

Rio Grande Irrigation, Vitality, and Ecosystem Restoration (RIVER)

Group 3:

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Mission Statement

The mission of RIVER is to ensure the health and sustainability of the Rio Grande watershed to enhance natural biodiversity while also promoting sustainable use. We hope to minimize use of the river and increase biodiversity by 30% by 2050 while also ensuring equitable access among communities.

Background & History

The Rio Grande is one of the most iconic rivers in North America and holds significant cultural, ecological, and economical importance between the United States and Mexico. The river is approximately 1,900 miles long and flows through 3 U.S. states (Colorado, New Mexico, and Texas) and 4 Mexican states (Chihuahua, Coahuila, Nuevo León, and Tamaulipas). It is ranked as the fourth longest river in the U.S., beginning in southern Colorado in the San Juan mountains and flowing through New Mexico, Texas, and eventually emptying into the Gulf of Mexico.

Despite its length and importance, the Rio Grande faces numerous challenges, contributing to its status as the 10th most endangered river in the world. One of the primary concerns is the heavy demand for its water resources along the river, with approximately 80% of its water being diverted for irrigation purposes in agriculture. This extensive use places pressure on the river's flow and exacerbates issues related to water scarcity and the health of the watershed.

Historically, the Rio Grande has been a vital component of the livelihoods and cultures of people who inhabit the watershed. Indigenous communities such as the Pueblo and Apache have relied on the river for sustenance, agriculture, and spiritual significance for centuries. With the arrival of European settlers in the 16th century, the Rio Grande became a significant location for Spanish colonial expansion to facilitate trade and transportation.

In the 1830s, the Rio Grande became a focal point of conflict between South Texas and New Mexico over territorial claims and water rights. This dispute continued on for some time and later on in 1884 the Rio Grande river became officially recognized as the international border between Mexico and the U.S., solidifying its status as a symbol of national boundaries and cross-border relations. This delineation came with opposition, though, during the Chamizal Dispute in 1899. Centered around a disputed area between El Paso, Texas, and Ciudad Juarez, Mexico, the Chamizal Dispute underscored the complexities of border demarcation and the need for diplomatic resolution.

Despite its role as a geopolitical boundary, the Rio Grande has also served as a cultural and ecological corridor, connecting diverse communities and ecosystems along its course. Fast forward to 1978, the river was designated as a Wild and Scenic River, highlighting its outstanding scenic, recreational, and ecological values. Furthermore, in 1997 it received further recognition as an American Heritage River, signifying its importance as a national treasure and

emblem of American history and identity. Today, the Rio Grande faces numerous challenges, including water scarcity, overuse, forest fires, and habitat degradation among many more. It is vital that efforts are taken to preserve and enhance the river to ensure its long-term sustainability and success.

