, uneven-aged (Caution needed)
  - Multiple-species, uneven-aged (Caution needed)
  - Are results measurable? (MUST)
  - Acceptance of Work must be developed and included as part of the Contract Package (MUST)



Region 3 Designation by Prescription Key and Approval Form

bola District: Mt. Taylor Project Name: Zuni Mtn Stewardship Agreement

Designation by Prescription - Key and Approval Form

The following form documents the rationale as to whether to use Designation by Prescription (DxP) on timber removal projects (timber sale, stewardship, contract or stewardship agreement). This form is included as a part of the cruise design. The process to implement DxP is approved and signed by the District Ranger (FSM ID 2440-2016-1- 2441.03-5).

1) Are the stands that you are proposing to use Designation by Prescription currently single species, even-aged stands? YES__X__ NO_____ Document site location and acres on page 2.
   a. If yes, these stands are a good fit for use of DxP. Proceed to # 4.
   b. If no, proceed to #2 and #3.
2) Are the stands you are proposing to use Designation by Prescription currently single species, uneven aged stands? YES_____ NO__X__ Document site location and acres on page 2.
   a. If yes, caution will need to be taken with these initial stand conditions given that the end result of applying DxP may be difficult to measure. Proceed to #4.
   b. If no, and the stands are neither the conditions listed in items 1 and 2 of this key. Proceed to #3.
3) Are the stands you are proposing to use Designation by Prescription currently multiple species, uneven aged stands? YES____ NO__X__ Document site location and acres on page 2.
   a. If yes, caution will need to be taken with these initial stand conditions given that the end result of applying DxP may be difficult to measure. Proceed to #4.
   b. If no, not a good candidate for DxP. Stand conditions should be either #1 or #2 described above.
4) Can you measure the desired end result? YES__X__ NO_____
   a. If yes, then DxP is suitable for use on the sale. Proceed to #5.
   b. If no, do not use DxP. Utilize a different designation method.
5) Do you have an Acceptance of Work provision developed to measure the desired end result? YES__X__ NO_____
   a. If yes, include below and in the cruise design and subsequent contract package.
   b. If no, convene a team (i.e. Presale Forester, Sale Administrator, and Silviculturist) to develop the Acceptance of Work provision based on a method of measurement to meet the desired end result.

Recommended by: /s/: *Shawn Martin*, on April 1, 2019

Presale Forester

Concurrence by: /s/ Ian Fox, on April 1, 2019

Contracting Officer

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The Sale Admin Inspection Process

Table 2a. Criteria for acceptance

			Groups		Interspaces / Regen Openings				
Cutting Units	Type	Residual BA (ft²/acre)	% plots	Acceptable size (ac.)	% plots	Acceptable width (ft.)	Acceptable tree removal	Acceptable tree quality	
ZM1, ZM2, McG5, Perea9	Plot	Measured BA	Y/N	Y/N (0.1-1)	Y/N	Y/N (30-200)	Y/N	# des/acc trees	# total trees
	CU	60-70 ft²/acre	60-80%	≥90%	20-40%	≥75%	≥75%	≥75%	
CD1, McG1-5, McG7-10, Perea 4, 6, 7	Plot	Measured BA	Y/N	Y/N (0.1-1)	Y/N	Y/N (50-200)	Y/N	# des/acc trees	# total trees
	CU	50-60 ft²/acre	60-80%	≥90%	20-40%	≥75%	≥75%	≥75%	
CD2, McG7	Plot	Measured BA	Y/N	Y/N (0.1-1)	Y/N	Y/N (30-200)	Y/N	# des/acc trees	# total trees
	CU	60-70 ft²/acre	50-70%	≥90%	30-50%	≥75%	≥75%	≥60%	
Perea 10	Plot	Measured BA	Y/N	Y/N (0.1-1)	Y/N	Y/N (30-200)	Y/N	# des/acc trees	# total trees
	CU	50-70 ft²/acre	60-80%	≥90%	20-40%	≥75%	≥75%	≥75%	

