WUI Example for EGDe$

1 WUI Case Study Overview

There is no "with Uncertainty" variant of the WUI Example. This is a highly simplified example only meant for illustrative purposes and is not a true representation of a full economic or LCC analysis. Furthermore, many of the assumptions made herein are unjustified and should not be considered as recommendations.

Narrative

Several towns in a WUI area recently had a wildland fire, with an estimated return rate of 25 years, burn near them. Smoke was a minor nuisance, and no evacuation was required nor were there any reported health impacts. Ultimately there was no damage to any property, nor any fatalities from the fire. The fire ended when a large rain storm passed through. In examining the impacts of the fire, one major issue was that it burned a riparian forest, and in the aftermath, a large amount of runoff went into the local river. The town relies on this river for drinking water, and the large amount of runoff has caused substantial issues.

Their treatment plant recorded a substantial increase in turbidity (400 %) over a 12-month period after the fire (Tecle and Neary 2015), greatly increasing treatment costs and hampered operations. Assuming a base cost of water treatment of 0.0198 USD per m^3 (75 per million gallons USD) and a 0.25 % increase in cost for each 1 % increase in turbidity (Dearmont et al. 1998), the cost of water treatment doubled. The towns in the region use roughly 402 000 m^3 (approximately 106 million gallons) per month (Southern California Public Radio 2017). Due to the fire, the treatment plant incurred an additional 95 515 USD in chemical costs. The increased turbidity also increased the amount of sludge the plant was required to dispose of, resulting in an increased cost of 1.9 million USD (Danahey 2017, Mar 27). All losses from the previous fire are provided in Table 1.

Table 1. Losses caused by increased erosion due to instigating fire

Loss Category	Description	Loss value
Direct	Increased water treatment chemical cost	$95 515
Direct	Increased sludge removal cost	$1.9 million (Danahey 2017, Mar 27)
Indirect	Recreational Value (Wildland Fire)	$77.71 per trip[1] (Hayley et al. 2003) 1500 trips lost after fire
Indirect	Additional indirect costs to water treatment plant	33 % of increase in direct costs (Zuzulock 2003)
Recovery and Replacement	Reseeding	$120 per acre (Reynolds and Sikole) for:

[1] Based on weighted average of "time after burn" values for both hikers and bikers using forest land

		3000 acres

Worried that a larger fire could potentially inhibit the ability of the treatment plant to provide water, a proposal was put forward that the towns should seek assistance in managing the forest in their area. This would include an organized reconstruction of the riparian forest lost during the fire, as well as management of adjacent forested areas to lessen the chances of a wildfire. The forested area in question is roughly 6000 acres, 500 of which are considered riparian.

The primary tactic for forest adjacent to riparian areas (roughly 1500 acres per burn (U.S. Forest Service a)) would be prescribed burns every four years for fuels management, while 50 acres of erosion susceptible riparian area would be reseeded and contoured with straw wattles to create an additional barrier to runoff. The reseeding itself is considered a recovery and replacement cost as it is required regardless of the management strategy. From an input perspective, this means only the reduction in reseeding cost needs to be entered into the analysis.

The sentiment among those opposed is that the treatment plant operated fine during the fire's aftermath and the fire events of the type that initiated the problem are sufficiently uncommon to justify the status quo. Unsure of whether to go forward an economic analysis was sought to compare the alternatives.

For the purposes of this example there are two alternatives, (1) do nothing or (2) go forward with the management plan above. The town uses a 4 % discount rate and is looking at a planning horizon of 50 years.

2 Assumptions

The following values are assumed for both alternatives:

Planning horizon – 50 years
Recurrence rate of Fire Event – 25 years
Real discount rate – 4 %
Value of a statistical life – Not Applicable

Other key assumptions have been made to simplify the example. These are not necessarily realistic and should not be considered prescriptive for an actual LCC analysis.

1. There is a zero probability of a prescribed fire escaping containment or causing loss of life.
2. All areas covered by the affected water treatment plant are covered in the analysis
3. Future fires will be considered to occur in the same area, and thus would not threaten populated areas
4. The burn area is non-populated
5. The analysis is only focused on the impact of a 25-year fire.

Assumptions related to specific values derived for the analysis are mentioned as they arise from the narrative.

3 Data

3.1 Cost Data

Table 2 contains all the elements related to the cost of implementing the management plan.

Table 2. Costs related to implementing the mitigation measure

Cost Category	Description	Cost
Direct	Straw wattles	$2.87/ft^2 (homewyse 2017)
Indirect	Indirect costs of remediation	10 % of direct cost (U.S. Forest Service b)
OMR	Prescribed burn – fuels management	$15.00 per acre (North Carolina Forest Service (NCFS) 2009) $3.45 per mile for hauling[2] (NCFS 2009) $100 per hour – tractor[3] (NCFS 2009) 10 % of direct costs as indirect costs (U.S. Forest Service b) Frequency – 4 years (Mobley 1973, U.S. Dept. of Agriculture) starting in year 4

3.2 Benefit Data

Event Related Benefits (*Benefits* screen in EDGe$)

Table 3 contains the expected loss reduction from the mitigation measure. There is no loss reduction in *Recreation Value* in the event a wildfire occurs, under the assumption that it is primarily a psychological driver for keeping people away.

