

# Minute 323

Environmental  
Work Group

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## 2019 Implementation Report



July 2023

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# 1 CONTEXT

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Minute 323, Section VIII.C.5. stipulates that the binational Environmental Work Group (EWG) is responsible for “preparation of reports every two years on progress in the Water Delivery and Restoration Plan program, to include environmental benefits achieved, water deliveries and funding toward commitments, including funding provided by private entities, acres/hectares restored/maintained, implementation progress and monitoring results.”

This report documents 2019 progress in the water delivery and restoration plan programs and in funding toward commitments. This report will be prepared annually, and partially fulfills the Minute requirement, specifically documenting: water deliveries and funding toward commitments, including funding provided by private entities<sup>1</sup>, United States, and Mexico; hectares/acres restored/maintained, and implementation progress for both restoration and science and monitoring activities. The EWG in 2019, 2021, 2023, 2025, and 2027 will also prepare monitoring reports that document environmental benefits achieved and science and monitoring results. These biannual monitoring reports may be combined with annual progress reports when feasible. Minute 323, Section VIII.B. describes the following commitments:

- \$9 million dollars of funding for restoration projects, with the United States, Mexico, and a binational coalition of NGOs each providing 1/3 of the total dollar amount over the term of the Minute. Delivery of 210,000 acre-feet (259 mcm) of water, with the United States, Mexico, and a binational coalition of NGOs each providing 1/3 of the total volume over the term of the Minute. Water for the U.S. government environmental commitment, in the amount of 70,000 acre-feet (86 mcm), will be provided in the first five years of this Minute. Further, during the term of this Minute, the two governments will cooperate with the binational coalition of NGOs to identify additional funding, water supply sources, and to advance water conservation projects to meet the targets for environmental water and restoration recommended by the Binational EWG.
- \$9 million dollars of funding for scientific research and monitoring, with the United States, Mexico, and a binational coalition of NGOs each providing 1/3 of the total dollar amount over the term of the Minute.

The Environmental Work Group has prepared several scoping documents that define activities and implementation guidelines for the term of the Minute. While some of these documents remain in “draft” status, they are substantially finished and intended as guidance rather than rules. Implementation of environmental activities proceeds with the recommendations of the EWG and approval from both Sections of the IBWC. The EWG has verified that activities listed in this report that count toward the Minute 323, Section VIII.B. commitments are included in the respective Programmatic Frameworks and annual plans. These documents prepared by the Minute 323 EWG include:

- Restoration Programmatic Framework,
- Water Delivery Programmatic Framework,
- Monitoring Programmatic Framework.
- 2018 and 2019 Colorado River Limitrophe and Delta Water Delivery and Restoration Plans,
- 2018 and 2019 Monitoring and Science Plans, and
- 2018 Restoration Eligibility Criteria.

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<sup>1</sup> The following private donors supported Minute 323 Environmental Activities in 2019: Walton Family Foundation, Sonoran Joint Venture, Marisla Foundation, WWF-Carlos Slim Foundation Alliance, Hewlett Foundation, Bonneville Environmental Foundation, Enterprise Foundation, Gonzalo Río Arronte Foundation, Tinker Foundation and other anonymous donors.

## 2 MINUTE 323 ACCOUNTING (IN US DOLLARS)

Table 1. Minute 323 Accounting

		2019 Annual Expenditures <sup>2, 3</sup> and Water Volumes <sup>4</sup>				Minute 323 Cumulative Expenditures <sup>2, 3</sup> and Water Volumes <sup>4</sup>				Minute 323 Targets
		Mexico	United States	NGO	Grand Total for 2019, annual	Mexico	United States	NGO	Grand Total for Minute 323, cumulative	2018-2026
Expenditures for restoration (\$)		\$1,619,704	\$645,620	\$841,914	\$3,107,238	\$3,168,176	\$645,620	\$1,691,421	\$5,505,217	\$9,000,000
Expenditures for monitoring and science (\$)		\$97,428	\$935,815	\$359,030	\$1,392,273	\$167,031	\$1,249,183	\$766,079	\$2,182,293	\$9,000,000
Total		\$1,717,133	\$1,581,435	\$1,200,944	\$4,499,511	\$3,335,208	\$1,894,803	\$2,457,500	\$7,687,510	\$18,000,000
Volume of water deliveries	m <sup>3</sup>	0	0	13,579,874	13,579,874	0	0	28,188,990 <sup>5</sup>	28,188,990	258,000,000
	AF			11,009	11,009			22,853	22,853	210,000

<sup>2</sup> Expenses do not include overhead salaries from US, MX or NGOs or any other EWG stakeholders

<sup>3</sup> This table does not show funding that is committed but not yet expended.