District: _____ Date: _____

Inspector/Title: _____

I. SPECIFICATIONS LISTED IN CONTRACT PROVISION C2.355# OR K-C.3.5.5#

a) Residual Basal Area	n/a		b) % Plots in Groups	Plot w/in group (Y/N for the plot)	
	n/a			60-80% of all plots w/in groups for CU to pass	
c) Group Size	0.1-1 acre (Y/N for the plot);		d) % Plots in Interspaces	Plot w/in interspace (Y/N for the plot)	
	≥90% of group plots "Y" for CU to pass			20-40% of all plots w/in interspace for CU to pass	
e) Interspace Width	30-200 feet (Y/N for the plot)		f) Tree Removal in Interspaces	Tree removal acceptable (Y/N for the plot)	
	≥75% of interspace plots "Y" for CU to pass			≥75% of interspace plots "Y" for CU to pass	
g) Tree Quality	Record # desirable/acceptable trees and total # of trees for plot				
	≥75% of residual trees desirable/ acceptable for CU to pass				

II. COMPLIANCE FINDINGS (Fixed Plots: 1/10 acre = 37.2'; 1/4 acre = 58.9')

Plot #		% Plots in Groups	Group size (0.1-1 acre)	% Plots in Interspace	Interspace width (40-200 feet)	Tree Removal w/in Interspace	Tree quality (1/10 ac. plot)	Plot #		% Plots in Groups	Group size (0.1-1 acre)	% Plots in Interspace	Interspace width (40-200 feet)	Tree Removal w/in Interspace	Tree quality (1/10 ac. plot)

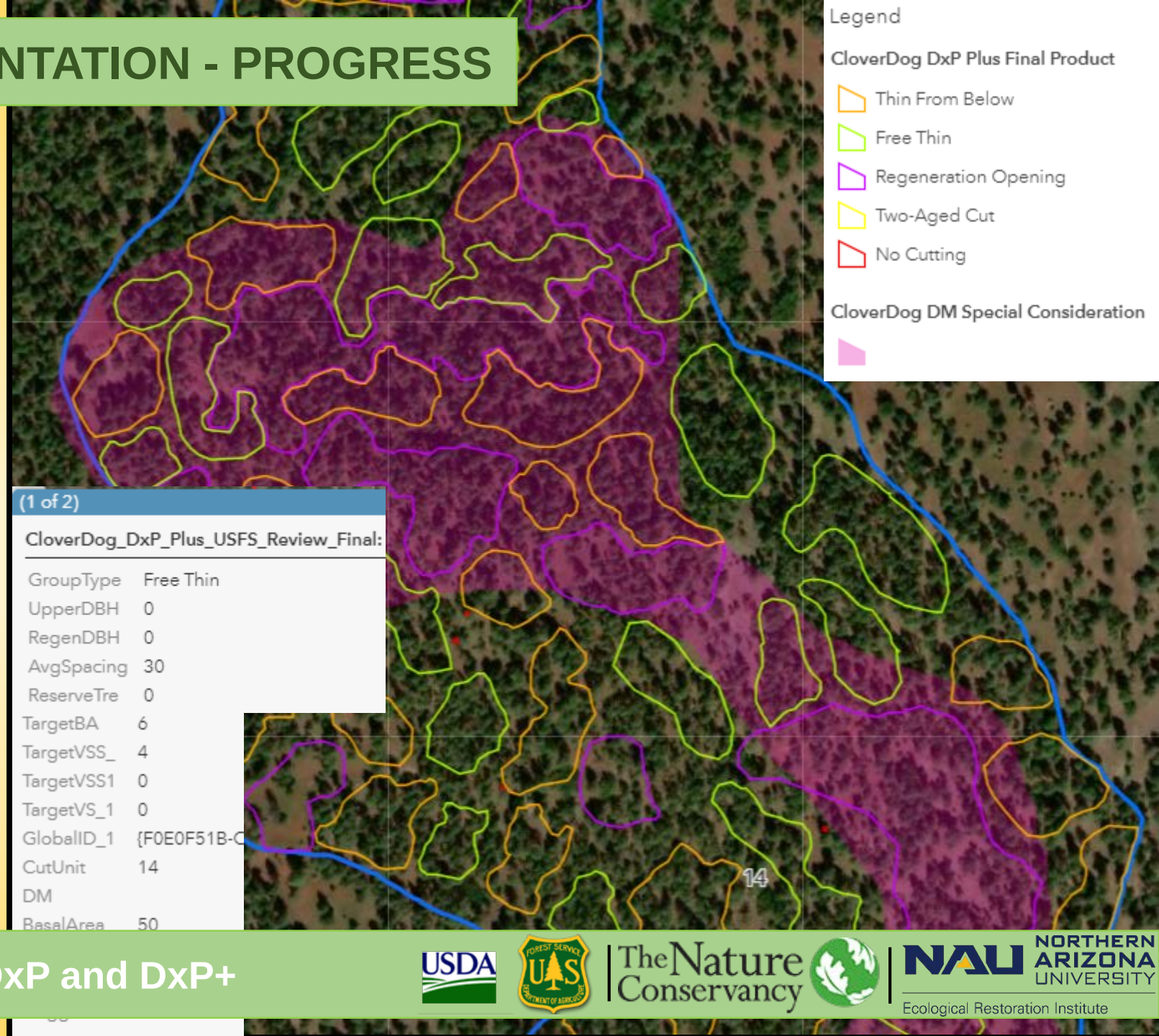
Comments:

