Cranston Piles Prescribed Fire Review, San Jacinto RD, San Bernardino National Forest

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Introduction

The high mountain valley surrounding Mountain Center and the Keenwild Fire station in the San Jacinto Mountains of Southern California (Figure 2) has burned twice recently in large fires: in 2013's Mountain Fire and 2018's Cranston Fire. The resulting fuel complex often closely resembled that of a heavily managed fuelbreak, with wide open pine stands, light grass and some areas of brush regeneration.

Figure 1 Tweet from BDF official account informing the public on ongoing pile burning in the Cranston project. Note the date (1/12/21) is more than two full days before discovery of the Bonita Fire (~0115 hrs, 1/15/21).

Beginning in January 2021, San Bernardino National Forest (BDF) firefighters began burning piles of cut and stacked fuels in the Cranston Fire scar (Figure 1). The total acreage of all pile burn units within this project is 110 acres. Over three days of ignitions (January 6th, 7th, and 12th), BDF fire personnel successfully burned 49 acres of this 110.

In the very early morning of January 15th, a fire was reported adjacent to the burn unit from January 12. Total burned area from the wildfire was 715 acres (Figures 3 and 4).

Unit and Vicinity Maps

Figure 2 Vicinity map of Southern CA with incident location on the BDF identified.

Figure 3 Aerial imagery of part of the Cranston Fire footprint (Google Earth, Imagery from 12/2019). In the morning on January 15th, the Bonita Fire spread from a point off the bottom edge of the image followed wind flow paths, primarily between Keen Ridge (A) and the feature indicated with the letter B. The fire reached but did not cross Hwy 74.

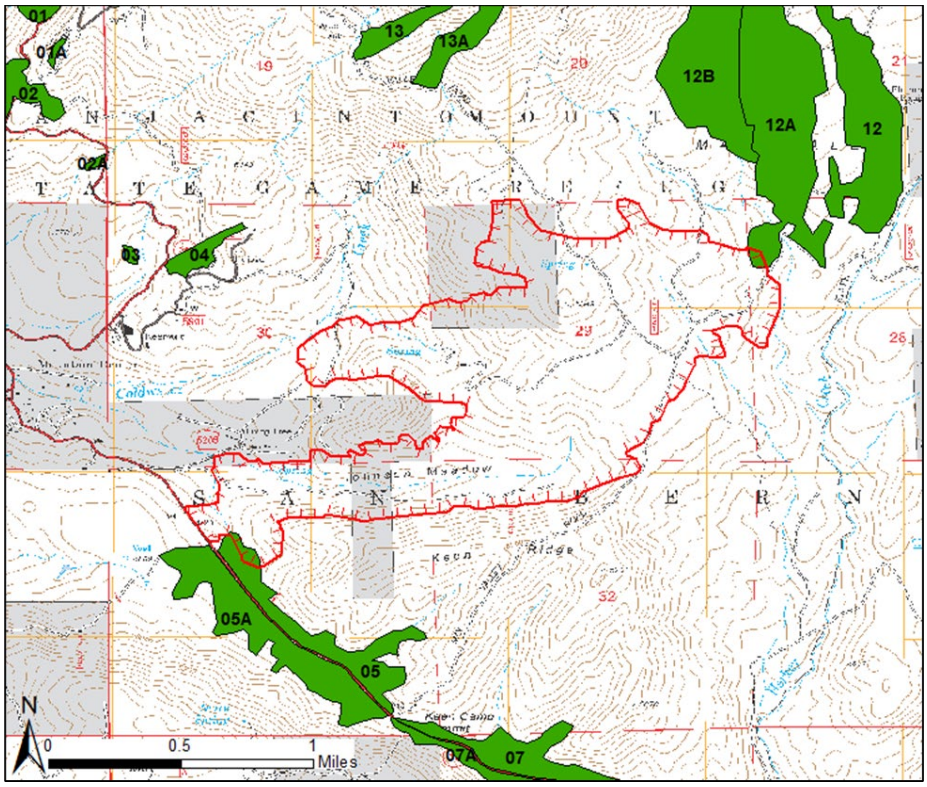

Figure 4 Map depicting Cranston Reforestation Units and final Bonita Fire Perimeter. The Bonita Fire origin was identified[1] as a pile inside Unit 12A.

[1] Details of the investigation into the cause of the Bonita Fire were provided to the Cranston RX review team in the Wildland Fire Origin & Cause Supplemental Incident Report. "O&C Report" hereafter.

Part 1

Narrative

Figure 5 Burning pile on the Cranston Reforestation project.

Beginning on January 6th, BDF fire management personnel began burning piles in the Cranston Fire Reforestation Project. The first day of planned ignitions following the holidays was January 5th, but COVID-related staffing issues led to a postponement until the following day. Due to winter staffing patterns, weather and fuel conditions, and other factors, all prescribed burning on the San Jacinto Ranger District (SJRD) is planned for the period between January 2nd to mid-to-late April. Further, the highest levels of staffing are during the middle three days of the week – Tuesday through Thursday – and ignitions operations were planned for those days, with the rest of the week left for patrol and mop-up.

Ignitions began January 6th and continued over three days – January 6th, 7th and 12th – accomplishing 49 acres. No significant issues arose during burning operations. Piles were, on average, between 6’ x 6’ x 6’ and 6’ x 6’ x 8’, consisting of fire-killed brush and pine limbs. Piles were very dry, and typically consumed down to a smoldering stage in less than one hour. The fuels in the units outside of the piles themselves closely resembled a treated fuelbreak (Figures 8 – 10). Outside of the unit, fire behavior modeling was performed using Fuel Model SH7 – Very Heavy Load, Dry Climate Shrub. Personnel onscene were instructed by the burn boss to hold the piles they lit – that is to scratch in a small handline or take other actions to keep fire from spreading outside of the pile footprint.