<sup>4</sup> Water year runs from October 1 through September 30 (applies to water delivery volume only)

<sup>5</sup> This volume includes 6,074,236 cubic meters [4,924 AF] credited from excess of the Minute 319 base flow volumes delivered.

### 3 HABITAT RESTORATION

Table 2. New area restored by site & habitat type in 2019 with funding provided by Minute 323.

	Miguel Aleman		Chaussé		Laguna Grande		Total	
Habitat Type	Area Restored							
	Ha	Acres	Ha	Acres	Ha	Acres	Ha	Acres
Open water/marsh habitat	0	0	0	0	0	0	0	0
Cottonwood Willow (flood)	0	0	0	0	4.7	11.6	4.7	11.6
Mesquite Bosque	0	0	0	0	8.5	21.0	8.5	21.0
Mesquite Upper Terrace	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	13.2	32.6	13.2	32.6
Cumulative area restored as of 2019	100.5	248.3	62.3	153.9	229.4	566.7	392.2	969.0

Table 3. Area of habitat maintained and managed in 2019 by site and habitat type.

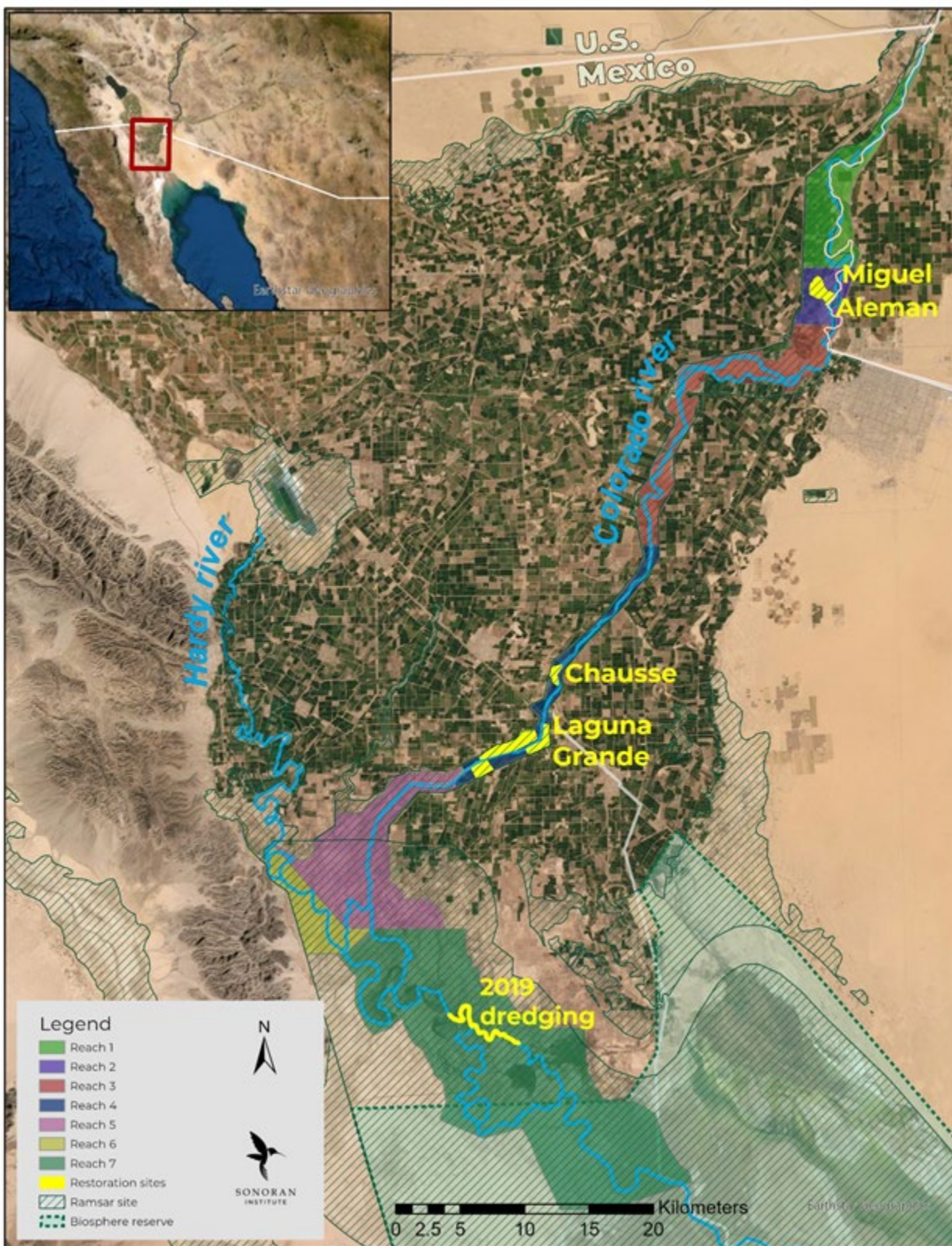
	Miguel Alemán		Chaussé		Laguna Grande		Total	
Habitat Type	Area Maintained and Managed							
	Ha	Acres	Ha	Acres	Ha	Acres	Ha	Acres
Open water/marsh/wetland	0.3	0.7	8.3	20.5	3.9	9.6	12.5	30.8
Cottonwood Willow	0	0	19.5	48.1	124.8	308.4	144.3	356.6
Mesquite upper terrace	0	0	29.0	71.7	6.1	15.1	35.1	86.7
Mesquite Bosque	24.2	59.9	5.5	13.6	18.3	45.2	48.1	118.8
Upland habitat	57.0	140.8	0	0	0	0	57	140.8
Riparian	13.9	34.4	0	0	0	0	13.9	34.4
TOTAL	95.4	235.8	62.3	153.9	153.1	378.3	310.9	768.1