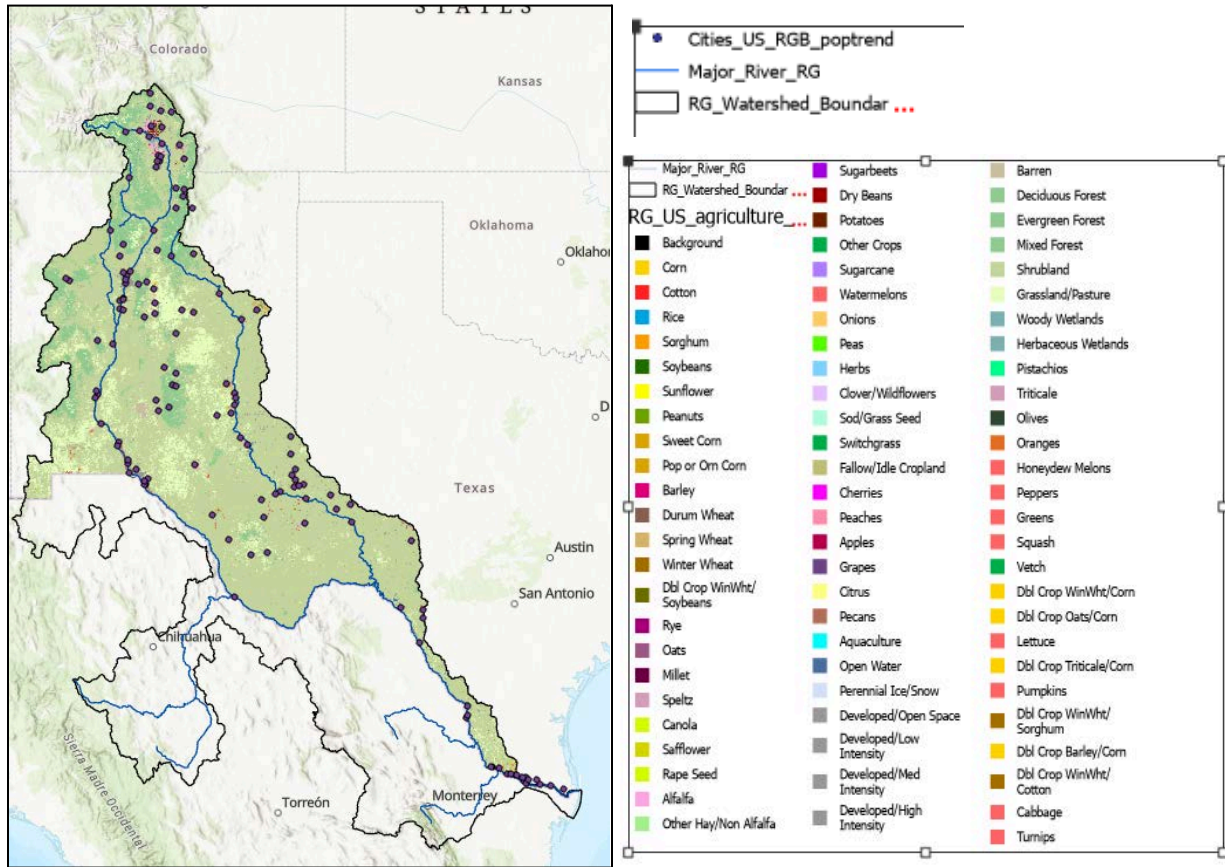


Figure 1.1: Rio Grande River Basin, Rio Grande, Farmland, and populated cities.

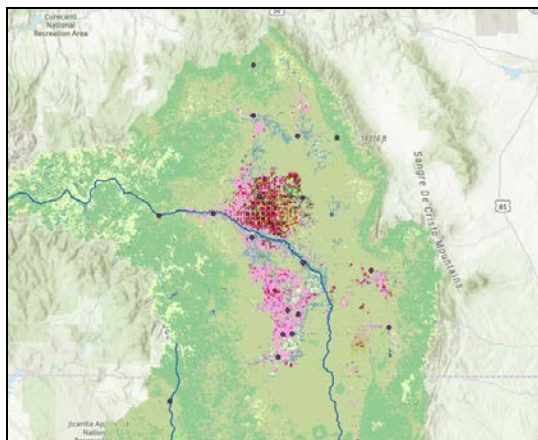


Figure 1.2 (left): top of Rio Grande, U.S.

