Attachment 1A: Effect of Wildfires on Transmission Line Reliability

Collocation of Transmission Alternatives with the Southwest Powerlink

1. Reasons for Concern About Wildfires

The potential for wildfires to impact the operation of transmission facilities is a concern which must be considered when siting new transmission lines. This is particularly true for transmission lines passing through the southern portion of San Diego County due to the history of wildfires in this area. SDG&E's existing 500 kV line, the Southwest Powerlink (SWPL), has experienced a number of outages as a result of wildfires along this transmission corridor. A second 500 kV line, collocated for the entire distance between the Imperial Valley and Miguel substations, would be expected to experience a similar outage frequency. The simultaneous loss of both transmission lines could pose a significant reliability concern for SDG&E.

This study defines the varying risk of wildfire along the SWPL in order to illustrate where the fire risk exists and how it changes along the 85-mile SWPL route between the Imperial Valley Substation (Milepost 0) and the Miguel Substation (Milepost 85). In particular, this study evaluates the two segments of the SWPL that would be used in alternatives being considered for the Sunrise Powerlink EIR/EIS:

- MP 0 to 36 (Interstate 8 Alternative; BCD Alternative; Modified Route D Alternative)
- MP 0 to 52 (Route D Alternative; West of Forest Alternative)

How do Fires Cause Transmission Outages?

Transmission lines located in areas with high fire risk and high occurrence of lightning strikes creates a reliability risk. Dense smoke from wildfires can "trip"[1] a circuit, causing it to go out of service, or outages can result from emergency line de-rating or shut-downs during a nearby fire in order to prevent thermal damage to the line, to prevent a smoke-caused trip, or to meet the safety needs of firefighters.

When a wildfire occurs very near a transmission line right-of-way (ROW), wood poles can burn. Lines carried by steel towers are also vulnerable to heat from wildfire. The conductors on both wood- and steel-carried transmission lines are susceptible to physical damage from the heat of a wildfire, and conductor damage is not repairable (conductors must be replaced). A fire can force the outage of a transmission circuit if it raises the ambient temperature of the air around the conductors above the line's operating parameters. Heavy smoke from a nearby wildfire can contaminate a transmission line's insulating medium, which is the air surrounding the conductor.[2] Smoke can cause an outage as a result of a phase-to-phase, or phase-to-ground fault because the ionized air in the smoke can become a conductor of electricity resulting in arcing between lines on a circuit or between a line and the ground.

[1] A "trip" of a transmission line occurs when the system's protective equipment shuts down power flow over a given segment of the line in an effort to mitigate potential damage to the interconnected equipment.

[2] Turley, Ron. "Southwestern Colorado teamwork earns fire plan award" Closed Circuit, March 25, 2005. Western Area Power Administration, an agency of the US Department of Energy. Accessed 2/05/07. http://www.wapa.gov/

In an effort to protect the transmission facilities from this type of power surge the system's protective equipment can shut the line down, resulting in an unplanned outage.

2. Wildland Fires and Risk Reduction Measures

The vast majority of wildfires in California (98 percent) are caused by human sources. Examples of human-caused ignition sources are campfires, hot ash from cigarettes, sparks from chainsaws and other equipment, short-circuits from faulty equipment on power lines, infrequent collisions of aircraft, and arson. The three components of fire risk are ignition points, fuel buildup, and weather conditions. Although weather conditions cannot be controlled, risk reduction measures can be taken to reduce the number of ignition points, and fuel buildup near transmission lines can be controlled to reduce the risk of an ignition source resulting in fire. Non-human ignition sources include lightning and interference by large birds and other wildlife. Fuel sources include living and dead vegetation beneath and adjacent to transmission line ROWs.

2.1 Fires Caused by Transmission and Distribution Lines

Fires can start at transmission lines or substations for a variety of reasons. These fires are much more likely to start along small transmission and distribution lines due to the shorter distance from conductors to the ground, and because the conductor phases are closer together.

1. Large birds and raptors can develop a preference for a particular pole or tower as a roosting place. Two problems arise from this situation. First, their droppings can build up on insulators to the point that a flash-over between conductors and the crossarm can occur. This situation can cause a line fault and glowing debris to fall to the ground. Second, during take-off or landing, large birds' wings can touch two conductors simultaneously and create a short circuit. This situation can cause the bird to fall to the ground, sometimes in flames, and ignite dry vegetation below the conductors. Mitigation for these events includes clearing of vegetation around poles used as perch sites. Many situations may be remedied with the installation of raptor perches, providing a secure perch on poles or towers away from sensitive equipment.[3]

2. Small animals resting on transformers in substations or on power poles can also start fires by causing short-circuits when their bodies come into contact with both transformer bushings. Mitigation for this event would include use of a plastic wildlife protection boot over one bushing of the transformer to prevent birds and other animals from causing direct short-circuits between transformer bushings.[2]

3. Other conditions that may lead to potential fire problems are damaged hardware, damaged insulators, weather- or bird-damaged poles, and broken strands on conductors. Porcelain insulators will allow a flash over if they lose too much of the skirt to breakage. Broken crossarms, damaged poles or bent brackets and braces can allow conductors to touch the ground or come into contact with each other.[2] Implementation of routine line inspection procedures is necessary to mitigate the effects of faulty equipment. Utilities and fire protection agencies are both responsible for inspection of power lines.

---

[3] California State Fire Marshal. Power Line Fire Prevention Field Guide. Department of Forestry and Fire Protection. March 27, 2001.

2.2 Fire Risk Reduction Practices and Measures

2.2.1 Practices and Systems to Reduce Risk

SDG&E's Electric Standard Practice defines procedures and routine practices for personnel working on or near power lines to minimize wildfire ignition by personnel and equipment. These include centralized dissemination of fire risk information, discussion of fire safety procedures at tailboard meetings, guidelines on smoking, the appointment of a Fire Patrol guard under high fire risk conditions, and requirements for a project specific fire plan, fire mitigation and control tools, and water supply to be carried on all SDG&E vehicles. SDG&E has on staff a permanent Fire Coordinator. The Fire Coordinator is the liaison to fire services, the key contact for questions about fire plans, and the coordinator of fire safety training.

The **Red Flag Warning System** is a joint effort between state, federal, and local fire agencies intended to pass along critical fire weather information to users and occupants of wildland areas to bring about more prudent actions in their wildland-related activities. When a Red Flag Warning is issued, SDG&E takes action in the following ways: notifications take place; tripped lines are not tested manually or remotely until the line has been patrolled or the cause of the interruption has been identified and repaired; a Fire Patrol guard is assigned to any operation that has the potential to cause a fire; no open burning is permitted; all fires are extinguished; all tree pruning and removal activities cease; all blasting is discontinued; all grinding and welding discontinues; vehicular travel is restricted to cleared roads except in case of an emergency; smoking is not permitted.

The **US Forest Service** implements the **Project Activity Levels (PAL)** system to reduce the risk of fire on National Forest land. The PAL system restricts work activities during peak fire risk hours depending on a forest's PAL level, or level of fire risk. SDG&E follows PAL guidelines and performs daily checks of PAL levels for all work areas by calling the PAL hotline services.

2.2.2 Measures to Reduce Risk of Outage

Following are measures that could reduce the risk of transmission line outage. More detail on these types of measures is presented in EIR/EIS Section D.15 (Fire Management).