Table 4. Minute 323 funds spent on restoration and maintenance in 2019, by site.

Site Name	Source of funds			2019 Minute 323 costs
	MX	US	NGO	
Miguel Aleman	\$0	\$244,299	\$129,173	\$373,473
Chaussé I	\$0	\$0	\$535,290	\$535,290
Laguna Grande	\$0	\$186,335	\$62,269	\$248,605
Estuary	\$0	\$214,985	\$115,181	\$330,167
Federal land concessions	\$1,619,704 <sup>6</sup>	\$0	\$0	\$1,619,704
Total	\$1,619,704	\$645,620	\$841,914	\$3,107,238

<sup>6</sup> In-kind contribution by the Mexican Federal Government

Figure 1. Map of Colorado River Limitrophe and Delta region with active riparian and estuary restoration sites



### 3.1 MIGUEL ALEMÁN

**SITE MANAGER:** Pronatura Noroeste (PN)

**2019 FUNDS EXPENDED AND FUNDING SOURCE:**

Table 5. Restoration phases at Miguel Alemán

Phase	Year	Has	Acres
I	2014	35	86.48
II	2016	12	29.65
III	2016	13	32.12
IV	2017-2018	40.5	100.07
V	2019	0	0
Total		100.5	248.3

In 2019 there were no restored acres in Miguel Alemán. Implementation of Phase V will include the restoration of 35 hectares (86.5 acres) of high terrace habitat, maintenance and management of Phases I, II, III and IV, plus the production of 13,500 native trees/shrubs in nurseries located at the site. Phase VI will be the last active restoration site in the Miguel Alemán complex and will include restoration of 35 additional hectares (86.5 acres). Only maintenance and management activities will be performed at the site in the future.