Ignitions ceased in the mid-afternoon of January 12th, and further prescribed burning was canceled Forestwide with the forecasted onset of very dry and windy conditions. Onsite there were no significant concerns about the forecasted weather, as the area around the Cranston units was usually very sheltered from wind, and the piles were burning down readily. The forecast seemed to point to high winds particularly focused on wind-prone locations, like Banning and Cajon Pass, both far from the units. As the burn boss departed the unit on the late afternoon of the 12th, he noticed light smoke lingering in the pine trees on the eastern side of the unit. A few piles remained to burn

that they weren't able to get to that day, but he planned to burn them when ignitions continued at a later date.

Over the following two days, an engine came to the unit to patrol and mop-up any heat they found. On both days the patrols reported to dispatch that there was minimal heat or smoke at the scene. These patrols also sprayed water in areas where they identified heat. No control concerns were expressed by these patrols to the burn boss, nor did the burn boss feel concerned by what he observed himself. The mountain valley around Mountain Center was typically sheltered from Santa Ana *foehn* wind events. One local fire manager said that often when the wind would blow through Banning Pass (about 15 air miles away) at over 60 mph, it would be so light in the Mountain Center area that you could "barely fly a kite." This phenomenon was a widely known piece of local knowledge on the SJRD.

The wind event arrived in the vicinity of the Cranston pile burn units in the very early morning of January 15th. BDF fire management had planned for the event by providing staffing for fire engines through the night. Between 0115 and 0120, a fire was reported in the vicinity of the Cranston pile burns, initially reported on Bonita Vista Rd. Driven by steady high winds through light, flashy fuels, the fire ran to burn 715 acres of grass, brush and scattered pines trees (both live and snags). Firefighters from the federal, state and local governments stopped forward spread of the fire after less than 12 hours, and the fire was reported 100% contained on January 26, 2021.

Cause investigation began with a preliminary investigation on the morning of January 15th, once daylight allowed for detailed examination. The preliminary investigation pointed to remnants of smoldering fuels in a burn pile becoming active under the high wind and low relative humidity conditions of night of January 15th and spreading by way of underground smoldering in roots to unburned fuels adjacent to the pile footprint. A subsequent investigation beginning the following day reached largely the same conclusion, determining a slightly different precise location as the path of escape from a pile (identified in the O&C Report as "Pile 1"). This O&C Report was completed February 5th and furnished to this review team.

Lessons Learned

- BDF personnel emphasized the support of the BDF fire organization around conducting prescribed fire operations on the terms that they can safely and effectively do them, even with the constraints that exist.
- The redundancy built into prescribed fire approval and notification can seem overkill but means that everyone in the organization who needs to know likely does know what is going on and has an opportunity to express concerns.

Part 2

Review Elements

1. **Analysis of the seasonal severity, weather events, and on-site conditions leading up to the wildfire declaration**

As part of the review for the Cranston Prescribed Fire, an analysis of the seasonal severity, weather events, and on-site conditions leading up to the wildfire declaration has been requested. This analysis is divided into three time periods: Before ignitions, during ignitions and the period between the last ignition and the Bonita fire initial action.

Background

The SJRD pile burn plan covered several burn projects throughout their area of the BDF. The Cranston Reforestation units are a group of burn units approximately two miles east of Mountain Center in the central San Jacinto mountain range. These units comprised 110 acres on a southeast aspect between 4500 and 6000 ft. The units are in the footprint of the 2018 Cranston fire.

Before Ignitions

Southern California was experiencing abnormally dry conditions to begin January 2021 (Figure 6). The period from December 1 to January 31 was used to establish season trends for fuel moisture values and indices. 1000-hour fuel moisture levels in the San Jacinto mountain range were near 20-year averages and trending drier[2].

100-hour fuel moisture levels were near 20-year lows. Energy release component was near average and trending hotter. Measured live fuel moistures in Chamise fuels near the project area were a little above the critical level of 60%; 66% on January 4, 2021.

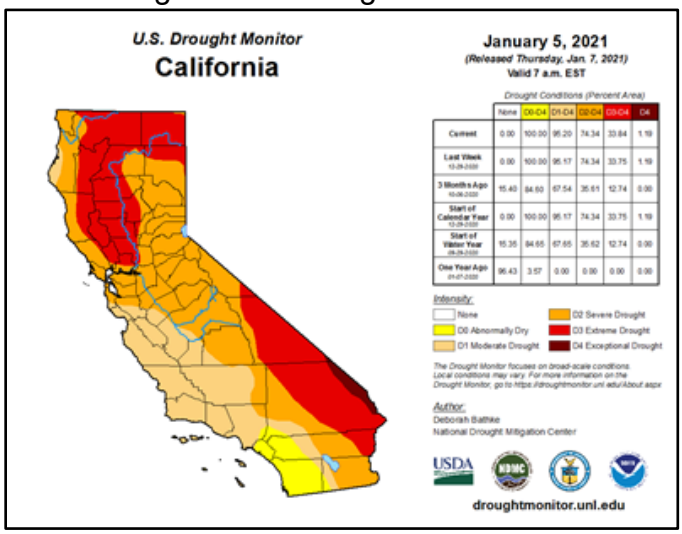

Figure 6 Abnormally dry conditions across Southern CA in the period leading up to the escape.

This data suggests a fire environment that was trending toward drier conditions and fire behavior presenting an increased resistance to control. It is worth noting that fuels in Southern California change rapidly with increases in heat and decreases in atmospheric moisture. The reduction in seasonal moisture in the project area had the greatest effect on the 100-hour fuel moisture. The conditions

[2] Figures depicting fuel and weather conditions referenced thoughout this section are located in Appendix A.

leading up to ignitions, while dry, did not represent an extreme departure from average December-January conditions.