Utility Fuel Modifications

- Expand fuel clearance (+50%) in tower footprint where fire risk ranking is High or Very High
- Reduce fuel maintenance intervals within the expanded fuel clearance tower footprint (mechanical, hand, and herbicide treatments)
- Reduce fuel maintenance intervals within the established "Wire Zones" between towers where fire risk ranking is High or Very High (mechanical, hand, and herbicide treatments)
- Identify and prioritize fire risk "Fuel Reduction Border Zones" for reoccurring fuel modification treatments. For example one such "Border Zone" should be established where appropriate (veg, slope, fire ranking, etc.) between the existing SWPL and the proposed new 500 kV line.
- Design fuel modification prescriptions to reduce crown density and mimic early successional stages of site specific vegetation type.
- Reduce fuel loads below 10 tons/acre within "Border Zone"

- Alter fuel structure by removing ladder fuels and reducing canopy to less than 20% closure.
- Establish "fuel management mosaics" within the "Border Zone" for initial implementation and reoccurring maintenance
- Alter species composition as needed to achieve prescription

Utility Fire Prevention and Suppression

In addition to the above, the utility could mitigate fire risk by implementing the following measures:

- Initiate or increase powerline fire patrol frequency during 25th percentile or greater fire weather periods
- Improve and maintain strategic emergency ingress/egress roads capable of safely transporting fire equipment and personnel
- Collaborate with local fire and community organizations on fire prevention education and outreach programs
- Continue to fund utility/local fire suppression departments and organizations.

2.3 Fuel Clearance Requirements

The California Public Resources Code (PRC) and SDG&E's **Electric Standard Practice Policy and Guide for Encroachment** set forth requirements, guidelines, and best practices for mitigation of ignition and fuel sources in transmission line ROWs.

PRC Section 4292 requires clearance of flammable fuels for a 10-foot horizontal radius from the outer circumference of power line poles and towers. Section 4293 requires clearance of all vegetation for a specific radial distance from conductors, based on the voltage carried by the conductors: four feet for 2,400-71,999 V, six feet for 72,000-109,999 V, and 10 feet for 110,000 V. In addition this section requires the removal or trimming of trees, or portions of trees, that are dead, decadent, rotten, decayed or diseased and which may fall into or onto the line and trees leaning toward the line. SDG&E's policy for minimum clearance from ground to any transmission conductor of 500 kV is at least 40 feet when the conductor is at maximum designed sag.

The **SDG&E Vegetation Management Program** through the Construction Services Department has an extensive tree pruning and removal program to provide adequate line clearance. It also treats all non-exempt power poles in the specified area to maintain the 10-foot clearance required by PRC 4292. Personnel from Land Services, Facilities, and Fire Coordination work together to meet defensible space requirements, as well as other fuel hazard reduction where applicable.

SDG&E and the **California Department of Forestry** have agreed to follow a Memorandum of Understanding, which aims to optimize communication and cooperation between the two parties in order to minimize fire risk and to mutually benefit the parties in funding fire mitigation efforts.

While it is generally possible to control fuel buildup by removing vegetation in utility line ROWs, vegetation clearing to control fuel sources may encounter legal opposition or require lengthy environmental compliance measures when the taking of a listed endangered species or the modification of critical habitat is undertaken.

3. Defining Fire Risk Along SWPL

Fire risk is defined by three main components: fuel, weather, and ignition sources. Each of these components is described below, with specific reference to the segments of the SWPL that would require collocation in the alternatives being considered.

3.1 Fuel

The growth and accumulation of vegetation within and alongside transmission lines provides the fuel component of the three elements necessary to create and spread a wildfire incident. Availability of plant-based fuels affect a site's potential for wildfire to result from an ignition source. Although SDG&E manages vegetation to reduce fuel loads within the wire zone, wildfire fuels have grown and accumulated adjacent to the SWPL. A buildup of fuel load increases the potential for wildfires to occur, generating heat and smoke, which can subsequently trigger a transmission line outage. For the purposes of illustrating the presence or absence of this critical wildfire element, fuel data have been obtained from GIS sources and quantified into a volumetric measure of fuel, in tons of vegetative fuel per acre. These spatial data are derived from aerial photographs from 2005 and 2006,[4] and fuel volumes were extrapolated from observed vegetation cover. The quantitative fuel volumes have not been field verified. Fuel volume categories were ranked by increasing fire risk and assigned a risk rank value between 1 and 5.[5]

Table 1. Fuel Available along the SWPL

Fuel (Tons/Acre)		SWPL Mileposts	Assigned Risk Rank
< 6	0-9	0-24	1
6-9	9 to 12	25-29	2
9-15	12 to 15	30-36, 64, 84-85	3
15-20	15 to 20	37-53, 73-74, 76, 78-79, 82-83	4
> 20	>20	54-63, 65-72, 75, 77, 80-81	5

Source: Forester's Co-op (see Appendix 3A and 3B for methods)

Figure 1 is a graphic depiction of fuel availability along the SWPL using the five categories defined in Table 1. (The two red arrows indicate where the SWPL alternatives would diverge from the existing transmission line.) These data illustrate the following regarding the two SWPL segments under consideration for alternatives.

[4] California Department of Forestry, Glenn Barley, CDF Inspector, December 2006, Fuel, Weather, and Fire Data for Southern California; Fire and Resource Assessment Program, FRAP, January 2007, Provided Spatial Analysis on Fire History, Fuel Ranking, Fire Threats to People and Assets, http://frap.cdf.ca.gov/data/frapgisdata/select.asp; California Wildlife Habitat Relationships, CWHR, January 2007, Provided GIS Vegetation Data for Sand Diego and Imperial Counties, http://www.dfg.ca.gov/bdb/html/cwhr.html.

[5] It should be noted that risk rank values were assigned to demonstrate the *relative* levels of fire risk between individual one-mile segments along the SWPL. These values should **not** be interpreted as multiplicative values, where a Milepost with value 5 has 5 times greater fire risk than a Milepost with value 1. It is not possible to assess numerical fire risk probabilities due to the complexity of interacting factors that cause fire, however, a comparison of relative fire risk of segments of the SWPL is the next best option.

MP 0 to 36 (Interstate 8 Alternative; BCD Alternative; Modified Route D Alternative)

Much of this segment has very low levels of available fuel that could contribute to a fire. The first 29 miles of the SWPL corridor have the lowest fuel ranking, and Mileposts (MP) 30 through 32 fall into the second lowest ranking category.

MP 0 to 52 (Route D Alternative; West of Forest Alternative)

Between MP 37 and 53, available fuel becomes more dense, with much of the segment having 15 to 20 tons of fuel per acre.

3.2 Weather

Extreme weather conditions, or conditions favorable to the ignition and spread of wildfire, are driven by three factors: wind speed, relative humidity, and fuel moisture. When wind speed is high, relative humidity is low, and fuel moisture content is low, weather conditions are considered to be extreme. Low humidity and fuel moisture content increase the flammability of fuel sources. High wind speeds can affect both the intensity and extent of a wildfire by—on the one hand, providing oxygen to, and on the other hand acting to spread—a fire. The extreme weather percentile rankings are based on the number of days during the fire season that a site experiences extreme weather conditions. For example, a site is in the 95th percentile if it experiences extreme weather conditions 95 percent of the time during the fire season.

Table 2 presents extreme weather data,[6] and relative fire risk is ranked[7] by increasing extreme weather percentile. Relative risk of wildfire as a factor of extreme weather conditions along the SWPL is illustrated in Figure 2.

Table 2. Extreme Weather along the SWPL

Extreme Weather (percentile)[8]	SWPL Mileposts	Assigned Risk Rank
75th	0-28	2
75th to 85th[9]	29-43, 82-85	3
85th	44-55, 66-76	4
95th	56-65, 77-81	5

Source: Forester's Co-op (see Appendix 3A and 3B for methods)

These data illustrate the following regarding the two SWPL segments under consideration for alternatives.

MP 0 to 36 (Interstate 8 Alternative; BCD Alternative; Modified Route D Alternative)

The first 28 miles of the SWPL are in a zone where extreme weather risk is lowest among the corridor. As a result, this component of fire risk is the most favorable for a transmission line. The easternmost 4 miles of the next weather segment include the second lowest risk zone.

MP 0 to 52 (Route D Alternative; West of Forest Alternative)

The two western alternatives would diverge from the SWPL at MP 52, in the second highest weather risk zone.