Figure 2. Restoration Phases at Miguel Aleman

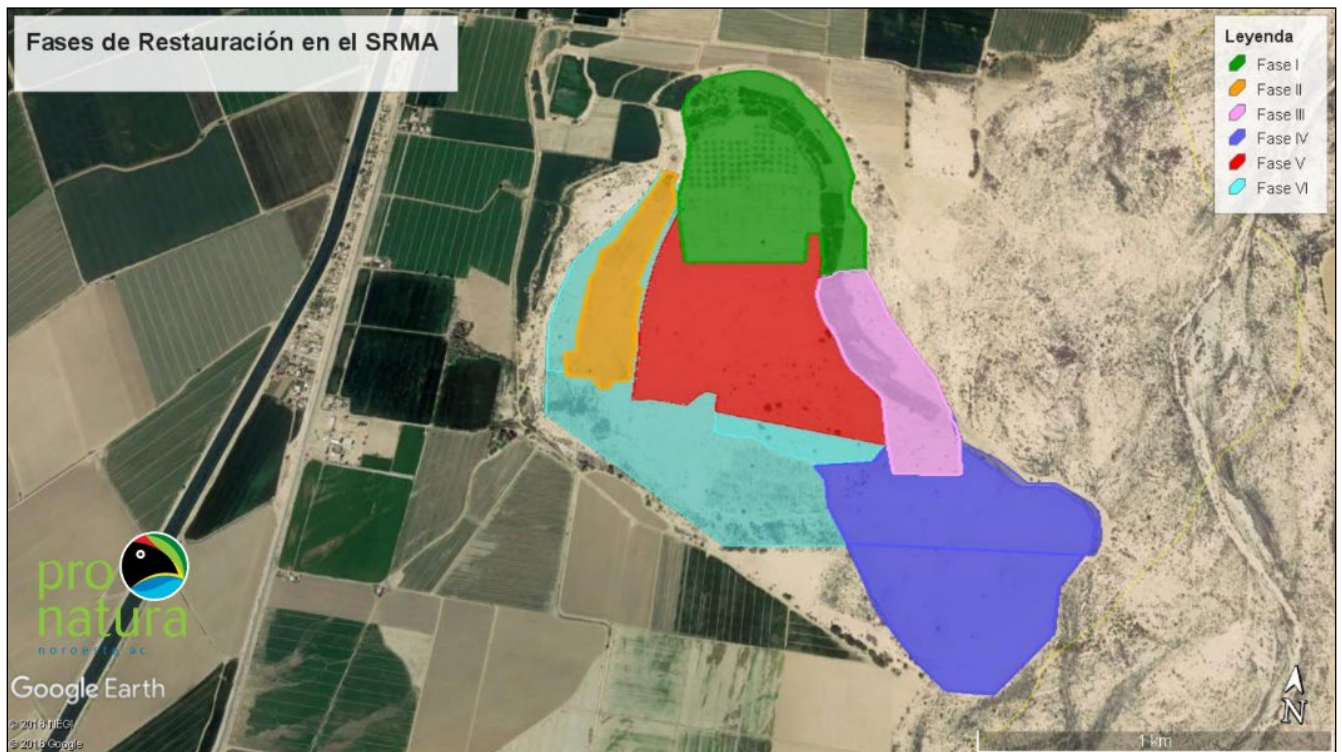


Table 6. 2019 Miguel Alemán Funds Expended and Funding Source per commitments in Minute 323 (USD)

	Funding source		Total	Units	Number of units
	US <sup>7</sup>	NGO			
Planning and design	\$7,900	\$46,299	\$54,199	Lot	1
Planting activities (site preparation and production of native plants)	\$38,350	\$14,536	\$52,886	Ha	35
Tree planting	\$6,850	\$3,601	\$10,451	Tree	12,250
Plant PROTECTION	\$0	\$6,228	\$6,228	Plant protection	12,250
Maintenance & management	\$28,999	\$52,247	\$81,246	Ha	100.5
Water delivery fees	\$8,900	\$0	\$8,900	HaDR	139
Implementation monitoring <sup>8</sup>	\$13,300	\$190	\$13,490	Ha	100.5
Water delivery infrastructure	\$140,000	\$6,073	\$146,073	Ha	35
<b>Total</b>	<b>\$244,299</b>	<b>\$129,173</b>	<b>\$373,473</b>		

**HABITAT MAINTENANCE AND MANAGEMENT ACTIVITIES:**

Table 7. Habitat Types Maintained and Managed at Miguel Alemán in 2019:

Habitat type	Phase I		Phase II		Phase III		Phase IV		Phase V	
	Has	Acres	Has	Acres	Has	Acres	Has	Acres	Has	Acres
Wetland (Lagunita)	0.3	0.74	0	0	0	0	0	0	0.3	0.74
Riparian	7.45	18.4	0	0	5.98	14.77	0.5	1.23	13.93	34.4
Mesquite Bosque	5.25	12.97	12	29.65	7.02	17.34	40	98.84	64.27	158.8
Upland habitat	22	54.36	0	0	0	0	0	0	57	140.84
<b>Total</b>	<b>35</b>	<b>86.47</b>	<b>12</b>	<b>29.65</b>	<b>13</b>	<b>32.11</b>	<b>40.5</b>	<b>100.07</b>	<b>135.5</b>	<b>334.78</b>

<sup>7</sup> U.S. funding provided by United States Department of the Interior, Bureau of Reclamation via an Interagency Agreement with the U.S. IBWC through the process established between both Sections.

<sup>8</sup> Implementation monitoring includes plant density, survival, and growth 2x/yr during the first two years of site establishment.



Figure 3. Habitat maintenance and management activities included irrigation ditch maintenance, removal of invasive or non-native species, and irrigation.



### 3.2 CHAUSSÉ

**SITE MANAGER:** Restauremos El Colorado, A.C. (“Restauremos”)

Chaussé is located in Reach 4 and includes an old meander of the Colorado River as a level 4 restoration area.

Table 8. Habitat Restored by Phase at Chaussé

Phase	Year	Has	Acres
I	2016-2018	53.0	131
II	2018-2019	9.3	22.9
Total		62.3	153.9

Phase 1 (see Figure 5) included the installation of two dams and one delivery point on the Canal Alimentador del Sur as well as grading and planting the site. Phase II (see Figure 5) includes the 2.1 km long corridor along the main channel of the Colorado River within the Chaussé land concession. Both phases of Chaussé were fully planted by the end of 2018, thus in 2019 all of Chaussé was under its first year of maintenance (62.6 hectares/155 acres total).

At the Chaussé restoration site, water control structures are used to fill an old river meander and mimic natural flooding. As a result, it has been possible to enable the creation of habitat types in 54 has (133 Ac) not possible at sites where irrigation is limited to flood, furrow, and drip operations. In addition, the site design benefits the river by allowing water to return to the main river channel after irrigating Chaussé.