During Ignitions

On-site weather observations were consistent with National Weather Service (NWS) spot weather forecasts requested for the burn. The environment continued to dry with relative humidity levels near record lows. As burn operations resumed on Tuesday, January 12th, 10-hour and 100-hour fuel moisture dipped below the 10th percentile. The RAWS station closest to the project area, Keenwild, showed this trend toward a drier fire environment. Documented fire behavior observations were within acceptable parameters and didn't indicate an increased or undue threat of escape.
While not near record dry levels for the area, the data suggests abnormally dry conditions in the project area for that time of year. Fire behavior observations did not suggest abnormal fire behavior. Again, while conditions continued to trend drier, weather conditions were within burn plan parameters.

Period Between the Last Ignition and the Bonita Fire Initial Action

Weather condition continued to warm and dry after ignitions on the afternoon of January 12th. The NWS office in San Diego issued a fire weather watch/red flag warning on January 13th at 2000 hrs for strong winds in the project area starting midnight January 15th. Keenwild RAWS recorded BI and ERC levels at the 97th percentile on January 15th, with high BI above the previous 20-year maximum (Figure 7). The Bonita fire was detected around 0115 hrs on January 15th.

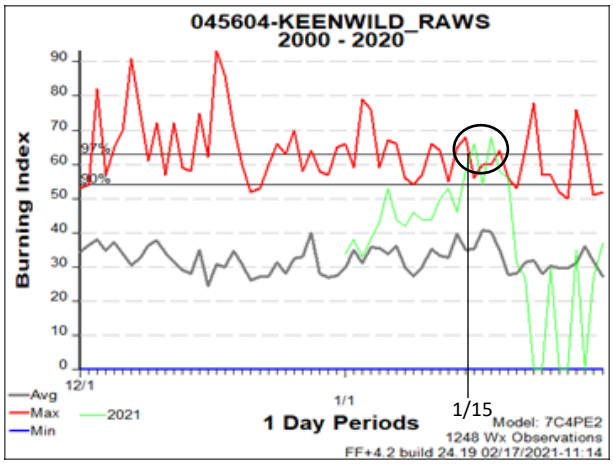

Figure 7 Burning Index graph from Keenwild RAWS, showing period of record high (indicated by black circle).

Figures 8 – 10 over the following pages depict the fuel and topography in the vicinity of the Cranston Reforestation units burned between January 6th and 12th.

Figure 8 Representative fuels and topography in the Cranston Reforestation units. Photo is of Unit 12B, adjacent to the unit identified as having produced the escape.

Figure 9 Photo taken during pile burning operations, showing pile size and density, fuel loading, and topography in the burn unit. Note light, matted grass fuels, and presence of snow on adjacent slope.

Figure 10 Photo showing aftermath of pile burning. Note complete consumption of piled fuels, as well as fuels and topography of burn unit and vicinity.

Lessons Learned

After analyzing contemporaneous fuels and weather data and discussing these factors with the prescribed fire practitioners, some key factors and considerations were revealed.

- Despite fire weather and fuels conditions being unremarkable relative to the rest of a very busy 2020 fire season, they were quite dry (near or at 20-year records) for the time of year. The predicted wind event on January 15th in fact set a new record Burning Index at Keenwild.
- The presence of snow, mud, matted grass and other indicators and signs of winter conditions may have created a false picture of the actual receptivity of fuels and the potential for extreme shifts in weather. Snow and mud on roads made travel to the prescribed fire units difficult just days prior to ignitions. Over a span of days, these conditions changed, allowing for ready burning of piled fuels and then rapid rate of spread through natural surface fuels previously under snow.

2. Analysis of the prescribed fire plan for consistency with agency policy and guidance related to prescribed fire planning and implementation

A review of the San Jacinto District Pile Burn Plan was conducted and found that most areas of the burn plan did not cover the Cranston Reforestation piles.

The Interagency Burn Plan Template (PMS 424) was used in every element of the development of the San Jacinto District Pile Burn Plan, however there were some elements consisting of generic text that was not specific to the burns being planned. All required elements in PMS 484 were present.

A few issues were found that spanned multiple elements: Most of the burn plan is labeled as “Appendix A: Prescribed Fire Plan” in the footer of the pages. Appendix A is also identified as “Maps, Vicinity and Project Map” in the list of appendices on page A-30. Minimum staffing requirements are inconsistent in numerous elements. Appendices referenced in the burn plan were mislabeled or missing.

Element 1: Signature Page

- The plan was prepared by a qualified Type 2 Burn Boss (RXB2) qualifying him to be a Type 3 Burn Plan Preparer per PMS 424.
- The burn plan was reviewed and approved by the Forest Fuels/ Prevention Officer who is qualified as a RXB2 and qualified to review Type 3 burn plans per PMS 424.

- The Agency Administrator (District Ranger) is qualified at the Journey level and per Delegation of Authority for Fire Management Decisions FY2021 qualified to sign Type 3 Burn Plans.

Element 2A: Agency Administrator Ignition Authorization

- Signed by qualified Agency Administrator and provided the permissible dates to implement the prescribed fire project of 1/1/2021-12/31/2021.

Element 2B: Prescribed Fire Go/No-Go Checklist

- Go/No-Go Checklist was completed and signed on all ignition days: January 6th, 7th and 12th, 2021.

Element 3: Complexity Analysis Summary

- The overall complexity rating was Low. The Complexity Analysis addresses only fuel break burning to maintain defensible space, not the reforestation units.

Findings: No risk factors or complexity associated with the Cranston piles were addressed. In conversation with the Burn Plan Preparers the composition of the Cranston Reforestation Pile units was similar to the adjacent fuel break units, due to the multiple recent wildfires (Mountain Fire in 2013 and Cranston Fire in 2018) in the area.