---

6 Plumas National Forest, Jason Moghaddas Fire Ecologist, January 2007, Provided Fire Weather, FARSITE, FLAMMAP Data ; National Oceanic & Atmospheric Administrator, NOAA, January 2007, Provided Specific Weather Patterns and Trends, http://www.nws.noaa.gov/; National Weather Service, NWS, January 2007, Provided Fire Weather Data, Precipitation and Wind, Figures, http://www.weather.gov/geodata/; National Climatic Data Center, January 2007, Provided San Diego and Imperial Counties Weather Data, http://lwf.ncdc.noaa.gov/oa/ncdc.html.

7 The risk ranking scale begins at value 2 and omits value 1 in order to weigh more heavily the influence of extreme weather conditions on cumulative fire risk.

8 Extreme weather is presented in terms of percentiles, rather than as number of days per fire season that an area experiences extreme weather, due to grain size limitations of spatial weather data.

9 This is given as a range of percentile values because the raw data from which this datum was generated are based on a range of values.

3.3 Ignition Sources

However favorable site conditions may be, a point of ignition is required to initiate a wildfire event. The vast majority (98 percent) of wildfires in California are attributable to human-caused points of ignition. Examples of human-caused ignition points include campfires, cigarettes, lawn mowers, power lines, arson, and others. Not all ignition sources are reported, and not all ignition points result in fire. However it is useful to model fire risk as a result of ignition sources in order to detect any underlying pattern since ignition is the fundamental source of wildfires.

Table 3 presents the number of reported ignition points that occurred within each mile of the SWPL route over a 25 year history.[10] These data represent the actual number of known fires of any size and duration that started in this area in the past 25 years regardless of whether they triggered a transmission line outage. A risk value of between zero and five is assigned to each category according to increasing number of reported ignition points.[11] Figure 3 presents a graphic illustration of the number of ignition points along the SWPL.

Table 3. Ignition Point History along the SWPL

Number of Reported Ignition Points (25-year history)	SWPL Mileposts	Assigned Risk Rank
0	0-23, 26-27, 29, 31, 34-38, 42, 46, 51, 66, 75, 81-85	0
1	24-25, 28, 30, 32, 39, 45, 52, 57, 73-74, 76, 78-79	1
2	44, 47-49, 55-56, 58-59, 62, 64, 77	2
3	33, 41, 43, 53-54, 60-61, 80	3
4	50, 63	4
6+	40, 65, 67-70, 72	5

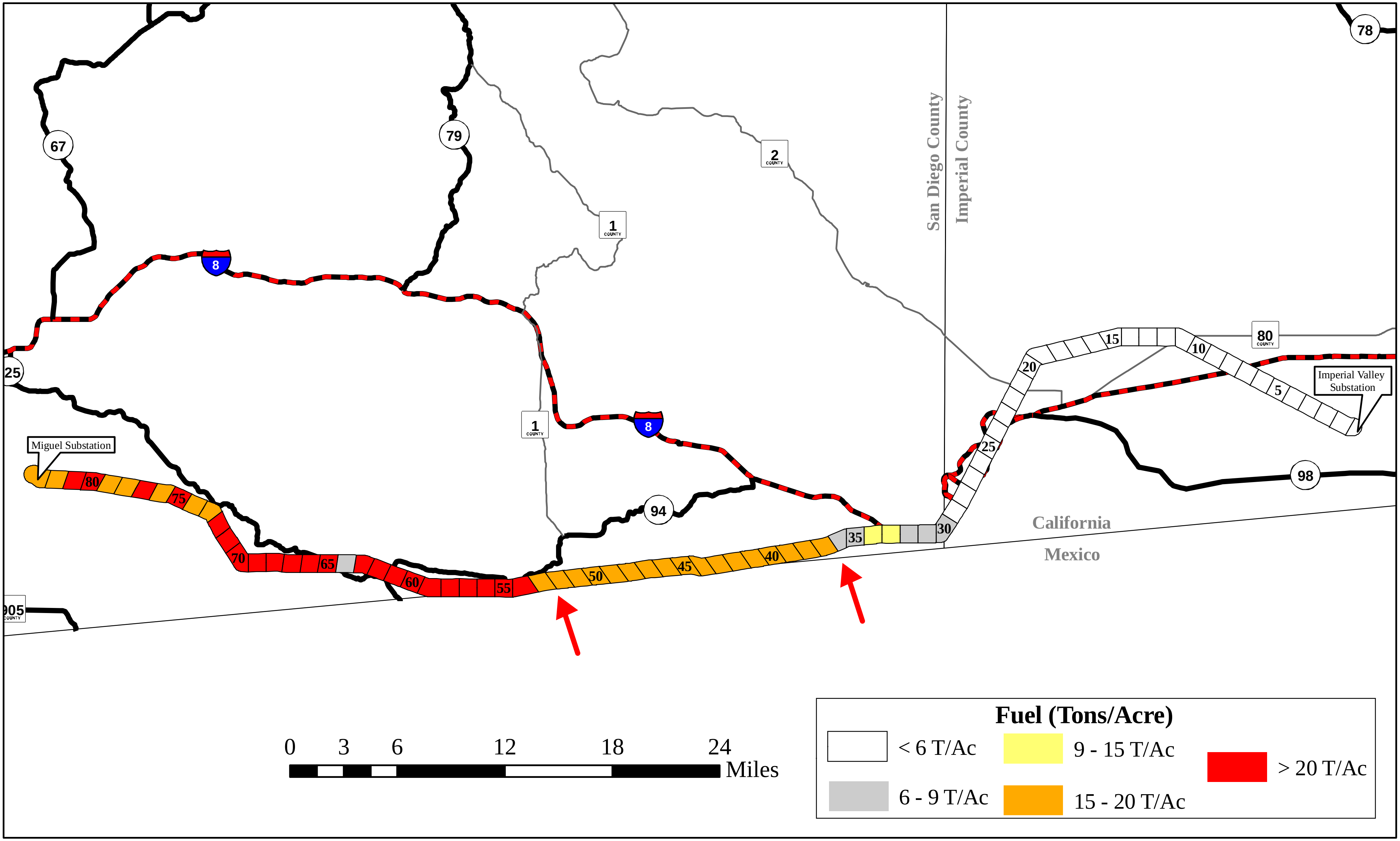
Source: SDG&E Data Response ALT-69a and ALT-69b.

A great majority of these reported ignition points are human caused and therefore random in nature and unpredictable. It is therefore difficult to assign a quantitative risk to an aggregation of random events such as gunshots, insulator flashovers, automobile accidents, and others. It is reasonable to expect, however, that a 25-year history of individual fires that are the result of these random events is predictive of future fire occurrences. A risk rank has been assigned to these ignition point values to represent the locations of reported historical ignition points along the SWPL in an effort to model where future wildfire-causing ignition points may occur.

---

10 El Dorado National Forest, Jeff Barnhart, Fuels Officer, January 2007.

11 A base value of zero (rather than a base value of 1) is assigned to mileposts that experienced zero reported ignition points because a future level of risk cannot be predicted to be greater than zero based on a history of zero reported ignition points.