DxP and DxP+

DxP+ Project Examples

Kaibab NF – Clover SPA

- Targets:
  - No 4FRI interspaces, group sizes, etc.
  - Heavier emphasis on DM infection (City EIS)
- Results:
  - Average group size one acre
  - Interspace ~36%
  - DM sanitation shading
  - No cuts for YP's



DxP and DxP+

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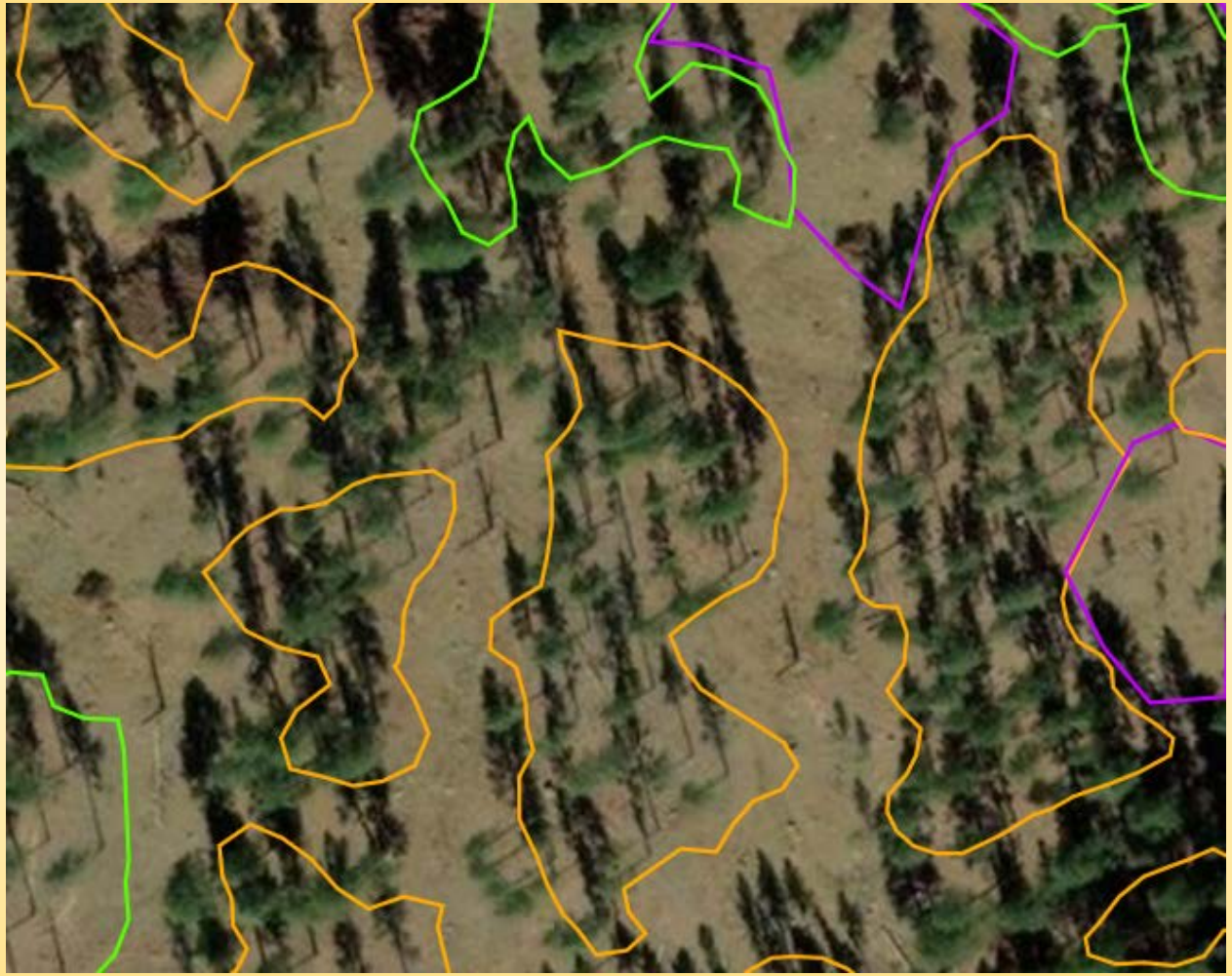
Coconino NF – Chimney Springs