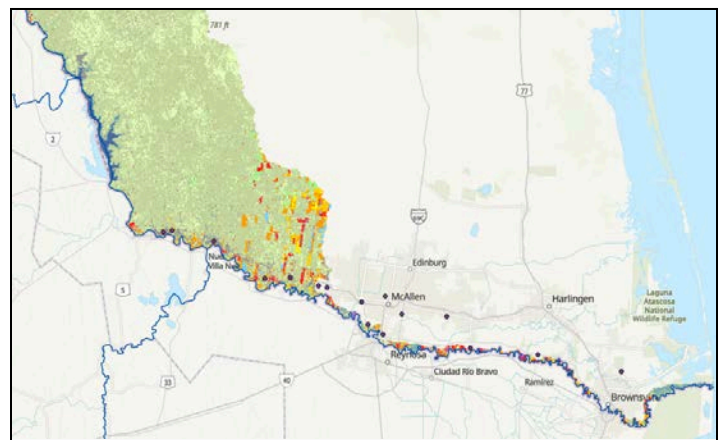


Figure 1.3 (right): bottom of Rio Grande, MX

Important Agreements Regarding the Rio Grande Basin

	Rio Grande Basin	
1906 Convention- US and Mexico	1938 Rio Grande Compact- CO, NM, TX	1944 Treaty- US and Mexico
US: <ul style="list-style-type: none"> - must annually deliver 60,000 AF (acre-foot) of water to be used in Juarez Valley - ... under regular conditions... reduced during periods of drought 	Equitable water distribution between the 3 states' rights and needs	Mexico: <ul style="list-style-type: none"> - must deliver 350,000 AF (acre-foot) annually to the US - 6 major tributaries that feed into the Rio Grande: Mexico has the rights to $\frac{2}{3}$
	Measure and monitor water use, resolve disputes, and coordinate water management efforts among the 3 states	US: <ul style="list-style-type: none"> - Right to all flows from Rio Grande tributaries in the US - 6 Mexican tributaries: US has rights to $\frac{1}{3}$
		Created the International Boundary and Water Commission (IBWC)

Management and Oversight

The International Boundary and Water Commission (IBWC) stands as a vital partnership between the United States and Mexico, focusing on the management and conservation of shared water resources along their border. This joint commission oversees an array of critical infrastructure, including flood control levees, storage reservoirs, diversion dams, and wastewater treatment plants. By collaboratively maintaining these facilities, the IBWC ensures the protection

of both nations from flooding events and facilitates the sustainable use of water resources in the region.

Working in tandem with the IBWC, the Environmental Protection Agency (EPA) plays a pivotal role in safeguarding water quality along the border. Through initiatives such as the National Water Quality Inventory and the Clean Water Act, the EPA conducts comprehensive monitoring and assessment of water quality, identifying areas of concern and implementing measures to prevent and control pollution from various sources. Recent efforts, such as the allocation of funding for 11 projects aimed at reducing air pollution, improving water quality, and enhancing waste management, underscore the EPA's commitment to addressing environmental challenges in the border region.

Additionally, the U.S. Bureau of Reclamation (USBR) plays a crucial role in water management, infrastructure development, flood control, environmental restoration, and interstate cooperation. With a focus on sustainable water resource management, the USBR collaborates with federal, state, and local stakeholders to implement innovative solutions to water-related challenges. By investing in infrastructure projects and fostering interstate cooperation, the USBR plays a key role in ensuring the resilience and sustainability of water resources along the U.S.-Mexico border.

In summary, the collaborative efforts of the International Boundary and Water Commission, the Environmental Protection Agency, and the U.S. Bureau of Reclamation are essential for managing and conserving water resources along the U.S.-Mexico border. Through joint initiatives and partnerships, these organizations work tirelessly to protect water quality, mitigate flood risks, and promote sustainable water use, ensuring the well-being of communities on both sides of the border for generations to come.

Problem 1: Forest Fires

Forest fires in the Rio Grande watershed pose significant challenges to water quality, with extreme ramifications for both the environment and human communities. The 2011 Las Conchas fire, spanning 150,000 acres, serves as an example, where the aftermath led to increased erosion, elevated turbidity, and heightened levels of suspended solids in the Rio Grande. This elevated turbidity, coupled with suspended solids, contributed to escalated fish mortality rates. The

decline in fish populations and aquatic macroinvertebrates, often considered indicator species of water quality, further exacerbated the decline of water quality in the river. These factors, combined with post-fire effects such as ash and soot runoff, have contributed to immense deterioration in water quality, resulting in detrimental impacts on aquatic ecosystems and wildlife populations.

Furthermore, the degradation of water quality in the Rio Grande poses risks to human health, as many communities rely on the river as a primary source of agricultural irrigation, drinking water, and recreational activities. Addressing the intricate relationships between forest fires and water quality in the Rio Grande necessitates preventative solutions, including proactive forest management strategies, fuel reduction efforts, and enhanced monitoring. By prioritizing the preservation and restoration of water quality in the Rio Grande watershed, stakeholders can work towards protecting both ecosystem health and the sustainable livelihoods of those dependent on the river's resources, while also preventing future forest fires reaching the capacity that they have in the past.

Solution 1: Forest Fires

To address the challenges posed by the aftermath of the Las Conchas fire and prevent future forest fires from reaching Las Conchas capacity, we propose two primary solutions. The first solution focuses on fuel reduction strategies in the forests surrounding the Rio Grande. Through controlled burns, prescribed burns, and mechanical thinning, we will reduce the amount of unnecessary flammable vegetation. Unnecessary vegetation such as invasive plants, leaf litter, and dry brush serve as flammable fuel, aiding forest fires in rapidly spreading. By reducing the fuel load in these areas, the likelihood and severity of future forest fires can be mitigated, allowing for more effective containment strategies when fires do occur.