Aspen Environmental Group

Forester's Co-Op
Professional Forestry & GIS Services
(530) 273-8326
www.forco-op.com

Sunrise SWPL Alternative Evaluation of Fuel Index Data Model

SWPL Assessment Corridor
1 Mile Segments

Low Fire Risk Data Model

Moderate Fire Risk Data Model

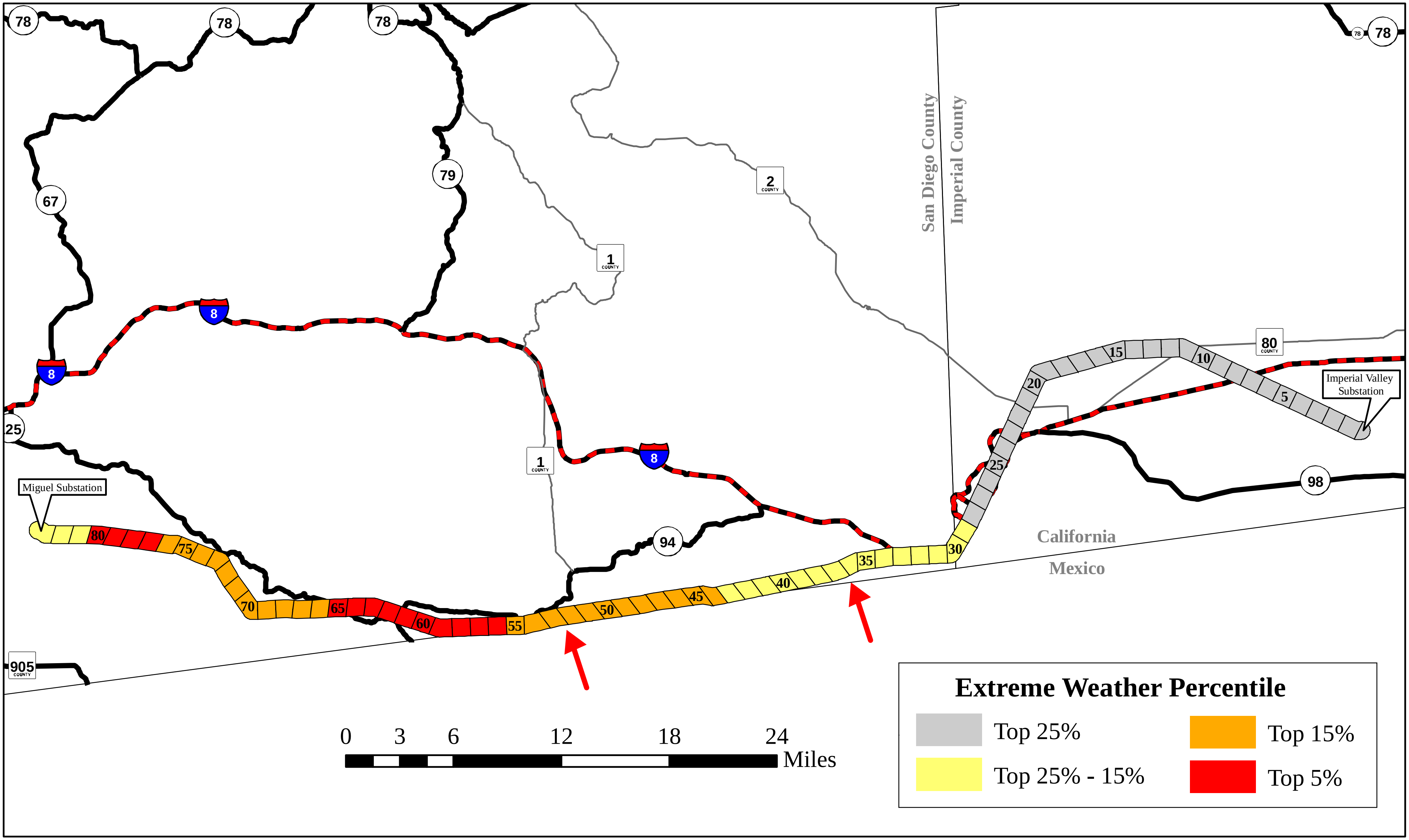
High Fire Risk Data Model

Very High Fire Risk Data Model

N

Sunrise Powerlink Project

Figure 1. Fuel Risk Assessment Model Along the SWPL



Aspen Environmental Group

Forester's Co-Op
Professional Forestry & GIS Services
(530) 273-8326
www.forco-op.com

Sunrise SWPL Alternative Evaluation of Weather Fire Index Data Model

SWPL Assessment Corridor — 1 Mile Segments

Low Fire Risk Data Model

Moderate Fire Risk Data Model

High Fire Risk Data Model

Very High Fire Risk Data Model

N

Sunrise Powerlink Project

Figure 2. Weather Fire Index Model Along the SWPL

These data illustrate the following regarding the two SWPL segments under consideration for alternatives.

MP 0 to 36 (Interstate 8 Alternative; BCD Alternative; Modified Route D Alternative)

No ignition points were reported along the first 24 miles of the SWPL, and eight ignition points were reported between MP 24 and 36. This segment is a low fire-risk zone based on ignition history.

MP 0 to 52 (Route D Alternative; West of Forest Alternative)

Thirty-five ignition points were reported east of MP 52, and the segment between MP 40 and 45 shows an especially high fire risk based on ignition history. The two western alternatives would pass through this high-risk area before diverging from the SWPL at MP 52.

4. Fire History

The history of wildfires in a region is useful in understanding the fire regime, or frequency of fire, in a given landscape. Chaparral biotic communities have evolved and flourished with regular wildfire occurrences. The SWPL corridor transects these fire-adapted communities, yet the transmission line is negatively impacted when fires occur. The fire regime over the past 25 years along the SWPL has been modeled in an effort to predict the risk of future fire events that may damage the line. Table 4 presents the "25-Year Fire History" – the number of fires greater than 300 acres in extent that occurred within each mile of the SWPL route. Milepost segments are ranked according to the number of fires that occurred in each segment over the last 25 years, and a risk value is assigned to each category. Not every fire resulted in a system power outage. Figure 4 illustrates the fire history along the SWPL.

Table 4. 25-Year Fire History along the SWPL

Number of Fires	SWPL Mileposts	Assigned Risk Rank
0	0 – 35, 83-85	1
1	36, 46, 50-51, 60-63, 74-76, 81-82	2
2	39, 52-53, 64, 67-73	3
3	40, 47-48, 54, 56, 58, 65-66, 77	4
4-6	49, 55, 57, 59, 78-80	5

Source: SDG&E Data Responses ALT-69a and ALT-69b

These data illustrate the following regarding the two SWPL segments under consideration for alternatives:

MP 0 to 36 (Interstate 8 Alternative; BCD Alternative; Modified Route D Alternative)

Only one fire was reported in this first segment of the line, presenting a low fire risk based on historical fire occurrence.

MP 0 to 52 (Route D Alternative; West of Forest Alternative)

These two alternatives pass through a high fire risk zone before they reach their point of divergence with the SWPL, MP 52. At least 19 fires occurred along this segment over the past 25 years.

5. SDG&E's Outage History Along the SWPL

Between 1986 and 2005, a 20-year span, there were 33 reported power outages resulting from 16 distinct wildfire or lightning events along the SWPL transmission line. The data in Table 5 lists the fire related outages, sorted by milepost, and each colored band represents a unique fire event. This table illustrates that the vast majority of fire related outages (over 85 percent) occurred west of Milepost 52.

The data in Table 5 illustrate the following regarding the two SWPL segments under consideration for alternatives. Outage data show the following:

- Six fires occurred west of MP 60 caused outages for a total duration of 40 hours 54 minutes
- Three fires between MP 31 and MP 52 caused outages for a total duration of 12 hours 35 minutes

MP 0 to 36 (Interstate 8 Alternative; BCD Alternative; Modified Route D Alternative)

In the segment east of MP 37, one fire event resulted in two SWPL outages on the same day.

MP 0 to 52 (Route D Alternative; West of Forest Alternative)

In the segment east of MP 52, three fire events resulted in four SWPL outages.