- Total 1,626 acres
  - Leave Tree Mark = 228 ac
  - DxP – Cutter Select = 356 ac
  - DxP+ (Tablet) = 1,036 ac
- Targets:
  - 50-90 ft^2/acre BA
  - Groups 0.1-1 acre
  - Interspaces 25-100 feet wide
  - 10-20% of area in regeneration openings



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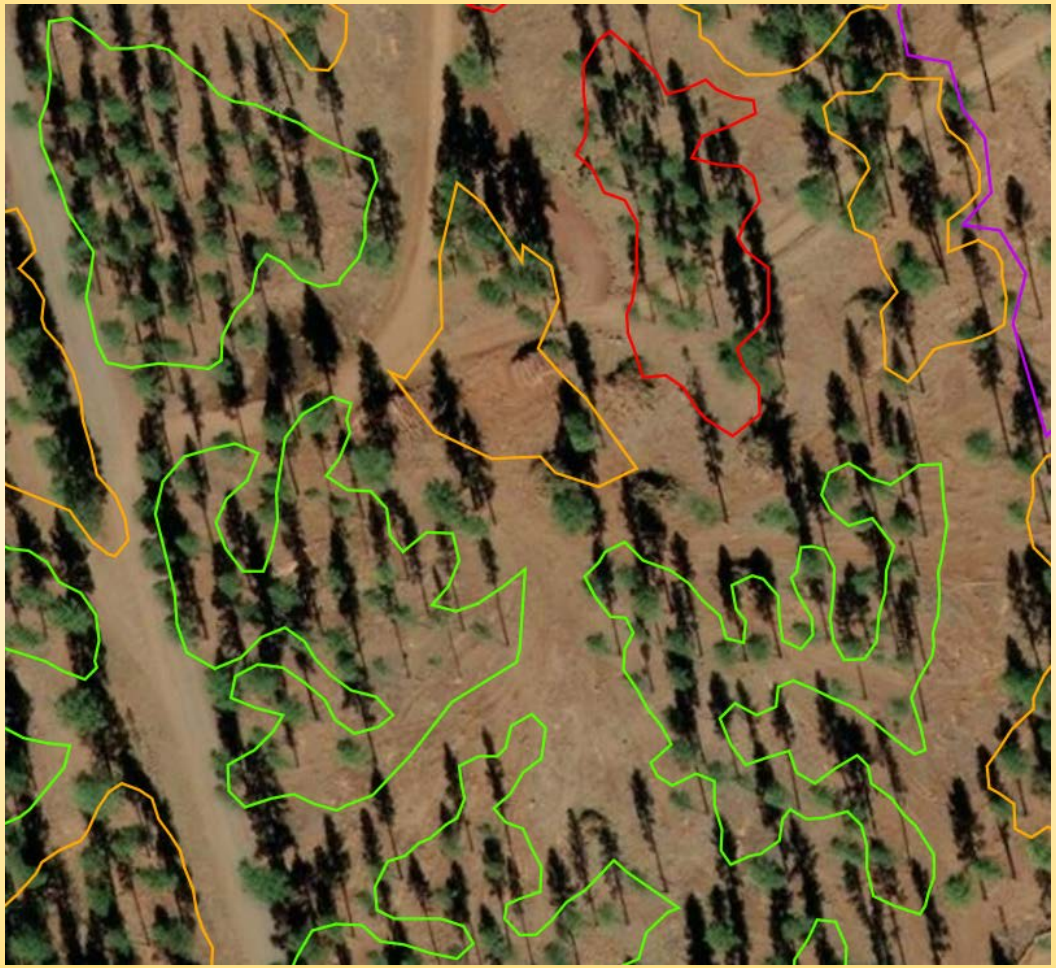
Coconino NF - Chimney Springs