- Complexity Analysis addresses burning to maintain defensible space.

Findings: Cranston Reforestation units were not identified as fuel break units or admin site units in the burn plan that were to be burned to maintain defensible space. They were units containing piles that were being prepared for tree planting in the Cranston Fire (2018) footprint.

Element 4: Description of Prescribed Fire Area

- 4B Unique Features, Natural Resources, or Values: “All areas identified in the Burn Plan (reference Appendix A; West Ridge, Strawberry, and station piles are fuel breaks within designated Wildland Urban Interface and Structure Defense Zone”

Findings: The San Jacinto Pile Burn plan does not address what is adjacent to Cranston Reforestation units, however located in Appendix A, is a map of the Cranston Reforestation project area.

Element 5: Objectives

- 5A Resources Objectives identified are maintenance of fuel breaks and administrative site maintenance to meet the desired conditions for WUI Defense Zones.

- 5B Prescribed fire objectives identified “maintain fuel reductions on previously treated Wildland-Urban Interface (WUI)” Element 9: Treatment Resource Objectives in the Complexity Analysis identify the objective “reduce 90% of available fuels within the project boundary to maintain the defensible space around the communities.”

Findings: Resource objectives for the Cranston Reforestation Project were not addressed here but mentioned in Element 4A Physical Description, “the purpose of the project is to replant the expected lost forest in non-wilderness portions of the Cranston Fire.” Additionally the PFIRS registration under the Cranston Reforestation General Description as “Fuels to be removed/burned to make area available to replantation of pine tree.”

Element 6: Funding

- 6A The Burn Boss is to complete a detailed daily cost analysis using Appendix L: Cost Tracker.

Findings: No Appendix L: Cost Tracker could be found in the burn plan packet.

Element 7: Prescription

- 7A Prescription Narrative mentions that “normally piles will be burnt when factors keep risk low” but does not discuss what factors and that a utilization of a Severity Matrix may be used as an onsite guide to meet desired burning conditions. Appendix E: Severity Matrix, recommends “a Low/Moderate burn range with severity points between 13 and 79 according to the matrix outputs.”

Findings: No reference for severity points as Appendix E Severity Matrix Worksheets were not provided in the burn plan packet to review. No reference to the fire modeling done in Appendix E or empirical data was included to support the prescription.

Element 8: Scheduling

- 8A Implementation Schedule states “lighting will generally take place during daylight hours.”
- 8B states “this is a multiyear project.”
- 8C Constraints in burn plan are “N/A.”

Findings: 8A statement conflicts with Appendix C Complexity Analysis Element 5. Prescribed fire duration: “Ignitions will occur during daytime hours; no nighttime ignitions will take place” which also conflicts with Appendix C Complexity Analysis Element 7. Number and Dependance of Activities “Active night ignitions will generally not take place…”

8B not specific to what project(s) of the four project areas identified in Element 4 that this applies to.

8C in Appendix C Complexity Analysis Element 10: Constraints lists constraints as; “weather and availability of Type III Burn Bosses.” Additional constraints to consider are smoke restrictions, staffing, regional preparedness levels, etc.

Element 9: Pre-Burn Consideration

- 9A1 On site considerations for burning in historic fuel breaks: “there have been multiple entries and manipulations that have occurred within the project boundaries. No significant impact is expected due to the multiple entries and disturbances that have occurred with the project boundaries.”
- 9C Minimum Organization or Capabilities Needed “ENGB+3”

Findings: 9A1 No pre-burn considerations mentioned about burning in the Cranston Reforestation Project area.

9C Does not include a RXB3 in the minimum organization.

Element 10: Briefing

- 10 A references the Briefing Checklist as Appendix J.

Findings: In the appendices Appendix H BDF Burn Boss checklist, has a briefing checklist imbedded. There was no Appendix J provided in the burn plan packet.

Element 11: Organization and Equipment

- 11A Positions Prescribed Fire Burn Boss - Qualified RXB3, Engine - Staffed ENGB+2

Findings: Minimum engine staffing listed as ENGB+2; conflicts with Element 9C, which says ENGB+3. No rationale provided for staffing minimum.

Element 13: Public and Personnel Safety, Medical

- 13A Multiple JHA’s provided in burn plan packet.
- 13B Mitigations for smoke impacts listed as calling “CHP, CalTrans and increasing road guards/signage.”
- 13C References Appendix G: Emergency Medical Plan.

Findings: 13A JHA from 2018 labeled as Appendix D. Additional JHA found in the Burn Plan packet from 06/16/2020, making labeled 2018 Appendix D JHA obsolete. Burn Boss documentation only contains signature on the last page of the JHA and does not indicate what JHA was used for briefing.

13B Smoke Mitigation in PFIRS registration listed as “Stop Ignition.”

13C Reviewing Appendix G, it was prepared on 10/1/18 and indicates that it is for operational period “FY19;” difficult to find in Burn Plan packet.

Element 15: Ignition Plan

- 15A Firing Methods state that “Fire predictions are based on ignition techniques of backing and flanking fires.”
- 15C Minimum Ignition Staffing is RXB3, ENGB+2.

Findings: 15A Fire modeling was done for head fire and backing fire.

15C Conflicts with Element 9C ENGB+ 3

Element 16: Holding Plan

- 16C Minimum Organization and Capabilities Needed: 1 RXB3 and ENGB+2 Findings: Conflicts with Element 9C ENGB+3 and no rationale for staffing minimum.

Element 17: Contingency Plan

- 17A Management Action Plans (Trigger Points) “should the burn move out of the designated prescribed fire area and cannot be contained by the forces on site within the next burn period the Burn Boss will activate the contingency resources.”
- 17C refers to the objective of “eliminating piled material to maintain fuels reductions on previously treated Wildland Urban Interface…” in Element 5.
- 17C Required Contingency Resources are: Engines- 1.