#### HABITAT RESTORED

In 2019 Restauremos’ activities in Chaussé focused on maintenance and management of previously restored areas.

Table 9. Chaussé restoration work (acreage by habitat type and by year).

Habitat Type	Chaussé I & II (2019 maintenance only)	
	Has	Ac
Open water/Marsh/Wetland	8.3	20.5
Cottonwood/Willow	19.5	48.2
Mesquite	5.5	13.6
Mesquite upper terrace	29	71.7
Total Area	62.3	153.9

## 2019 FUNDS EXPENDED AND FUNDING SOURCE:

Table 10. 2019 Chaussé Funds Expended and Funding Source per commitments in Minute 323 (USD)

Activity	Funding Source (NGO)
Maintenance & revegetation	\$381,598
Water delivery fees	\$93,437
Implementation monitoring	\$60,255
Total	\$535,290

## HABITAT MAINTENANCE AND MANAGEMENT ACTIVITIES

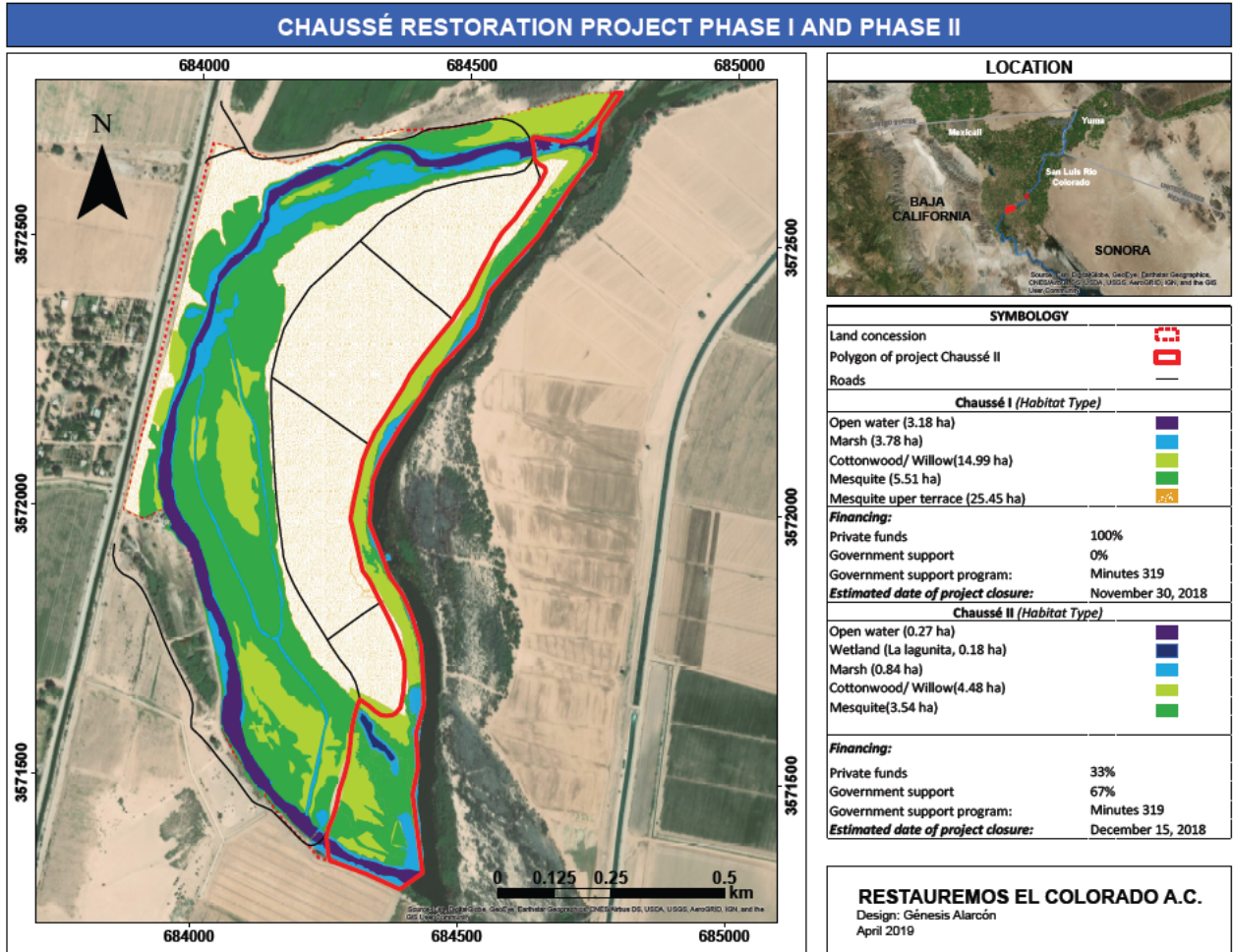
The Chaussé restoration site is located within the riparian corridor of the Colorado River floodplain in Mexico. It is located in Reach 4 and includes an old meander of the Colorado River that was rehabilitated in the first stage; two water delivery points for the Canal Alimentador del Sur have been built. The total area of Chaussé is 62.6 hectares (155 acres) in the floodplain of the river (federal zone in the jurisdiction of CONAGUA given as concession to Pronatura Noroeste AC).