The second solution revolves around upstream forest health management strategies. We will employ techniques such as reforestation, invasive species removal, and logging to enhance the overall health of forests upstream of the Rio Grande. By promoting good forest health in upstream forest regions, the quality of water flowing downstream into the Rio Grande will be improved. This not only protects the health of the aquatic ecosystem but also ensures a cleaner and more reliable water supply for the communities that depend on the river for irrigation,

drinking water, and recreation. To achieve this goal, we will work with the Rio Grande Water Fund and collaborate on our proposed strategies to increase upstream forest health.

Problem 2: Overuse

One of the major problems the Rio Grande faces is overuse. As stated earlier, over 80% of the river's waters are diverted for irrigation in agriculture. Populations have been increasing along the river for some time, as is use. A majority of the river is bordered by miles of crop land owned by farms who refer to their use of the Rio Grande as "water rights". Agricultural exports have quadrupled throughout the last decade from the U.S. and Mexico, and unfortunately the river suffers as a result.

This overuse of the river leads to several impacts that threaten its health and sustainability. Climate change especially exacerbates these challenges, leading to increased sublimation. This means that when the snow melts in the San Juan mountains at the mouth of the river, it immediately evaporates into vapor instead of melting into water. This decreases the overall water supply to an already overexploited river. In the last decade, there has only been 2 years where the Rio Grande has had a "full supply" of water and only 7 years in the last two decades. There have even been years where the Rio Grande does not even reach the Gulf of Mexico to deposit its water. Such impacts eventually threatened the agricultural livelihoods of the farmers who caused this overuse problem to begin with.

Overuse has negative ecological implications as well. Native species populations continue to dwindle while invasive species are spreading. In particular, the Eastern Cottonwood tree is a native tree that provides important habitat for many wildlife species, and has fallen victim to population decline due to other invasive plants, such as Salt Cedar Bush. There has also been a decrease in insect populations due to lack of standing pools of water from overuse, which has led to the endangerment of the Southwestern Willow Flycatcher, a native bird in the U.S. The loss of these important native flora and fauna can destroy ecosystems and threaten the health of both humans and wildlife.

Solution 2: Overuse

A few solutions can be proposed to combat this problem of overuse of the Rio Grande. An option that can be considered is adding dams along the river. Strategically placing dams along the river could control the amount of water diverted to each agricultural area. By setting limits on water withdrawals, dams can ensure equitable distribution of the river's resources while mitigating scarcity. We plan to set an additional 20 dams along the river by 2040 to further enhance management and protection of the Rio Grande.