Findings: 17A one of the trigger points identified in the contingency plan seems to combine the wording pertinent to a wildfire declaration, but as a trigger point for the contingency plan.

Page 33 of PMS 484, Element 18: Wildfire Declaration states:

A prescribed fire, or a portion or segment of a prescribed fire, must be declared a wildfire by those identified in the plan with the authority to do so, when either or both of the following criteria are met:

Prescription parameters are exceeded and holding, and contingency actions cannot secure the fire by the end of the next burning period, or,

The fire has spread outside the project area or is likely to do so, and the associated contingency actions have failed or are likely to fail and the fire cannot be contained by the end of the next burning period.

17C No Cranston Reforestation piles objectives were addressed in Element 5. Justification for number of required contingency resources is not present,

Element 18: Wildfire Declaration

- 18A Wildfire will be declared by the "Burn Boss in consultation with the Forest Fire Management Officer and Line Officer."

Findings: No criteria for declaring a wildfire is mentioned, only who will declare the wildfire.

Element 19: Smoke Management and Air Quality

- 19E Mitigations Strategies and Techniques to Reduce Smoke Impacts. No mention of mitigations for smoke impacts while burning. Mitigations mentioned do reduce smoke impacts, however not while burning.

Findings: Mitigations for smoke impacts while burning are mentioned in PFIRS registration.

Lessons Learned

From extensive analysis of the prescribed fire plan and in conversations with BDF fire management personnel, the following considerations came to light.

- Ensure that adequate time and attention is invested in writing the burn plan to ensure that it is a useful tool for implementation. Reference should be made to the parent NEPA documents (ensure they are current) to develop objectives. Consider potential outcomes and use the plan to adequately addresses each of those.
- Routine off-unit reviews are recommended to give an outside perspective and reduce just "rolling over" existing plans.
- Consistency throughout the burn plan is essential and organization is important. Organize the appendices so that they are useful tools for the Burn Boss to easily access. Organize the appendices into the main body of the plan if possible. If appendices are needed, ensure that appendices referenced in the burn plan are included and labeled correctly. Ensure that only forms and tasks that are realistically expected of the Burn Boss are included.
- Multi-unit or programmatic burn plans are an excellent tool for consolidating similar burn units together. However, burn plans must be relevant to each unit, and addressing the specifics of each unit identified in the burn plan is essential. It is suggested that a fresh burn plan be written from scratch when the existing plan becomes outdated, or new projects in different fuel types or with different objectives are added. This will also help to ensure that antiquated language, procedures, and forms are not included.

3. **Analysis of prescribed fire implementation for consistency with the prescription, actions, and procedures in the prescribed fire plan**

We did not identify any significant departure from the prescribed fire plan as signed and the implementation of prescribed fire operations.

- Notifications took place in accordance with the prescribed fire plan and regional and BDF policies;
- The burn was in prescription, with personnel observing and recording weather hourly during ignitions;
- Ignition operations had ceased long before extreme weather conditions of January 15th;
- Holding resources on scene were in compliance with the prescribed fire plan, as were contingency resources;
- The patrol organization and frequency met the requirements of the prescribed fire plan, and daily debriefings from patrols were used to plan subsequent patrols;
- Personnel visited the scene to monitor and patrol during working hours every day between when ignitions started early on January 6th until the at least the afternoon of January 14th. Three Type 3 engine-loads of water was used to mop-up an area of the burn with some lingering heat on the 14th.

4. **The approving Agency Administrator's qualifications, experience and involvement**

The approving Agency Administrator met all training, experience requirements and was fully qualified to approve prescribed fire plans at the low complexity level.

5. **The qualifications and experience of key personnel involved**

All key fire personnel were qualified at the appropriate level as determined by the project complexity analysis and USFS policy for the positions they were assigned according to current Incident Qualification and Certification System (IQCS) records. All other assigned personnel also have been found to be qualified in their respective positions.

Part 3

Findings, Lessons Learned & Recommendations

The following lessons and recommendations came from direct conversations with BDF personnel as well as extended discussion within the review team. As such, they represent both points directly from the Cranston RX burn itself, and points that Cranston highlighted which may be more programmatic in nature and regional or national in scope.

Risk Management

- All use of prescribed fire is inherently risky. The risk is mitigated through conformance with burn plan prescriptions and parameters but is never completely eliminated. Use of the risk management process is evident in the decision to staff modules overnight on January 14th-15th in anticipation of a Santa Ana wind event. Whether more extensive mop-up or committing an engine onsite to the most recent pile burns overnight would have significantly limited the size of the Bonita Fire is an open question and ultimately unknowable. Whatever the case, inclusion of all known hazards and conditions when determining risk is critical to inform decisions that best match reality. It is possible that recent cold weather, presence of snow, extensive use of water, and other factors led to a gap in the actual conditions on scene of the Cranston RX burn in the hours leading up to the escape, and how those conditions were perceived and used to inform decision-making.

Prescribed Fire SOPs

- In the unlikely event of an escape, the records that the local unit kept on all aspects of the burn become very important. Using standardized language, like we use reporting to and checking wildfires, could help ensure that the movement and actions of personnel are clearly recorded by the local dispatch center. The use of a patrol log or other document (similar to the ICS-214) can unify recordkeeping in one format and one location.

Wildfire Declaration

- As in other aspects of our culture, how we talk about wildfire declarations may play a role in how we perpetuate a stigma around unintended outcomes in prescribed burning. A substantially smaller percentage of prescribed fires become wildfires as initial attacks become extended attack fires. Yet our conversations around wildfire declaration/conversion are more negative; we describe a prescribed burn as being “lost” in a way we don’t generally talk about unsuccessful initial attacks (except ironically).