- Lessons Learned:
  - BA targets met under both DxP and DxP+
  - Spatial objectives more closely met with DxP+ than DxP
  - Operator successful at following polygons
    (45 of 50 plots cut according to polygons in Unit 9)
  - Dwarf mistletoe infection level effectively reduced with DxP+
    (proportion of infected trees reduced by 6.8%)
  - Proportion of “defect” trees was not reduced under DxP+
    (proportion of infected trees increased by 3.6%)

Coconino NF - Chimney Springs

- Lessons applied to subsequent projects:
  - Smooth out polygons
  - Set minimum polygon size (0.1 acres)
  - Reduce # of group types
  - Formalize inspection process for checking DxP+
  - Account for individual trees to be left



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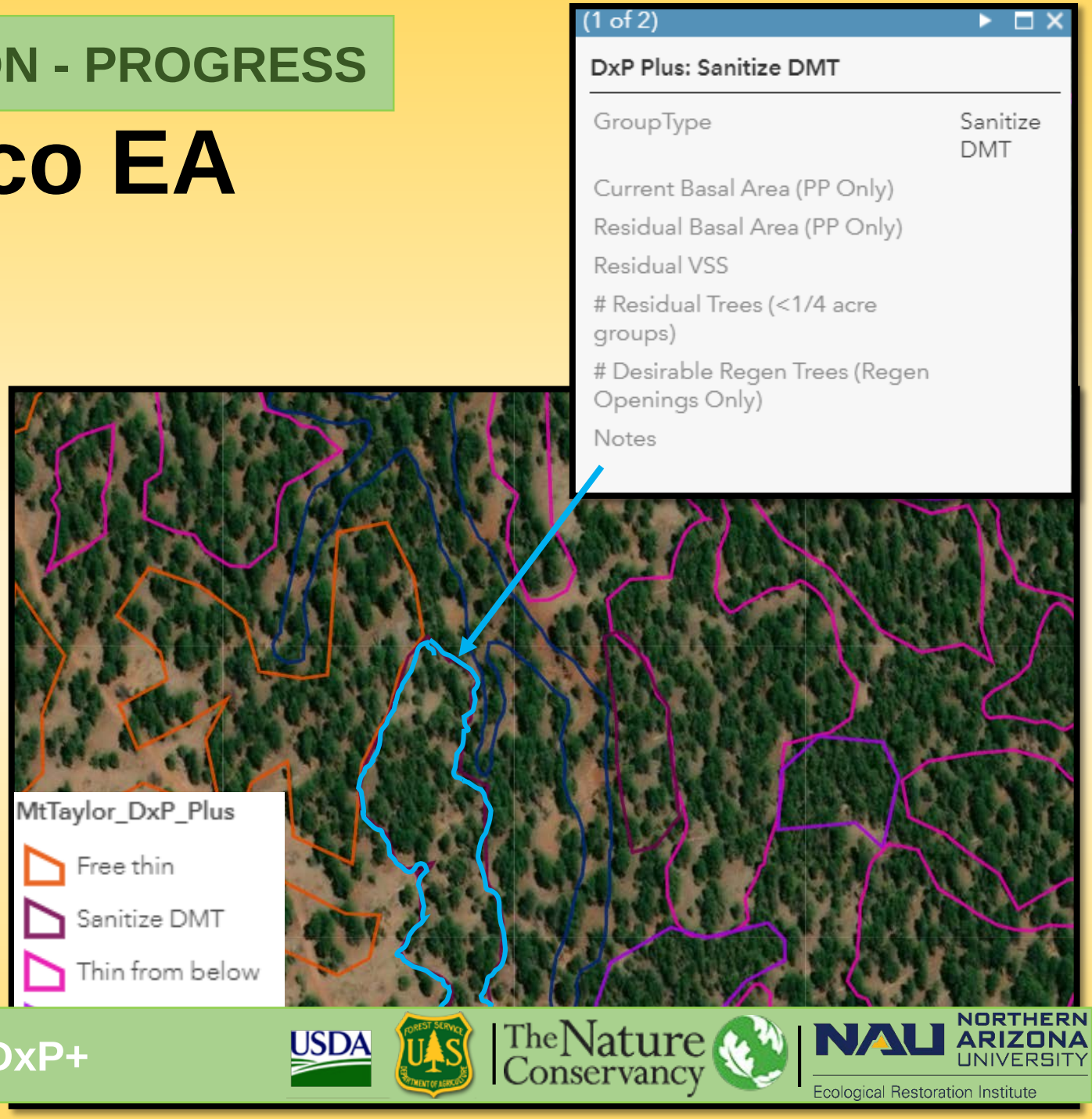
Cibola NF – Puerco EA