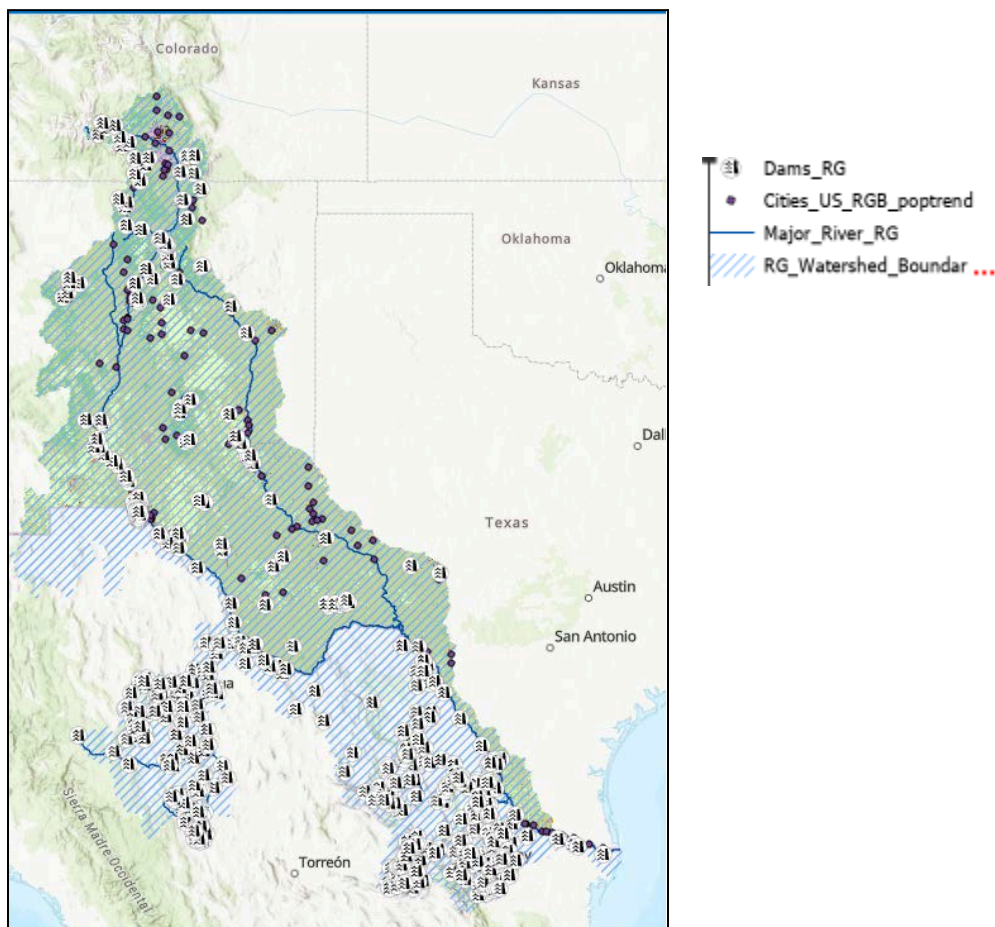


Figure 2: Dams in the Rio Grande River Basin

Another solution that can be effectively implemented is a new crop optimization strategy. This can offer a promising avenue to reduce water consumption by shifting the focus to less

water-intensive crops like chili peppers, and converting some agricultural land into restored wildlife habitat. Farmers have the opportunity to contribute to these conservation efforts while also maintaining economic viability. Incentives can be offered, such as compensation to farmers for lost crop revenue due to restoration, in the hopes that this would motivate them to participate. We strive to achieve our goal of turning 30% of agricultural land along the river into restored wildlife habitat by 2030.

Aside from ecological solutions, proposals for a new "water rights" system reinforce a shift towards prioritizing the environment and local communities along the Rio Grande. By prioritizing the needs of the environment and vulnerable communities, this system aims to foster resilience and equity in water management practices. Collaborating with native tribes that have long standing connections to the river's resources is essential for ensuring inclusive and culturally sensitive decision-making processes that honor indigenous perspectives and rights. The Santa Fe Indian School located in New Mexico is a prime example of community-based collaboration. The school has an education based program that has ongoing environmental monitoring, restoration, and mapping projects along the Rio Grande with tribal youth to protect the health of the river. Partnerships like these can promote equity and simultaneously protect the river.

Cross-border cooperation is essential in managing the Rio Grande and its shared resources between the U.S. and Mexico. The 1944 Treaty, which split the river evenly between the two countries, provides a foundation for collaboration and equitable resource allocation. Emphasizing the priority of the river's resources for vulnerable communities, regardless of nationality, reflects a commitment to addressing social and environmental justice concerns. Allocating 40% of water use to vulnerable communities along the river first acknowledges the importance of ensuring access to water for those most in need, promoting resilience and well-being in the face of water scarcity challenges.

Problem 3: Droughts

The challenges facing water resources along the Rio Grande present a complex web of interconnected issues, exacerbated by factors such as increasing population, climate change-induced droughts, and dependence on irrigation for agricultural production. As

population numbers increase, the demand for water escalates, placing pressure on already strained water sources. Additionally, there is the issue of limited time available for natural recharge of water supplies, further increasing the scarcity of available water.

The frequency and severity of droughts, driven by climate change, pose a significant threat to the Rio Grande's ecosystem and the communities that depend on it. In regions like the Rio Grande Valley, farmers find themselves reliant on the river's waters for irrigation. High-value crops such as citrus, vegetables, and sugar cane require substantial irrigation, while dryland crops like cotton, corn, and sorghum see yields slashed in half without adequate water supply. The repercussions of such losses are profound, with direct crop losses amounting to \$496 million and indirect impacts rippling through fuel, labor, machinery, and other sectors, totaling \$994 million in losses and leading to the loss of 8,400 full-time jobs.