Table 5. SDG&E's Unplanned Outage History[12] Along the SWPL

Date	Duration	Hours	Minutes	Reason	Location (mileposts)	Description
9/13/04	0:39	0	39	Fire	31-37	Forced outage due to fire
9/13/04	5:30	5	30	Fire	31-37	Forced outage due to fire
10/5/02	0:31	0	31	Fire	38-44	Forced outage due to fire
7/29/95	5:55	5	55	Fire	51-54	Forced outage due to fire
	Total	12	35		Between MP 31 and 52	
4/13/02	1:38	1	38	Fire	52-58	Forced outage due to fire
10/1/03	0:12	0	12	Fire	56	Forced outage due to smoke contamination or contact
8/1/86	0:04	0	4	Fire	57-59	Forced outage due to fire
8/1/86	0:12	0	12	Fire	57-59	Forced outage due to fire
8/1/86	2:50	2	50	Fire	57-59	Forced outage due to fire
7/25/87	3:52	3	52	Fire	59	Forced outage due to fire
	Total	8	48		Between MP 52 and 60	
8/30/95	0:09	0	9	Fire	60-65	Forced outage due to fire
8/30/95	0:17	0	17	Fire	60-65	Forced outage due to fire
8/30/95	0:20	0	20	Fire	60-65	Forced outage due to fire

[12] Unplanned outages can occur due to lightning strikes in addition to wildfires. Lightning strikes were omitted from this table because they do not present a line collocation risk as do fires.

Date	Duration	Hours	Minutes	Reason	Location (mileposts)	Description
8/31/95	3:06	3	6	Fire	60-65	Forced outage due to smoke contamination or contact
8/31/95	1:06	1	6	Fire	60-65	Forced outage due to smoke contamination or contact
7/23/96	0:52	0	52	Safety	68-69	Precautionary measure due to nearby fire
7/17/98	0:56	0	56	Safety	68-69	Precautionary measure due to nearby fire
11/4/98	2:49	2	49	Fire	68-69	Forced outage due to fire
10/3/99	11:25	11	25	Fire	70-75	Forced outage due to smoke contamination or contact
10/4/99	0:24	0	24	Fire	70-75	Forced outage due to fire
10/8/99	1:26	1	26	Fire	70-75	Forced outage due to fire
10/8/99	3:35	3	35	Fire	70-75	Forced outage due to fire
10/8/99	4:58	4	58	Fire	70-75	Forced outage due to fire
10/26/03	0:57	0	57	Fire	70-75	Forced outage due to fire
10/26/03	2:17	2	17	Fire	70-75	Forced outage due to fire
10/26/03	0:05	0	5	Fire	70-75	Forced outage due to fire
10/26/03	0:03	0	3	Fire	70-75	Forced outage due to fire
10/27/03	6:09	6	9	Fire	70-75	Forced outage due to fire
	Total	40	54		West of MP 60	

Source: SDG&E Data Responses ALT-69a and ALT-69b

6. Cumulative Fire Risk Model

Maps of each component of fire risk (Figures 1 through 4) are presented above, and a data-based model of relative fire risk along the SWPL route was developed by aggregating these factors. The combined fire risk model is presented in Figure 5. The ranges of shading for each mile of the SWPL result from adding the risk factors described above for each one-mile segment.

MP 0 to 36 (Interstate 8 Alternative; BCD Alternative; Modified Route D Alternative)

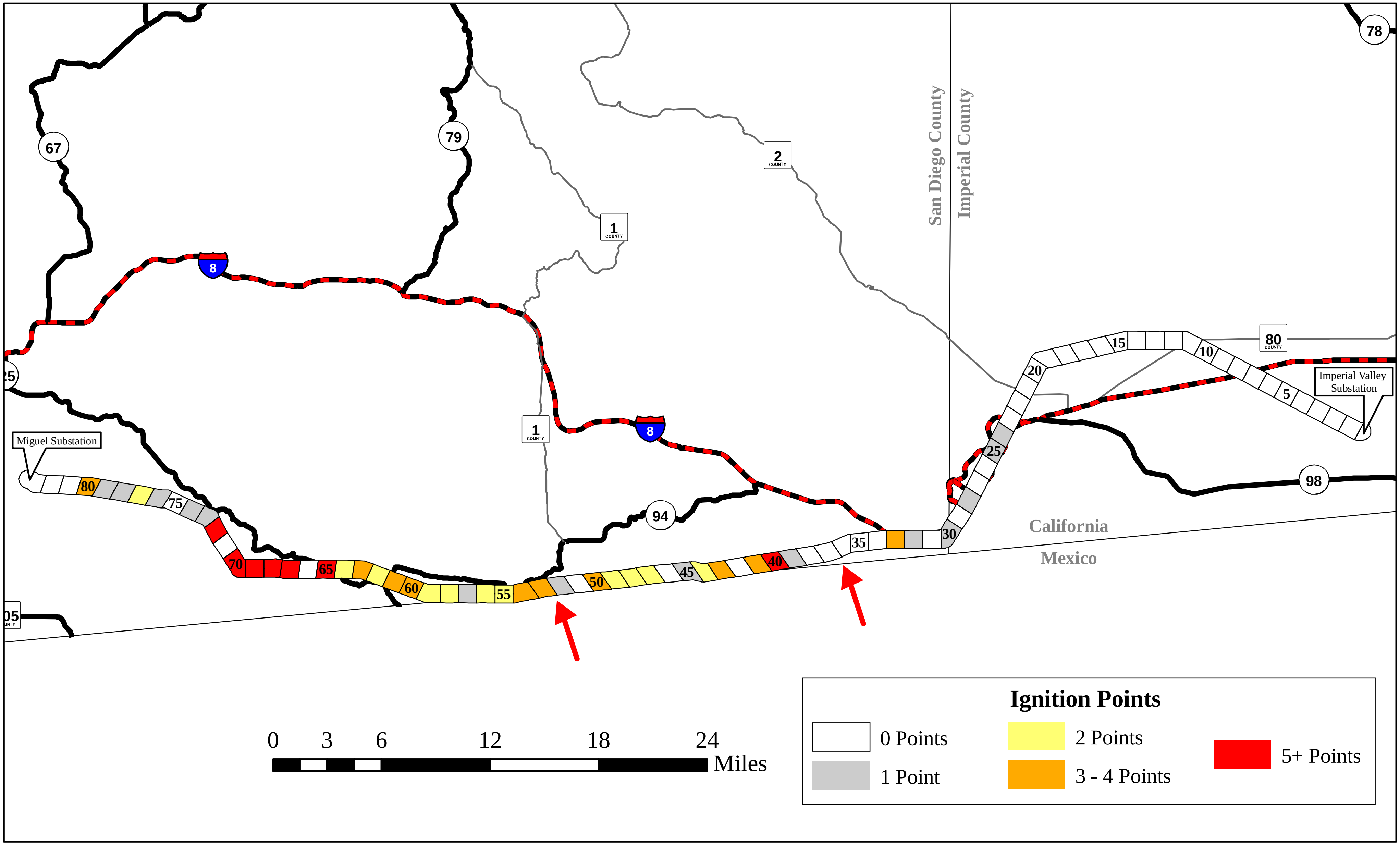
This portion of the SWPL presents a low cumulative fire risk.

MP 0 to 52 (Route D Alternative; West of Forest Alternative)

This portion of the SWPL presents a moderate to high cumulative fire risk.

As illustrated on Figure 5, fire risk increases from east to west along the SWPL, becoming consistently **moderate** at MP 39 and becoming **high** at MP 54. Red arrows indicate the two locations where SWPL alternatives would diverge from the transmission line.

This page intentionally blank.