The Chaussé restoration team consists of 20 people and 4 full time pick-up trucks dedicated to the site plus 3 more people in charge of water programming, delivery and monitoring.

2019 habitat maintenance and management activities at Chaussé included:

- Irrigation of all planted areas monthly (except pole-planted area)
- Maintenance and repair of all water control structures (except pole-planted area)
- Clearing invasive vegetation throughout the site
- Repair of and expansion of capacity in nurseries
- Plant production
- Replanting of eroded areas
- Repairs to the pumping, filtering and drip irrigation systems
- Repairs to levees and metal structures of gates (central and levees)
- Vegetation (survival) and hydrological monitoring (daily measurements on days of water deliveries and piezometers)

Figure 4. Maintenance Areas of Chaussé I & II (2019).



Figures 5, 6, 7, 8, 9 & 10. Maintenance and Management Activities in Chaussé



### 3.3 LAGUNA GRANDE

**SITE MANAGER:** Sonoran Institute (SI)

Sonoran Institute acquired three land concessions that make up the Laguna Grande restoration site in 2008. Small-scale restoration occurred from 2009-2012, with most projects located in the CILA Site land concession. The area has been restored in phases from 2013-2019, with areas of 20-71 hectares (49-175 acres) being restored at a time (land clearing, planting, irrigation). In 2019, the 10th year of restoration activities, Sonoran Institute focused on providing habitat maintenance and management to the 224 has (553 acres) of actively restored area and preparing 4 ha (10 acres) of land for planting. Maintenance activities in the 224 has (553 Ac) were as followed:

- 150 has / 370 Ac irrigated;
- 70 has / 173 Ac of invasive species removed;
- 4 has / 9.88 Ac revegetated.

Additionally, with support from 75 volunteers, Sonoran Institute planted 300 native trees in 0.4 ha (1 acre) of an old river meander (oxbow). Sonoran Institute expects to increase the restored area to at least 275 hectares / 679 Ac by the end of Minute 323.

#### 2019 FUNDS EXPENDED AND FUNDING SOURCE PER COMMITMENTS IN MINUTE 323

Table 11. 2019 Laguna Grande Funds Expended and Funding Source (USD)

	Funding source		Total	Units	Number of Units
	US	NGO			
Planning and design	\$11,213	\$0	\$11,213	Lot	1
Planting activities (site preparation and production of native plants)	\$33,109	\$0	\$33,109	Ha	0.4
Tree planting	\$0	\$1,125	\$1,125	Tree	300
Maintenance & revegetation	\$86,250	\$27,000	\$113,250	Ha	223.79
Water delivery fees	\$20,882	\$26,889	\$47,772	HaDR	518
Implementation monitoring <sup>9</sup>	\$22,138	\$0	\$22,138	N/A	N/A
Land and water protection	\$0	\$7,255	\$7,255	Ha	20
Project management	\$12,743	\$0	\$12,743	Project	1
<b>Total</b>	<b>\$186,335</b>	<b>\$62,269</b>	<b>\$248,605</b>		

<sup>9</sup> Implementation monitoring includes plant density, survival, and growth 2x/yr during the first two years of site establishment as well as water delivery monitoring and is included in the restoration eligibility criteria.

**HABITAT RESTORED:**

In 2019 Sonoran Institute restored 4.7 ha (11.6 Ac) of cottonwood/willow and 8.5 ha (21 Ac) of mesquite bosque at the Laguna Grande restoration site. Restoration activities primarily included tree production and planting, with 13,602 trees, shrubs, and herbaceous species planted or seeded.

Table 12. Areas restored in 2019 at the Laguna Grande restoration site.

Habitat Type	Area Restored	
	Ha	Acres
Cottonwood/Willow	4.7	11.6
Mesquite bosque	8.5	21.0
Total	13.2	32.6

Figures 11 and 12. Sonoran Institute’s annual tree planting event during the orientation session (left) and the planting of native trees (right) with volunteers and board members.



Figures 13 and 14. Sonoran Institute’s annual tree planting event before (left) and during the planting of native trees (right) with volunteers and board members.



**VEGETATION PLANTED:**

Table 13. Number of trees established at Laguna Grande in 2019

Common name	Scientific name	Number
Fremont cottonwood	<i>Populus fremontii</i>	180
Honey mesquite	<i>Prosopis glandulosa</i>	30
Coyote willow	<i>Salix exigua</i>	30
Gooding's willow	<i>Salix gooddingii</i>	60
Total		300

**RESTORATION ACTIVITIES:**

Figures 15 and 16. Production of cottonwood and willow cuttings and mesquite seeds germination, in the Sonoran Institute tree nurseries.