The situation is further compounded by ecological concerns, such as the need to capture endangered species like the silvery minnow and transport them to wetter areas to preserve biodiversity. In the Rio Grande Valley, the ramifications extend beyond agriculture, impacting cattle ranchers who struggle to sustain their livelihoods as dry conditions lead to depleted pastures and an inability to plant crops. Adding to the complexity, Mexico's failure to meet its water payment obligations to the United States has sparked tensions, culminating in farmer protests in 2020 as communities grapple with dwindling water supplies and economic instability.

Addressing these multifaceted challenges requires a comprehensive approach that encompasses sustainable water management practices, climate resilience strategies, and international cooperation. From investing in water conservation and efficiency measures to promoting alternative livelihoods for affected communities, concerted efforts are needed to safeguard the Rio Grande's waters and ensure the long-term viability of both ecosystems and economies along its banks. Only through collaborative action can we navigate the complexities of water scarcity and secure a more resilient future for all who depend on the Rio Grande's precious waters.

Solution 3: Droughts

Water conservation efforts play a crucial role in mitigating the challenges posed by water scarcity along the Rio Grande and other water-stressed regions. One key aspect of conservation involves upgrading water infrastructure to minimize leaks and losses, maximizing the efficiency

of water distribution systems. By addressing aging infrastructure and implementing modern technologies, communities can reduce wastage and ensure that precious water resources are utilized more effectively.

Another strategy involves conserving water during wet seasons for use during dry periods. This approach not only helps to buffer against droughts but also optimizes the seasonal fluctuations in water availability. Additionally, promoting groundwater use for drinking water purposes can alleviate pressure on surface water sources like the Rio Grande, helping to safeguard both water quality and ecological integrity.

Rainwater harvesting and treatment present further opportunities for water conservation and resource optimization. By reclaiming rainwater through treatment processes, communities can supplement their water supplies, particularly for non-potable uses such as irrigation and industrial processes. However, such initiatives necessitate investments in new delivery infrastructure and may result in increased costs for residents, highlighting the importance of balancing conservation efforts with affordability and accessibility.

The 2021 Rio Grande Regional Water Plan exemplifies a comprehensive approach to water management, addressing key priorities such as drought resilience, water quality management, ecosystem protection, and equitable allocation of water resources. Initiatives like "purple water," which involves treating sewage water for agricultural use, offer innovative solutions to water scarcity, saving significant volumes of water while minimizing environmental impacts. However, such measures come with challenges, including the need for robust infrastructure, financial investments, and potential increases in water costs for end-users.

Innovations in agricultural practices also aid in water conservation and drought mitigation. Cattle ranchers, for instance, can explore agreements to relocate livestock to different farm locations during dry seasons, reducing pressure on water resources in drought-affected areas. Similarly, transitioning to drought-resistant crops and implementing water-efficient irrigation techniques can enhance agricultural resilience to water scarcity. While these agricultural changes offer potential benefits, they may also entail significant costs and require careful planning and support from stakeholders to ensure successful implementation.

Conclusion/Recommendation

To address the pressing challenges, several recommendations are proposed for government action. Firstly, there is a pressing need to enhance government aid programs to support communities during drought periods, recognizing the heightened severity linked to climate shifts. Additionally, it is recommended that the government revisits existing treaties, such as the 1944 treaty, to ensure they effectively address contemporary climate challenges, particularly in the realm of water management. Community engagement should be prioritized throughout the policymaking process, soliciting feedback to ensure policies are inclusive and responsive to local needs.

In light of dwindling water resources, regulations on farmland sizes are advised, including capping the size of farmland and restricting the establishment of new farms beyond designated acreage limits. This approach aims to promote equitable water distribution and sustainable land use practices. Furthermore, significant investments in water infrastructure are recommended, including the construction of reservoirs and the development of water reclamation systems, to enhance water storage and efficiency in the face of escalating drought risks.

Lastly, biodiversity conservation efforts should be prioritized, encompassing initiatives such as habitat restoration and species protection. Measures like relocating small fish populations before droughts hit can help maintain biodiversity and ecosystem resilience amidst changing environmental conditions. By implementing these recommendations, the government can foster a more resilient and sustainable approach to addressing the complex challenges.

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