- When it is determined a wildland fire was caused by a prescribed fire, treating the cause dispassionately and objectively, similar to any other cause (i.e. lightning, vehicle-to-wildland, etc.). Avoiding the topic, or treating it as taboo, may tend to increase the stigma around wildfire declaration, in turn increasing unease around prescribed burning itself.

Fire Behavior & Weather

- Recent experience in the Western US points to the development of fire and weather conditions not previously seen by the current generation fire and land managers. The level of uncertainty and the extreme nature of the high end of fire behavior has become more familiar to us in the wildfire context, but perhaps less so in prescribed fires (particularly pile burns), which we may still see as more routine operations. If possible, research focused on developing tools to predict extreme weather conditions might be helpful in providing fire managers with more time and more certainty.
- To maintain and further develop a robust prescribed fire program throughout the region, prescribed burning will need to take place under conditions that are not ideal in all respects. This is increasingly true under a pattern of an increasingly dry, warm, and windy climate.
- Building redundancy in our prescribed fire program will allow for burning under more marginal conditions than were previously deemed acceptable. The key question is: “Can we hold what we have for the current forecast period?” This period is a constantly moving window of several days that needs to be continually evaluated.

Prescribed Fire Review Process

- Though not ideal, the use of videoconferences does allow for some establishing of personal connections that lead to more open and honest conversations. It cannot replace the benefits of meeting in person (below), but for follow-up conversations it could be an effective alternative to the review team remaining in travel status for an extended period.
- There is no substitute for at least a brief site visit and face-to-face discussion between the review team and key players in the RX and escape. Detailed descriptions, photographs, maps, Google Earth, etc. all only dimly approximate what can be learned at the site, walking the ground, with the people who were there.
- The team worked hard to assert our commitment to learning rather than finding fault or placing blame. This focus has been the centerpiece of the last 10+ years of internal reviews of unintended outcomes within the US Forest Service, and commitment to that principle has permeated through the organization from the WO-level where it was adopted through the regions and to the field. Maintaining a

strict focus on the future and not relitigating the past builds trust that makes reviews like this one successful. The last thing that anyone on the team or at Region 5 wants is a review process that results in more barriers or creates fear or uncertainty around prescribed fire implementation.

Acknowledgements & Recognition

Several times throughout this review, the review team saw this prescribed fire escape as having created an unexpected opportunity to look at a successful, resilient and professional program. In interviews with all levels – whether Forest Supervisor, Fire Staff Officer, District FMO or operational firefighter – never was there a sense of passing responsibility. In fact the higher in the organization the interviewee was, the more adamantly they asserted their personal responsibility and support for their employees and the actions they took. In the few weeks between the fire itself and the interviews, the BDF fire organization had clearly been focused on learning and improving internally, and presented many of the lessons learned to the team as developed ideas they had worked out in conversation together. This level of resiliency points to a commitment to learning rather than to blame.

The team would like to sincerely thank everyone at the San Bernardino National Forest with whom we interacted for their honesty, openness, and genuine engagement with this process.

Team Members

Frank Aebly—District Ranger, Upper Lake & Covelo RDs, MNF—*Team Leader Trainee*

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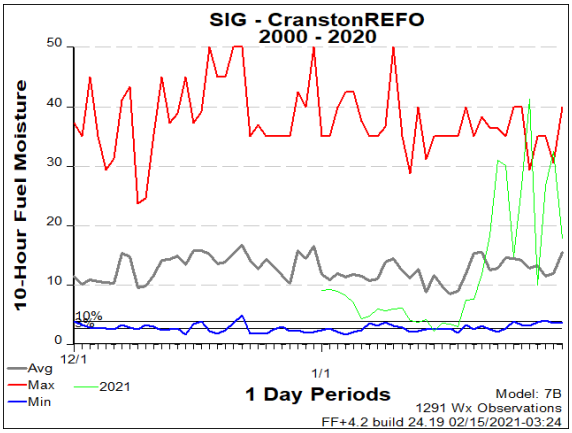
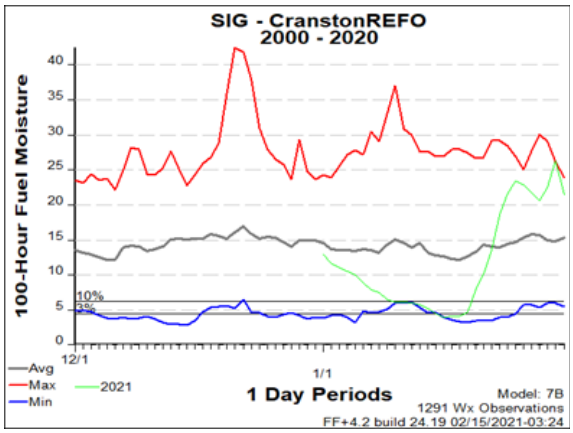
Robyn Woods—Regional Fuels Operations Specialist—Pacific Southwest Region—*Regional Liaison*