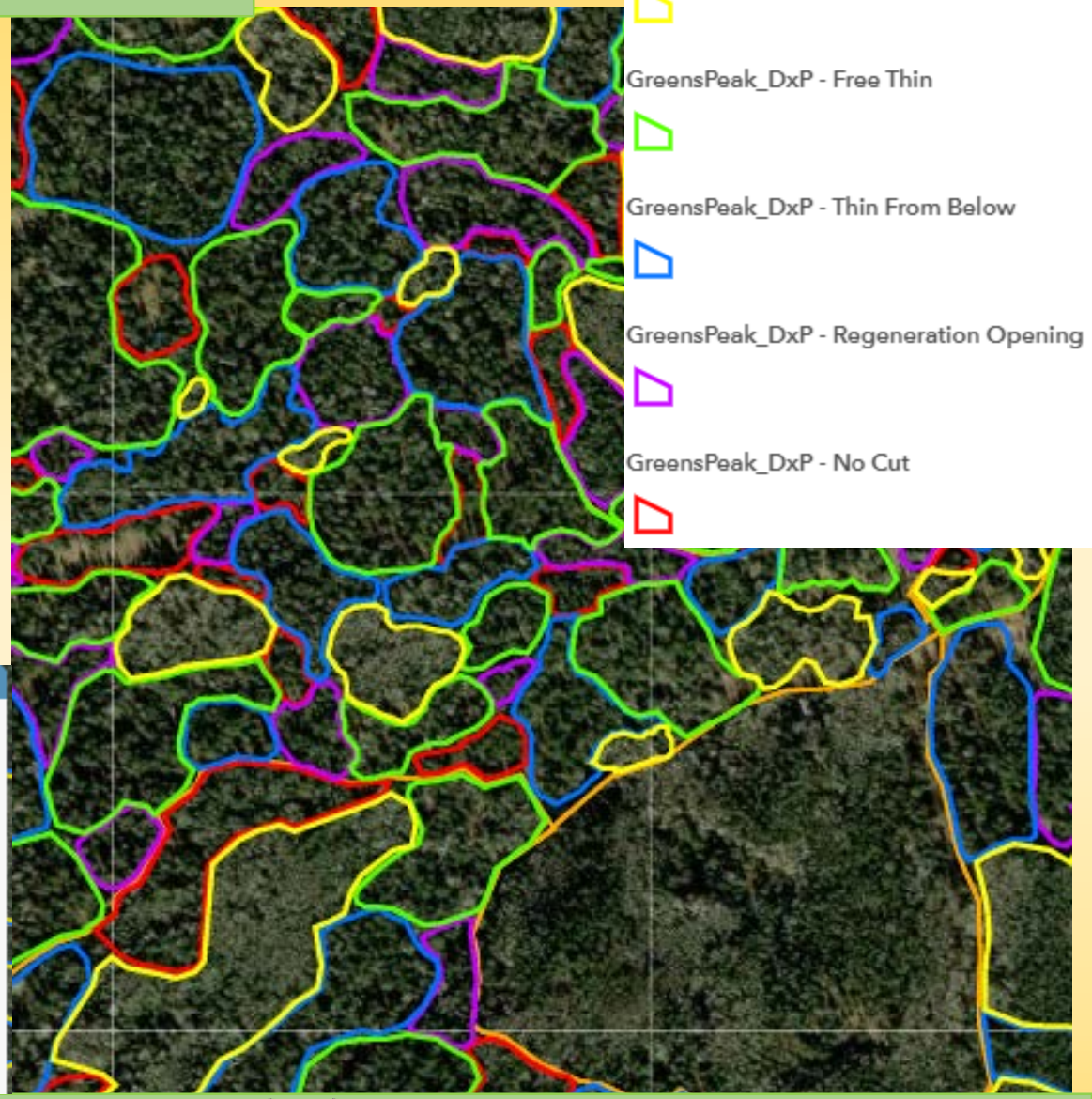
- Similar polygon types
  - Plus “Sanitize DM”
- No cuts used regularly for stream buffers
- No information in polygons
- BA targets will be met using field monitoring of residual BA