Sunrise SWPL Alternative Evaluation of Ignition Point Index Data Model

Aspen Environmental Group

Forester's Co-Op
Professional Forestry & GIS Services
(530) 273-8326
www.forco-op.com

1 Mile Segments — SWPL Assessment Corridor

Low Fire Risk Data Model

Moderate Fire Risk Data Model

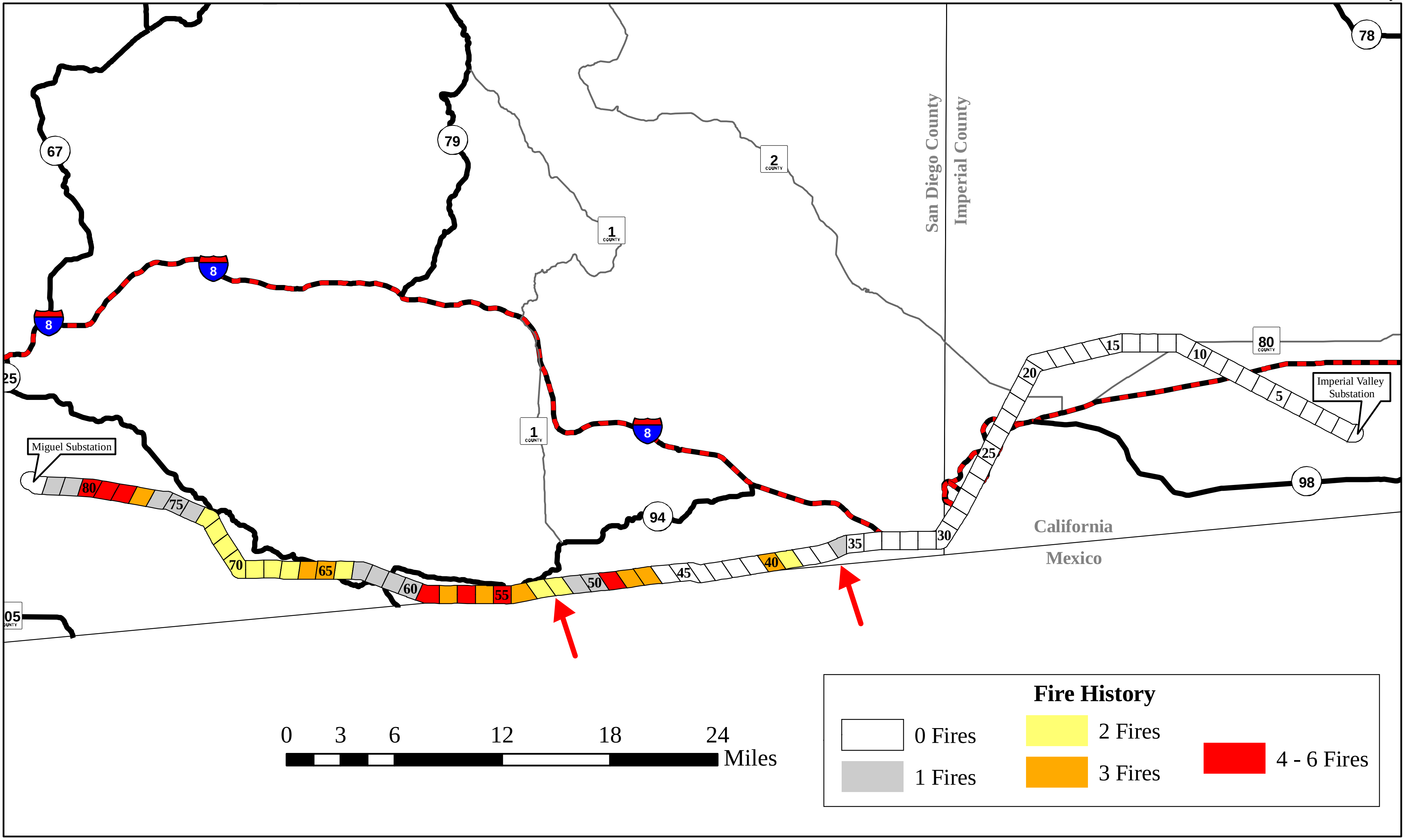
High Fire Risk Data Model

Very High Fire Risk Data Model

N

Sunrise Powerlink Project

Figure 3. Igniton Point History Model Along the SWPL



Aspen Environmental Group

Forester's Co-Op
Professional Forestry & GIS Services
(530) 273-8326
www.forco-op.com

Sunrise SWPL Alternative Evaluation of Fire History Model

SWPL Assessment Corridor (1 Mile Segments)

Low Fire Risk Data Model

Moderate Fire Risk Data Model

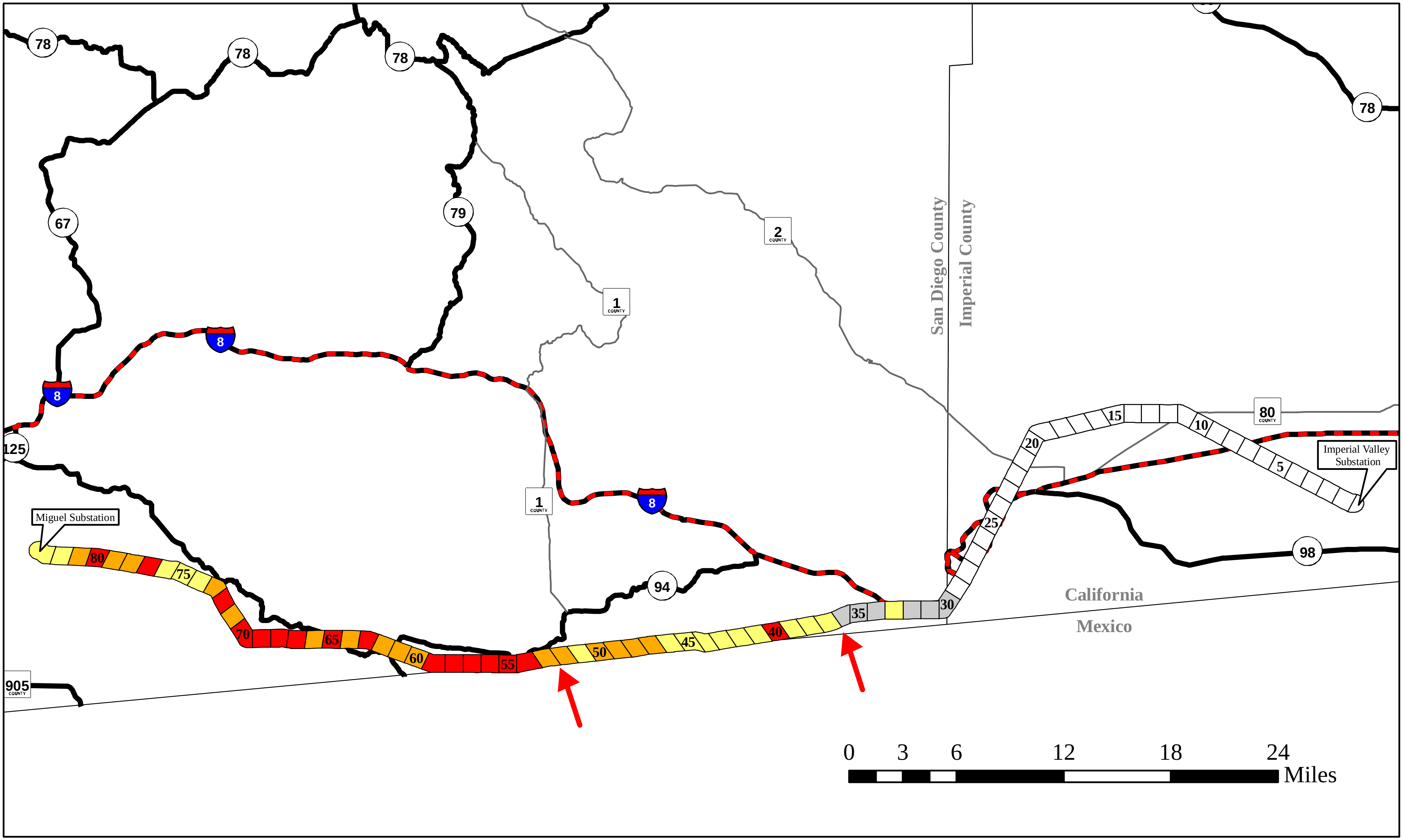
High Fire Risk Data Model

Very High Fire Risk Data Model

N

Sunrise Powerlink Project

Figure 4. Fire History Model Along the SWPL



Aspen Environmental Group

Forester's Co-Op
Professional Forestry & GIS Services
(530) 273-8326
www.forco-op.com

Sunrise SWPL Alternative Evaluation Combined Data Model of Fire Risk Assessment

SWPL Assessment Corridor (1 Mile Segments)	Low Fire Risk Data Model	High Fire Risk Data Model	N
	Moderate Fire Risk Data Model	Very High Fire Risk Data Model	

Sunrise Powerlink Project

Figure 5. Combined Data Model of Fire Risk Assessment Along the SWPL

This page intentionally blank.