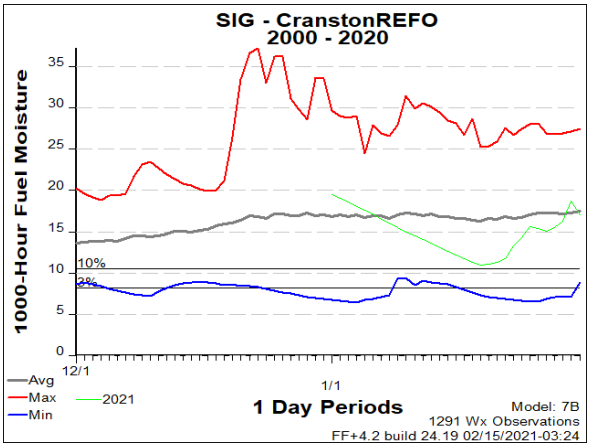
Appendix A. Fuels and Weather Figures



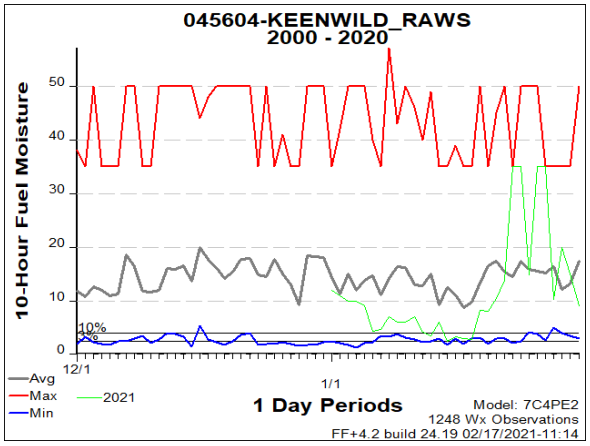
10-hr dead fuel moistures calculated from Cranston RAWS in the two-month period December-January 2020-21



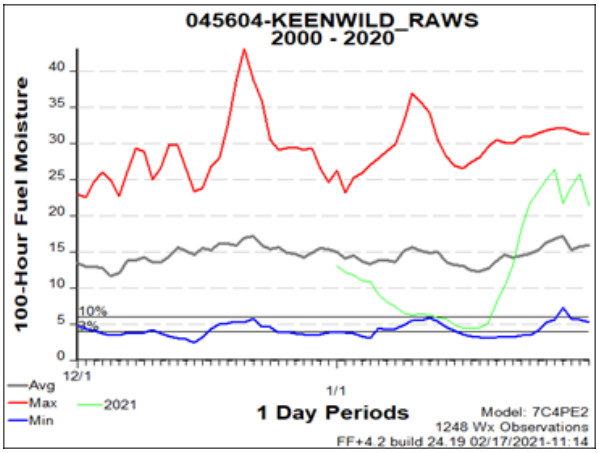
100-hr dead fuel moistures calculated from Cranston RAWS in the two-month period December-January 2020-21



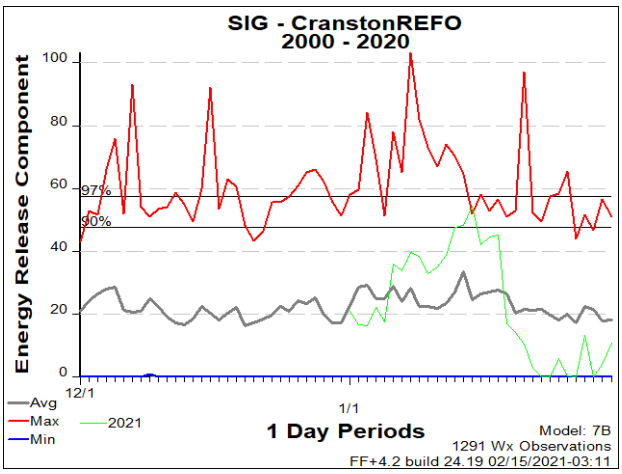
1000-hr dead fuel moistures calculated from Cranston RAWS in the two-month period December-January 2020-21



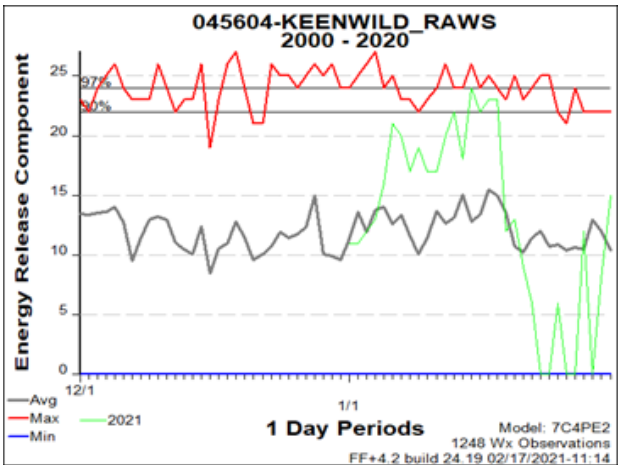
10-hr dead fuel moistures calculated from Keenwild RAWS in the two-month period December-January 2020-21



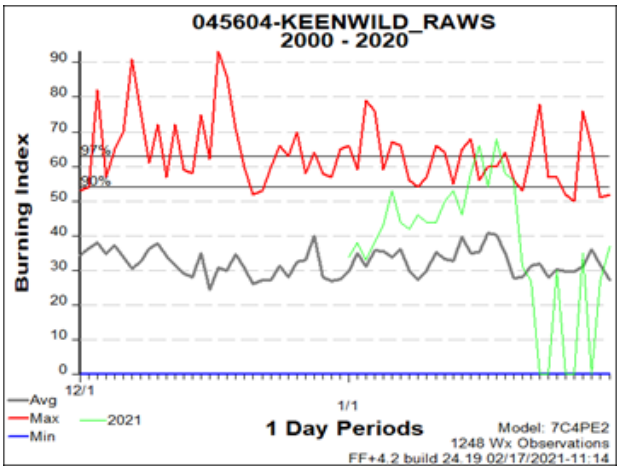
(Left) 100-hr dead fuel moistures calculated from Keenwild RAWS in the two-month period December-January 2020-21