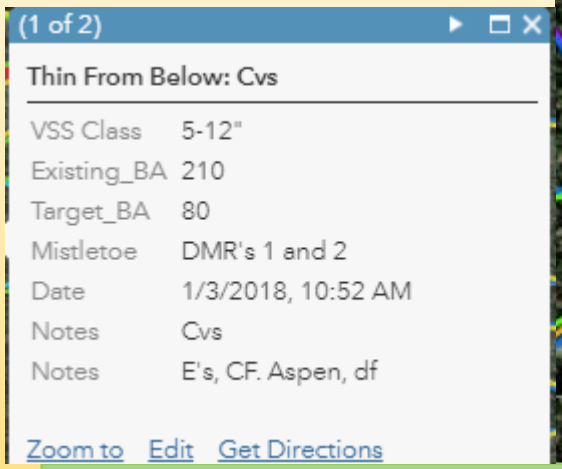


DxP and DxP+

A-S Greens Peak

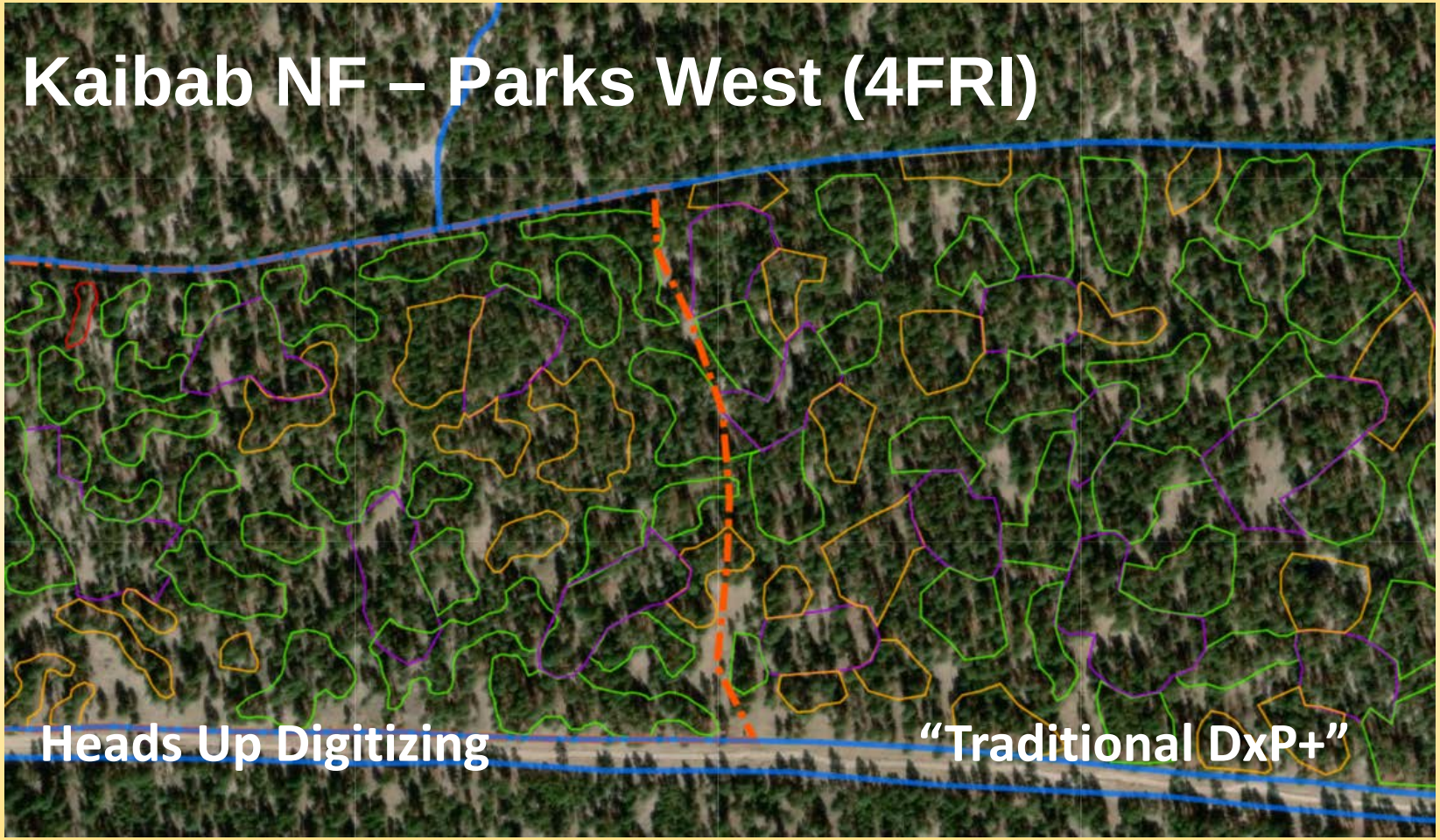
- Mixed conifer prescription
- No interspace
- Wide range of polygon sizes





DxP and DxP+

Heads up Digitizing – A New Approach to DxP+



What worked well?

- We demonstrated successful outcomes resulting from a stewardship agreement
- We implemented a GIS workflow using Arc Desktop, AGOL, and Arc Collector to digitize aspects of timber sale prep
- We now have spatial information to support management decisions and improve accountability
- We are refining a process that is repeatable and can be implemented at scale
- We are digitizing other timber prep tasks for a more integrated process
- Preliminary data suggests operational cost savings when compared with DxP and layout cost savings when compared with ITM

What worked well?

- We've had favorable outcomes with DxP+ and positive feedback from operators

Key points for implementation

- DxP+ is the exact same as straight DxP, plus a digital guide for operators to enhance harvest operations and improve on outcomes
- 4FRI's spatial targets for tree groups and interspace make it a great candidate for implementing DxP+ but it can also be used in mixed conifer
- Be aware of how the openness in interspace will affect the residual basal area needed within treed groups to meet unit level targets
- Be aware of how regeneration openings contribute to overall openness

Recommendations

- Consider remote sensing options for digitizing DxP+ tree group features
- Consider how to address special consideration areas such as dwarf mistletoe
- Consider how to account for the spatial error associated to GPS accuracy
- Consider updates to the USFS policy handbook that give clear guidance on going digital with timber sale prep tasks
- Consider standardizing data models to support automated processes

Contact Info

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