Table 3. Estimated loss reductions from implementing the mitigation measure

Loss Category	Description	Loss Reduction
Direct	Increased water treatment chemical cost	$83 576
Direct	Increased sludge removal cost	$1.7 million
Indirect	Additional indirect costs to water treatment plant	33 % of direct loss reductions
Recovery and Replacement	Reseeding	$120 per acre for: 1500 acres

Fatalities Averted

No fatalities were associated with the precipitating event, so there is no *Fatalities Averted* input.

[2] Assumed 100 miles for hauling
[3] Assumed 30 tractor hours, derived from tractor costs taken from [20]

Non-Disaster Related Benefits

There are concerns about the cost of the plan, and some of the area population are resisting the move, as it would require a tax increase and could potentially reduce the recreation value of the managed area. Recreational trips have a base value of 174.73 USD per trip (Englin et al 2008) and around 5000 trips per year (Planning, Recreation, and Support Section Marketing and Business Development Office). On the other hand, it is expected that the increased river health will increase the salmon population after a period of five years, and greatly improve watershed quality in 10 years. The relevant values are provided in Table 4.

Table 4. Non-disaster related benefits associated with the mitigation measure

Non-event item	Benefit
Recreational value (Prescribed burn)	$12.2 per trip[4] (Hayley et al 2003) with 750 fewer trips annually
Increased river health (salmon)	$308 per person[5] (Hanemann et al. 1991)
Increased river health (watershed)	$21 per person per month[6] (Loomis et al. 2000)

3.3 Externalities

No externalities are identified in this case. The entire coverage area of the water treatment plant is under consideration, and the area in question is far enough away that prescribed burns should not produce enough smoke to be a nuisance or cause health concerns. Any recreational value of the forest is accounted for, and the area is assumed non-populated, making hedonic price studies irrelevant. Potential externalities associated with a prescribed burn escaping containment are not considered in the current analysis.

4 EDGe$ inputs

Using the provided data, the inputs into EDGe$ can be calculated. The analysis assumes that mitigation measures reduce the severity of a 25-year fire.

Reduction in severity of a 25-year fire

The first analysis focuses on treating the effect of the mitigation measure as reducing the severity of a 25-year event. Non-monetized inputs are as follows:

Planning horizon – 50 years
Recurrence rate of Fire Event – 25 years (in base analysis)
Real discount rate – 4 %
Value of a statistical life – Not Applicable

[4] Based on weighted average of "time after burn" values for both hikers and bikers using forest land.
[5] Assumed effected population of 17 500 people
[6] Assumed effected population of 17 500 people

The inputs for cost are given in Table 5. Operations, maintenance, and repair costs start accruing in year four.

Table 5. Cost inputs into EDGe$ for the mitigation measure

Description	Value
Direct	$6 250 860
Indirect	$625 086
Operations, Maintenance, and Repair	$28 430 every 4 years starting in year 4

Table 6 contains the loss reduction inputs for the first analysis, while non-fire related benefits are presented in Table 7. Recreation value negative benefits start accruing in year one.

Table 6. Loss reduction input into EDGe$ for the mitigation measure

Loss Category	Description	Loss Reduction
Direct	Increased water treatment chemical cost	$83 576
Direct	Increased sludge removal cost	$1.7 million
Indirect	Additional indirect costs to water treatment plant	$588 580
Recovery and Replacement	Reseeding	$180 000

Table 7. Non-disaster related benefit input for the mitigation measure

Non-event item	Benefit
Recreational value (Prescribed burn)	($51 850) annually[7]
Increased river health (salmon)	$4 620 000 one-time[8] At year: 5
Increased river health (watershed)	$3 780 000 one-time[9] At year: 10

5 EDGe$ Output

EDGe$ output is presented in Table 8. The mitigation measure is economical per the analysis, as its *NPV* is roughly $500 000 compared to the implicit alternative of doing nothing. All other indicators, excluding the non-disaster ROI, suggest that the project will be beneficial as well.

[7] This represents the change in recreation value relative to the baseline for prescribed burns, like the case for wildland fires.
[8] It is assumed that the valuation is a one-time value, that is the value of increasing salmon population occurs only once
[9] It is assumed that the valuation is a one-time value, that is the value of improving the watershed quality occurs only once

Table 8. EDGe$ output for WUI Example

	Mitigation
Disaster Economic Benefits	
Response and Recovery Costs	$158 773
Direct Loss Reduction	$1 573 245
Indirect Losses	$519 171
Disaster Non-Market Benefits	
Value of Statistical Lives Saved	$0
Number of Statistical Lives Saved	0
Non-disaster Related Benefits	
One-Time	$6 316 346
Recurring	($1 098 555)
Costs	
Direct Costs	$6 250 860
Indirect Costs	$625 086
OMR	
One-Time	$0
Recurring	$139 830
Externalities	
Positive	
One-Time	$0
Recurring	$0
Negative	
One-Time	$0
Recurring	$0
Present Expected Value	
Benefits	$7 468 980
Costs	$7 015 776
Net	$453 204
Benefit-to-Cost Ratio	1.065
Internal Rate of Return (%)	4.79
Return on Investment (%)	0.13
Non-Disaster ROI (%)	-0.51

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