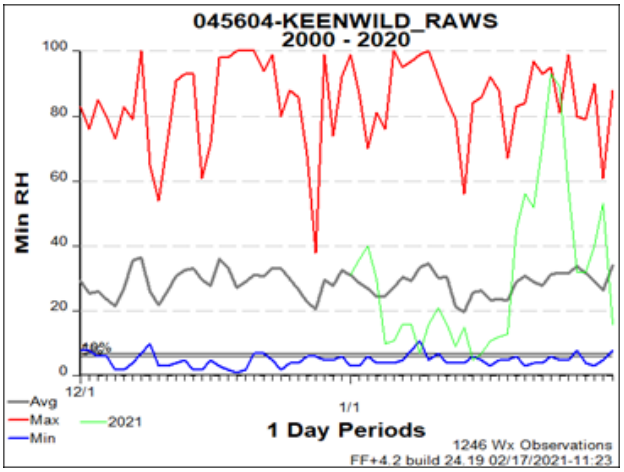
ERC calculated from Cranston RAWS in the two-month period December-January 2020-21



ERC calculated from Keenwild RAWS in the two-month period December-January 2020-21



BI calculated from Keenwild RAWS in the two-month period December-January 2020-21



RH measured at Keenwild RAWS in the two-month period December-January 2020-21

National Fuel Moisture Database

Banning (Actual Data)

Site Information | No RAWS | Close the Report

Banning - Chamise

	01-04	01-06	01-18	01-20	02-01	02-03	02-17	03-02	03-16	03-30	04-13	04-27	05-11	05-25	06-08	06-22	07-06	07-20	08-03	08-17	08-31	09-14	09-16	09-28	09-30	10-12	10-21	10-26	10-28	11-09	11-11	11-23	11-25	12-07	12-09	12-16	12-21
2021	66		66		74																																
2020		79		96		103	101	93	154	102	118	194	180	121	105	95	81	77	74	70	68	63		63		61		63		69		63		64			61
2019																							70		72		60		60		62		66		77	78	

National Fuel Moisture Database

Anza (Actual Data)

Site Information | No RAWS | Close the Report

Anza - Chamise

	01-04	01-06	01-18	01-20	02-01	02-03	02-17	03-02	03-16	03-30	04-13	04-27	05-11	05-25	06-08	06-22	07-06	07-20	08-03	08-31	09-14	09-16	09-28	09-30	10-12	10-21	10-26	10-28	11-09	11-11	11-23	11-25	12-07	12-09	12-16	12-21
2021	66		67		71																															
2020		73		77		79	73	72	73	80	80	201	201	149	133	112	96	96	97	78	75		62		65		64		70		68		70			68
2019																						91		81		67		67		65		76		84	84	

Live Chamise fuel moisture measured at Banning (top) and Anza (bottom) fuel sampling sites.

Appendix B. Cranston RX Pile Burn & Bonita Fire Chronology

All times below were taken from documents publicly available or made available to the review team by BDF FAM. Personnel numbers below are not exact but are what was identified in dispatch logs. Often, especially on burn days, significantly more firefighters were on hand to support operations but were not captured in dispatch logs. Color coding is arbitrary and meant only to differentiate dates.

Cranston Pile Burn

Time	Date	Comment	Personnel Onscene	Source	WX Obs
1013	1/6	Resources onscene & briefed - Ignitions begin	(2) T3 Engine, (1) UT, (1) Patrol, (1) Burn Boss	Dispatch Log, Notification RX Burn	AT: 52F, RH: 27%, FDFM: 9%, LFM: 65%, PIG: 30%, Wind: 3 NNW
1523	1/6	Ignitions complete, beginning mop-up	(2) T3 Engine, (1) UT, (1) Patrol, (1) Burn Boss	Dispatch Log, Notification RX Burn	AT: 56F, RH: 25%, Wind: 0-3 NNW
1637	1/6	30 acres complete, limited smoke, personnel will return tomorrow	Burn Boss	Dispatch Log	AT: 52F, RH: 27%, No Wind
0952	1/7	Units onscene, test burn	(2) T3 Engine, (1) UT, (1) Burn Boss	Dispatch Log, Notification RX Burn	AT: 52F, RH: 25%, FDFM: 9%, LFM: 65%, Wind: 3 NW
1535	1/7	Ignitions complete for the day	(2) T3 Engine, (1) UT, (1) Burn Boss	Dispatch Log, Notification RX Burn	AT: 53F, RH: 25%, Wind: 0-3 NNW
1700	1/7	10 acres complete, units released, piles lined, limited smoke, unstaffed for the night	(1) Burn Boss	Dispatch Log	
1231	1/8	No smoke, minimal heat, minimal threat. No ignitions.	(1) T3 Engine	Dispatch Log	

0930	1/9	No heat, no smoke. No ignitions.	(1) T3 Engine	Dispatch Log	
1305	1/10	No heat, no smoke. No ignitions.	(1) T3 Engine	Dispatch Log	
0953	1/12	Resources briefed, Starting Test Burn	(2) T3 Engine, (1) WT, (1) Patrol, (1) Burn Boss	Dispatch Log, Notification RX Burn	AT: 58F, RH: 30%, FDFM: 9%, LFM: 65%, No Wind
1650	1/12	Ignitions Complete, 9 acres complete	(2) T3 Engine, (1) WT, (1) Patrol, (1) Burn Boss	Dispatch Log, Notification RX Burn	
1707	1/12	No heat, light smoke, no burn tomorrow. Light smoke lingering in trees on eastern part of Unit 12A.	(1) Burn Boss	Dispatch Log	
1302	1/13	No heat, no smoke, mopped up	(1) T3 Engine, (1) Patrol	Dispatch Log	
Unk.	1/14	Mopped up	(1) T3 Engine	Interview	

Bonita Fire

~0115	1/15	Fire reported, Bonita Vista Rd		Inciweb	
0121	1/15	FICC Wildcad entry: Bonita Fire, 28893 Bonita Vista Rd	Wildland Fire Response from BDF & RRU	Wildweb, Keenwild RAWS	AT: 60F, RH: 13%, 10-hr FM: 5%, Wind: 9 mph (23 mph max)