Figures 17 and 18. Production of cottonwood and willow cuttings and mesquite seeds germination, in the Sonoran Institute tree nurseries. Field Staff performing activities in the nursery, such as flowering, pruning, and daily plant irrigation.





Figures 19 and 20. Sonoran Institute personnel in prospect visits. During the visits, soil samples were taken, groundwater levels were registered, and present vegetation was registered. The collected information will be used in the site's restoration design.



Figures 21 and 22. Soil sampling in the Laguna Larga Phase I site.



Figures 23, 24, 25 and 26. Invasive species removal to prepare new sites for future planting.



Figures 27 and 28. Hydroseeding a restoration site in Cori land concession with native tree, shrub, and herbaceous species.



**HABITAT MAINTENANCE AND MANAGEMENT ACTIVITIES:**

Habitat maintenance and management activities included manual removal of reemerging nonnative species, irrigation canal repairs, replanting with native trees, irrigation of restoration sites, and payment of water delivery fees.

Table 14. Existing Area Maintained and Managed at Laguna Grande in 2019

Habitat Type	Area Maintained & Managed	
	Ha	Acres
Open water/marsh/wetland	3.87	9.55
Cottonwood/Willow	155.52	384.13
Mesquite upper terrace	6.1	15.06
Mesquite Bosque	58.3	144
<b>TOTAL</b>	<b>223.79</b>	<b>552.74</b>

Figures 29 and 30. Nonnative Vegetation removal (primarily salt cedar and arrow weed) in existing restoration sites.



Figures 31 and 32. Nonnative vegetation removal along an irrigation canal.



Figures 33 and 34. Replanting in Cori Phase IV and CILA Sites.



Figures 35, 36, 37, 38. Watering sites.



### 3.4 ESTUARY

**SITE MANAGER:** Sonoran Institute

#### 2019 FUNDS EXPENDED AND FUNDING SOURCE:

Table 15. Estuary 2019 Funds Expended Per Commitments in Minute 323, and Funding Source (USD)

Restoration Activities	US <sup>10</sup>	NGO	Total
11.76 kilometers (7.30 miles) dredged along the main river channel and in an old meander.	\$204,790	\$42,420	\$247,211
5 culvert installation	\$0	\$31,143	\$31,143
Staff time during implementation	\$7,114	\$34,031	\$41,146
Travel expenses related to restoration activities	\$3,080	\$7,587	\$10,667
Total	\$214,985	\$115,181	\$330,167

#### RESTORATION ACTIVITIES

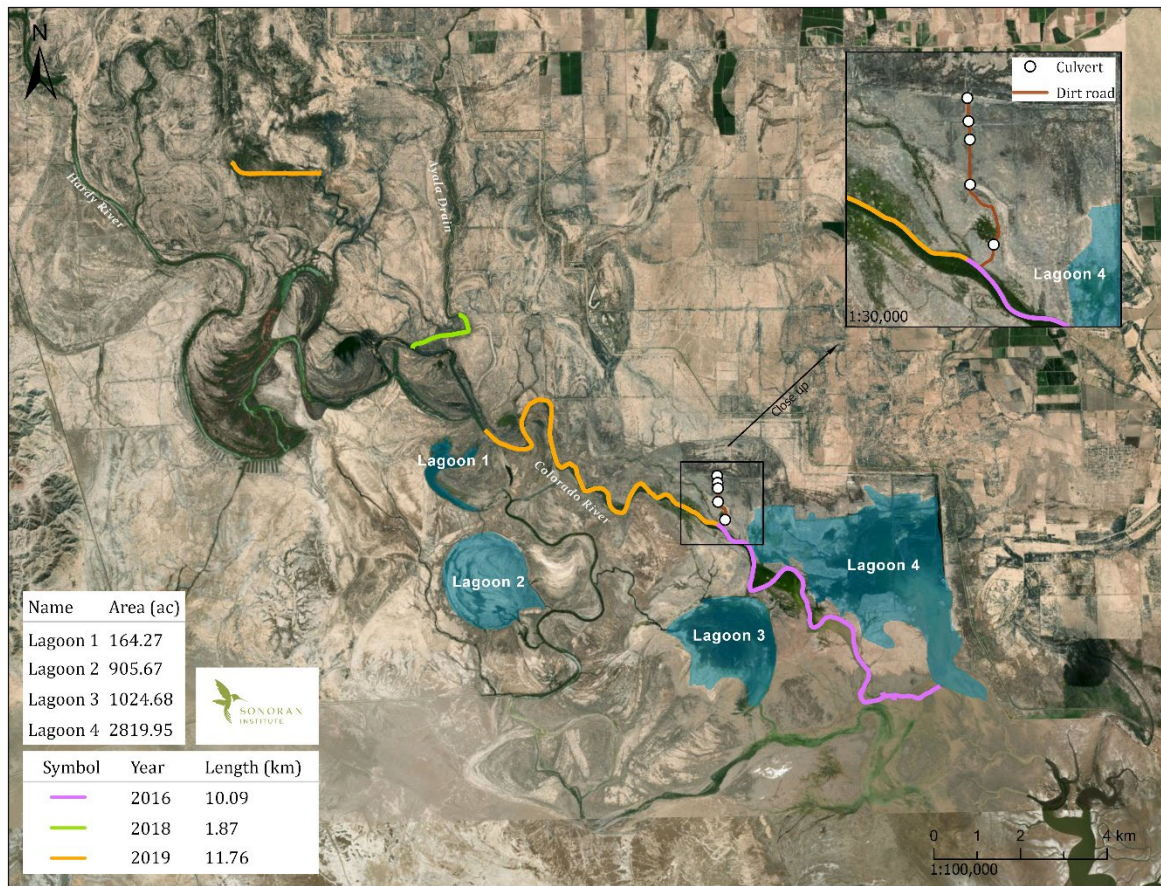
From 2016 to 2018, 11.96 km (7.43 mi) were dredged along the main river channel and the Ayala drain to improve connectivity of agricultural drainage flows to the upper estuary (Figure 38). In 2019, an additional 11.76 km (7.30 mi) were dredged, increasing the cumulative kilometers of dredged river-tidal channel to 23.72 km (14.73 mi). In addition to dredging activities, five culverts were installed in key points in the estuary to improve water flow from the main river channel to secondary channels and flooding zones.

