



Appendix 3a.
Climate Change Narrative Scenarios

Transboundary Madrean Watersheds Landscape Conservation
Design Report

Version 1.2
June 30, 2020



Scenario 1: A Wildfire in a Warmer World

The Year: 2025

BIOPHYSICAL CONTEXT: During the past decade, it is clear that droughts have become hotter, drier, and last longer, This is particularly noticeable in winter and spring, with warmer minimum temperatures and fewer precipitation events. As a result, fire seasons have become almost year-round, starting in mid-late February and ending in late November; there is also greater potential for a small fire to become a large, catastrophic wildfire depending on the availability of ladder fuels . Soils tend to be bone dry by May and perennial streams have become ephemeral.

SOCIOPOLITICAL CONTEXT: Fierce competition for limited water is the norm. Due to limited water regulations in rural areas, farmers continue to put in more wells on their property and pump copious amounts of groundwater to irrigate their crops. Ranchers must install and maintain additional stock tanks for livestock or reduce their herds. The City of Tucson is looking to raise water rates significantly yet again, not only to incentivize residential water conservation, but to maintain their revenue streams.

EVENT: It is April. We are in an especially dry spring that followed a moderate El Niño that enabled an abundance of grass to grow, yet has now cured into a layer of fine fuels. A camper in a mid-elevation campground accidentally ignites a wildfire when they fail to fully put out their illegal campfire. The fire spreads rapidly, especially due to the abundance of fine fuels, most of which are invasive grasses. The fire engulfs most vegetation along springs, streams & riparian areas alike. In some landscape patches, the fire was very intense, burning off the topsoil layer. Areas still stricken by last year's fire are After the fire, BAER team completes a short-term fix to prevent some erosion, by planting a fast growing grass seed mix that is contaminated with invasive species. By late June, grasses have failed to sprout due to the extreme temperatures and lack of soil moisture. Strong, dry winds continue to blow off top soils. By early July, several lightning storms have started small fires in remote areas, putting fire managers on high alert, banning the public from visiting the Forest Service areas in the area. Finally, by mid-July, a strong monsoon storm brings intense rains to mid to high elevations, generating flash floods and large debris flows.

ECOSYSTEM EFFECTS: Over the next several months in the lowland **grasslands**, Lehmann's Lovegrass (*Eragrostis lehmanniana*, ERLE) re-sprouts and expands its range into previously native-dominated zones (e.g., higher elevations). In upper Sonoran at buffelgrass' range, buffelgrass swiftly moves in. Biodiversity is reduced. In some grasslands, especially at extremely high elevations far from the edge of Lehmann's Lovegrass' and buffelgrass' range, native grasses begin to resprout (*Scenario alternatives*). However, a decade of warming has made the landscape no longer suitable to sustain native grasses and thus fail to resprout, reflecting more of a shift northward and upslope rather than an expansion. In uplands, post-fire

erosion following the heavy monsoon rains has paved the way for type conversion, shifting grasslands to ...?

Riparian zones along streams exhibit smaller stream perenniality. Length of continuous flow in creeks decrease and the total days of flow in the year decrease. Shady riparian canopy cover is lost and replaced by xxx. Water temperatures increase due to lack of shade and warm temperatures. Longitudinal connectivity of riparian vegetation decrease.

Scenario alternatives:

Mesquite bosque replaces Sacaton grasslands

Shrub encroachment in grasslands has functionally resulted in a type change

Although some **springs** were spared the worst effects of the fire due to their moist microclimate, they are now surrounded by an eroding landscape that is invaded by Monsoon rains threaten to obliterate springs as upland slopes that have burned severely are eroding dramatically silting in channels and in some cases rearranging the drainages

In **Madrean Evergreen Woodland and higher elevation forests**, a large enough area has burned that large areas of the uplands are denuded of undergrowth and trees. Due to the loss in canopy cover ponderosa pine seeds lose the cool moist niche they need to grow into trees

SOCIETAL IMPACTS & HUMAN RESPONSE: Rancher has to cut back their herd size or drill more wells because of less water.



Scenario 2: Megadisturbance & Rapid Ecosystem Transformation

The Year: 2040

BIOPHYSICAL CONTEXT: Hotter-drier drought periods are the norm, and occur throughout the year. Although rain events occur with less frequently –and total annual average precipitation is approximately 10 inches/year, storms are now more intense in both winter and summer, dropping more rain in a matter of minutes. Severe flooding occurs during those events due to the drier, more impervious soils; riparian areas are degraded and have experienced loss of soils. To exacerbate the situation, once typical single disturbance events (extreme heat and wind, insect outbreak, severe fire, strong storms leading to floods, followed by erosion, etc.) now seem to happen simultaneously or in rapid succession. This so-called “Megadisturbance” has led to a persistent ecological drought conditions, where even native species are physiologically stressed on a regular basis. This has led to increasingly frequent mortality and die-off events. Invasive grasses take hold across the landscape. Large-scale ecosystem transformation is underway and is shaping the ecology of landscapes non-intuitive ways.

SOCIOPOLITICAL CONTEXT: Contributing to the record drought is increased groundwater pumping in recent years as conditions have become hotter and drier. This is necessary for irrigation and general use by the growing cities of Tucson, Benson, and Sierra Vista. Little regulation of water in rural areas continues to be the norm. Stream diversion for ranching has become a problem. Cattle grazing further damage riparian vegetation and worsens the erosion.

EVENT: There is a very strong and persistent La Niña event following a moderate El Niño the year before; this aligns with other large-scale ocean-climate oscillations to bring the longest hotter-drier drought ever recorded.