7. Outages Due to Lightning

Another reliability concern raised by SDG&E is the risk of outages from lightning. Outages due to lightning strikes are a risk in any region that experience cloud to ground lightning strikes and areas with frequent lightning and open areas where the transmission towers are the tallest structures are particularly susceptible. As a result of the potential for extensive equipment damage that can be caused by lightning, transmission systems are designed with lightning protection (e.g., lightning arresters, shield wire, substation protection and control equipment). As a result, transmission outages due to lightning are generally of a reasonably short duration, minutes compared to multiple hours or days, as is reflected in Table 6 that shows the Lightning Outage History for the existing SWPL line.

Table 6. SDG&E's Lightning Outage History Along the SWPL.

Date	Duration	Days	Hours	Minutes	Reason	Location (mileposts)	Description
9/2/95	0:07	0	0	7	Lightning	Unknown	None provided
9/7/00	0:10	0	0	10	Lightning	Unknown	None provided
7/23/05	0:22	0	0	22	Lightning	Unknown	None provided
7/23/05	0:41	0	0	41	Lightning	Unknown	None provided
7/23/05	0:15	0	0	15	Lightning	Unknown	None provided

Source: SDG&E Data Response ALT-72a

Obviously, since multiple lightning strikes to ground may occur as a severe storm moves through and area, the risk that a second circuit could be struck by lightning before the first circuit is returned to service will be higher when there are multiple transmission lines in close proximity to each other. However, as shown in Table 6 above, on only one day in the entire history of the SWPL's operation has lightning been the cause of a multiple outage. This would imply that there is minimal risk of multiple lightning strikes from a single storm simultaneously causing an outage of multiple circuits.

8. Reliability Implications of Collocating a New 500 kV Line with the SWPL

Reliability Standards - Background

The NERC/WECC planning standards for the interconnected transmission system are intended to ensure system stability. Included in the planning standards are four categories of system conditions:

- **Category A** entails system conditions when all facilities are in service.
- **Category B** is applicable when a single element[13] of the interconnected system is out of service (also referred to as an N-1 condition).
- **Category C** exists when two or more elements are out of service.
- **Category D** is similar to Category C, except that the event causing the outage is expected to occur less often than once every 30 years.

Under Category A or B conditions the transmission system must be capable of maintaining service to all customers. In other words, the system should be able to operate, with the loss of any one element, without the need to curtail customer loads. Under Category C conditions only planned or controlled load

[13] An "element" refers to a generator, transmission circuit, transformer, or a single pole of a direct-current line.

dropping is permitted. Unlike Category A, B, or C, minimal conditions are placed upon a utility's response to a Category D condition. This is due to the low probability of a Category D event occurring.

All of the outages described in Categories A through D above would occur as the result of unexpected, rather than planned, events. The intent of these planning standards is to ensure that the transmission system can accommodate minor contingencies without the need to curtail service to customers or transactions between utilities. In addition to unexpected contingencies, the NERC/WECC standards also require entities to analyze their system performance under planned outages. Specifically, the standards state:

> *The transmission systems also shall be capable of accommodating planned bulk electric equipment outages and continuing to operate within thermal, voltage, and stability limits under the contingency conditions as defined in Category B of Table I.*[14]

The utility must ensure that its transmission system can continue to operate during the planned outage of a facility and a single contingency (N-1) occurs. In the PEA, SDG&E refers to the California ISO's requirement that they are able to serve load under a "G-1/N-1" condition,[15] which means that both a generator would be out of service (G-1) and a single transmission line would be out of service (N-1). This requires that when a generator is out of service for any reason, SDG&E's transmission system must be able to serve load even with the loss of any <u>other</u> single element of the system. The CAISO's requirement that a utility be able to serve load even under a "G-1/N-1" condition places a higher planning standard than required by NERC/WECC in that the generator outage need not be a planned event. Utilities typically plan generator outages to occur during non-peak periods. Participating transmission owners in the ISO must comply with the G-1/N-1 criteria under all load levels.

Reliability of a Second SWPL

Although the placement of multiple transmission circuits in a common corridor increases the risk of a multiple line outage, collocation is also often a necessary condition when siting new facilities. The public's desire to minimize the visual, as well as environmental, implications of transmission lines often necessitates their placement in common corridors. Additionally, the characteristics of the high voltage "bulk" transmission system, with frequently long transmission lines, at times necessitates crossings of lines in other corridors. An implication of collocating transmission facilities is that a single event could result in the outage of all facilities in a given corridor, just as a single event at the right place could feasibly disable two circuits routed in separate corridors. However, when considering the reliability implications of collocation, the principal determinant is the probability of a credible event resulting in the outage of multiple circuits.

The events which may result in an unscheduled outage of a transmission line can be grouped into two categories. The first category would include equipment failure as a result of age, manufacturing defects or prior system events which may have resulted in undetected damage. For example, the failure of a transformer at a substation may result in the outage of one or more transmission lines interconnected to that substation. The second category would include events external to the interconnected transmission system which can impact their operation. This second group could include natural events (such as fires, lightning, earthquakes, tornados, icing of lines and excessive wind) as well as human activities (such as

---

[14] Page 10, Western Electricity Coordinating Council "Reliability Criteria" dated April 2005.

[15] ISO Grid Planning Standard No. 3 – Combined Line and Generator Outage Standard.

planes, cars or vandalism). The risks of outages, as a result of events included in the first category, are independent of whether a line is collocated with another facility. In July of 2004 a fire at the Westwing substation, in Phoenix, Arizona, caused an outage of multiple transmission lines. Included in this outage were the collocated Palo Verde-Westwing 500 kV lines. The relevance of this example is that the transmission lines experienced a simultaneous outage as a result of their interconnection to a common substation, not because they shared a common corridor. It is the events included in the second category which pose an increased risk of outage due to the existence of multiple facilities in a common corridor.

Regionally, there are certain events with a higher risk of a multiple circuit outage. One of the risks for other areas of California, outages or damage due to icing of the lines, is less of a risk in San Diego County due to its southern location. The opposite, conditions resulting from heat, can be a more significant risk in this region. Transmission conductors sag between towers and the sag will increase with heat generated from a combination of current flow and ambient air temperature, a condition frequently experienced in hot summer months. Another reliability concern can result when tower structures are spaced too close together. It is possible for events such as high wind to cause the conductors of one circuit to touch those of the adjacent circuit on a separate tower. Likewise, it is possible when tower structures parallel each other too closely that the collapsing of a single tower (e.g. vandalism, major vehicle accident) can result in that tower falling into and disabling the other parallel tower line.

Human activity can also result in multiple circuit outages. Events such as an airplane flying into the corridor could also pose a risk of a multiple circuit outage as it could cut through the conductors of adjacent circuits or catch on a conductor carrying it across to the adjacent circuit. The placement of multiple circuits in close proximity could increase the potential for a vandal to simultaneously damage more than one circuit, but this could also be coordinated regardless of whether the circuits share a common corridor. Most of these events are “planned for” in the design of the transmission lines. Transmission circuits are designed to take into account the sag of the conductor under various transmission circuit loading and ambient temperature conditions. Spacing between circuits, which exceeds the height of the transmission towers, can limit the risk of one tower falling into another. In vehicle accident prone areas, blockades can be erected to protect tower structures. Locking tower bolts and selected insulator material, for example, can be used to reduce vandalism damage while maintenance procedures, such as tree trimming, can be strictly adhered to, and devices can be installed on transmission lines to make them more visible to aircraft in high risk areas (such as road and river crossings).

When placing multiple circuits in a common corridor proper planning can mitigate most of the credible contingencies which could cause a multiple line outage. When credible contingencies cannot be mitigated California ISO, WECC and NERC planning standards require an evaluation of the probability that the event will occur. (The implications of this probability analysis are discussed later in this section.) One common response to a credible contingency is the establishment of what is called a Special Protection System or Scheme (SPS).

An SPS establishes a specific response to a specific system contingency. Its intent is to maintain the stability and integrity of the interconnected transmission system when the specific system event occurs. Utilities typically rely on an SPS as an interim measure until upgrades/additions/modifications can be completed or when regulations or economics dictate that additional system upgrades would not be prudent. The establishment and use of an SPS is also an explicitly accepted procedure under the California ISO's Planning Standards.[16] Although the ISO's planning standards reference generator interconnections,[17] their application applies equally to transmission line outages. If the outage occurs on a transmission line used to import generation into a load pocket it is common for the SPS to include specified amounts of load dropping. Although undesirable, planned load dropping can minimize the implications of a transmission line outage. Under certain circumstances the use of an SPS, which includes load dropping, may be a more publicly acceptable response by a utility when compared to the implications of siting all transmission facilities in separate corridors.

When considering San Diego County, the risk of dual outages in a common corridor is likely highest due to earthquake (i.e., if the corridor transcends a fault zone), damage from high wind, fire and lightning. In many cases impact of the events can be mitigated through prudent engineering and spacing. Towers are typically designed to withstand the level of high winds historically experienced in a given region. Structures in fault zones can also be designed to withstand earthquakes of varying magnitude. Adequate spacing (in excess of the tower height) can minimize the potential for one circuit to affect the operation of an adjacent circuit.

SDG&E has expressed significant concerns regarding the potential collocation of a second transmission line with the existing Southwest Powerlink (SWPL). Of primary concern to SDG&E is the potential for a wildfire to cause an outage of all facilities in the SWPL corridor. Specifically, in Section 3.3.1.2 of the Sunrise PEA it states:

> *Normally, the probability of a double line outage would be quite small so the frequency with which load drop would be needed would likewise be small. However, the SWPL line transverses forest lands that are highly susceptible to wild fires. Based on recent history, the majority of outages on the SWPL line have been due to fires and these fires typically occur during the summer and autumn season.*

In other documents related to the Sunrise CPCN process, SDG&E has also expressed concerns related to the potential for a double line outage as a result of lightning.

With regards to collocation of the Sunrise project with a portion of the existing Southwest Powerlink, the question is; Under which contingency condition would an outage of both transmission circuits be classified?[18] As described in the previous sections, southern San Diego County is an area in which wildfires are the most likely cause of a transmission line outage. The frequency of fire would determine the relevant reliability criterion for a second SWPL, defined as follows:

- If a fire that resulted in an outage of the collocated circuits could be expected to occur with a frequency of <u>greater than once in every three years</u> then the outage would be classified as an "N-1" and fall within the **Category B** criteria. This would mean that the utility's transmission system must continue to operate without the need to drop any load.
- If the event were expected to occur at a frequency <u>between one in three to one in thirty years</u> then it would be classified as an "N-2" and fall within the **Category C** classification. Under Category C a

---

16 California ISO Planning Standards dated February 7, 2002.

17 Section III – ISO Grid Planning Guides for New Generator Special Protection Systems.

18 At the CPUC Technical Workshop held in San Diego on February 2, 2007, an ISO Lead Regional Transmission Engineer acknowledged that the outage of two transmission elements located in a common corridor would be deemed an "N-2." This means the outage of both lines would not be subject to the ISO's G-1/N-1 requirements.

utility is permitted to institute "planned/controlled"[19] load dropping in order to maintain the transmission system's integrity.

- If the event is expected to occur less than once in every thirty years then it would fall under **Category D** for which no planned response is required.

A review of Table 5 (SDG&E's Unplanned Outage History Along the SWPL) confirms that fires have been a common and frequent cause for an outage of the SWPL. The information contained in Table 5 indicates that there have been a total of 33 unplanned outages between August of 1986 and July of 2005, of which 28 were the result of a fire. If a second circuit were to parallel the SWPL for its entire length, and the historical frequency of fires were indicative of future occurrences, then an outage of both circuits could be expected to occur more often than once every three years. This would not only make the outage a "credible double contingency," but also place the event into a Category B condition. Thus, a second circuit, which paralleled the existing SWPL for its entire length, would not add to the import capacity of SDG&E under the CAISO's G-1/N-1 requirements.

Conclusions Regarding Reliability and Fire for a Second SWPL

The obvious conclusion of this assessment is that the reliability implications of collocating a second circuit along the existing SWPL are not constant along the entire route. Also, the EIR/EIS does not contemplate a 500 kV line paralleling the entire length of the SWPL. As clearly indicated in Tables 4 and 5 (25 Year Fire History along the SWPL and SDG&E's Unplanned Outage History Along the SWPL), the frequency of fires varies significantly along the SWPL corridor. Between MP 0 and 31 there have been no fires over the 25 year period analyzed. However, from MP 49 and west of that point, there have been multiple fires within many one-mile segments of the SWPL. A pictorial representation of the relative fire risk is presented in Figure 5 (Combined Data Model of Fire Risk Assessments). These data clearly indicate that the risk of an outage due to wildfires is minimal along the eastern portion of the SWPL corridor, but increases westward towards the Miguel Substation.

Conclusion 1: The Interstate 8, BCD, and Modified Route D Alternatives (paralleling SWPL only from MP 0 to MP 36) would create minimal reliability risk due to fire

There have been no fires between the Imperial Valley substation (MP 0) and MP 31 and only one fire between MP 31 and MP 38. The Interstate 8, BCD, and Modified Route D Alternatives would collocate with the existing SWPL from the Imperial Valley Substation to approximately MP 36. As previously discussed, there has been only one fire along this segment of the SWPL over the 25 year period analyzed. This fire occurred at about MP 36, in the area where these proposed alternatives would diverge from the existing corridor.

For the Interstate 8, BCD, and Modified Route D Alternatives the risk of a wildfire causing an outage on both the SWPL and the alternatives is minimal. Since only one fire has occurred between MP 0 and MP 36 over the last 25 years this contingency would, at worst, be deemed a Category C condition. Under both the WECC and CAISO criteria SDG&E would be permitted to implement planned/con-

[19] Footnote "d" from Table I of the NERC/WECC Reliability Criteria: Depending on system design and expected system impacts, the controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, and/or the curtailment of contracted firm (non-recallable reserved) electric power transfers may be necessary to maintain the overall security of the interconnected transmission systems.

trolled load dropping as an appropriate response to this event.[20] It could also be argued, by extrapolation of the 25 year historical data, that an outage of both the SWPL and Interstate 8, BCD, or Modified Route D Alternatives, caused by a wildfire, could be considered a Category D condition under which no contingency plans would be required.

Therefore, the Interstate 8, BCD, and Modified Route D Alternatives diverging from the SWPL at MP 36 would, at most, pose a minimal reliability risk.

Conclusion 2: The Route D and West of Forest Alternatives (south of Interstate 10) requiring collocation with SWPL for 52 miles would pose a reliability risk due to fire

The other SWPL Alternatives are the Route D and West of Forest Alternatives. These two alternatives would collocate with the SWPL through MP 52. It is clear from the fire risk assessment illustrated on Figure 5 that the risk implications of the additional 16 miles (MP 36 to 52) are significant. Within that segment, two sections (MP 40 and 47-50) have been assigned the second highest risk rank while a majority of the remaining sections pose a moderate fire risk.

For the Route D and West of Forest Alternatives the historical data and fire modeling would imply a reliability concern due to the past frequency of fires and the factors making fires more likely, especially between MPs 39 and 52.

[20] ISO Grid Planning Standard No. 4b – New Transmission versus Involuntary Load Interruption Standard.