In 2019, Sonoran Institute convened a group of experts (that includes TNC, Steve Nelson as independent researcher, CONANP/RBAGCyDRC<sup>11</sup>, Pronatura Noroeste, CIAD Guaymas, Facultad de Ciencias - UABC, Instituto de Ingeniería - UABC, and Sonoran Institute), who evaluated the results of an estuarine hydraulic model and recommended a three-phase dredging plan to inundate the largest possible area. The 11.76 km (7.30 mi) dredged in 2019, which consist of 9.57 km (5.94 mi) along the main river channel and 2.18 km (1.35 mi) in an old meander, complete the first phase of the plan.

<sup>10</sup> U.S. funding provided by the U.S. Fish and Wildlife Service via the North American Wetlands Conservation Act.

<sup>11</sup> Reserva de la Biosfera Alto Golfo de California y Delta del Río Colorado

Figure 39. Areas where sediment was removed to increase river-sea connectivity, 2016-2019. Source: Sonoran Institute, 2019.



### 3.5 HARDY RIVER

**SITE MANAGER:** Sonoran Institute

In 2019, Sonoran Institute collaborated with partners on a restoration demonstration project to transform 10 acres (4.04 ha) of salt-cedar-choked private land in the Hardy River into restored habitat for wildlife and future ecotourism opportunities.

Figures 40 & 41. Before (left) and after (right) implementing the demonstration restoration project on private land along the Hardy River.



In 2019, Sonoran Institute analyzed the survival rate of the planted trees and based on the results, provided the landowners with 210 additional native trees for replanting. They also conducted maintenance on the drip irrigation systems to ensure their efficiency and tree survival.

The 10-acre (4.04 ha) project has sparked the interest of neighboring river users to restore their lands. In fact, SI is in the process of formally collaborating with the Cucapa tribal group to replicate this community-based restoration model and restore 10-20 acres (4.04 – 8.08 ha) of riparian habitat on tribal land in the next two years. Working with Cucapa tribal members, SI identified potential tribal sites to be restored (Figures 13-14) and are reviewing site feasibility, including land and water titles.

Figures 42 & 43. Cucapa tribal leader, Antonia Torres, showing Sonoran Institute's staff the potential site to implement a community-based restoration project.



## 4 LAND CONCESSIONS

Mexico's National Water Commission (CONAGUA) has provided concessions for all lands on which habitat restoration takes place under Minute 323. These concessions grant rights to land use for 30 years. Mexico identified the 2019 annual value of these concessions as \$1,619,704 (USD). Under Article 233, Section IV of Mexico's Federal Law of Rights (Ley Federal de Derechos), concessions on federal lands held for the purpose of protection and conservation are exempt from payment for use, possession or exploitation. Specifically, not-for-profit civil associations that hold a concession or permit for environmental conservation or restoration of beaches, federal estuarine lands, as well as federal zones managed by CONAGUA are not required to pay standard land concession fees. CONAGUA's contribution provides certainty to the organizations engaged in restoration.

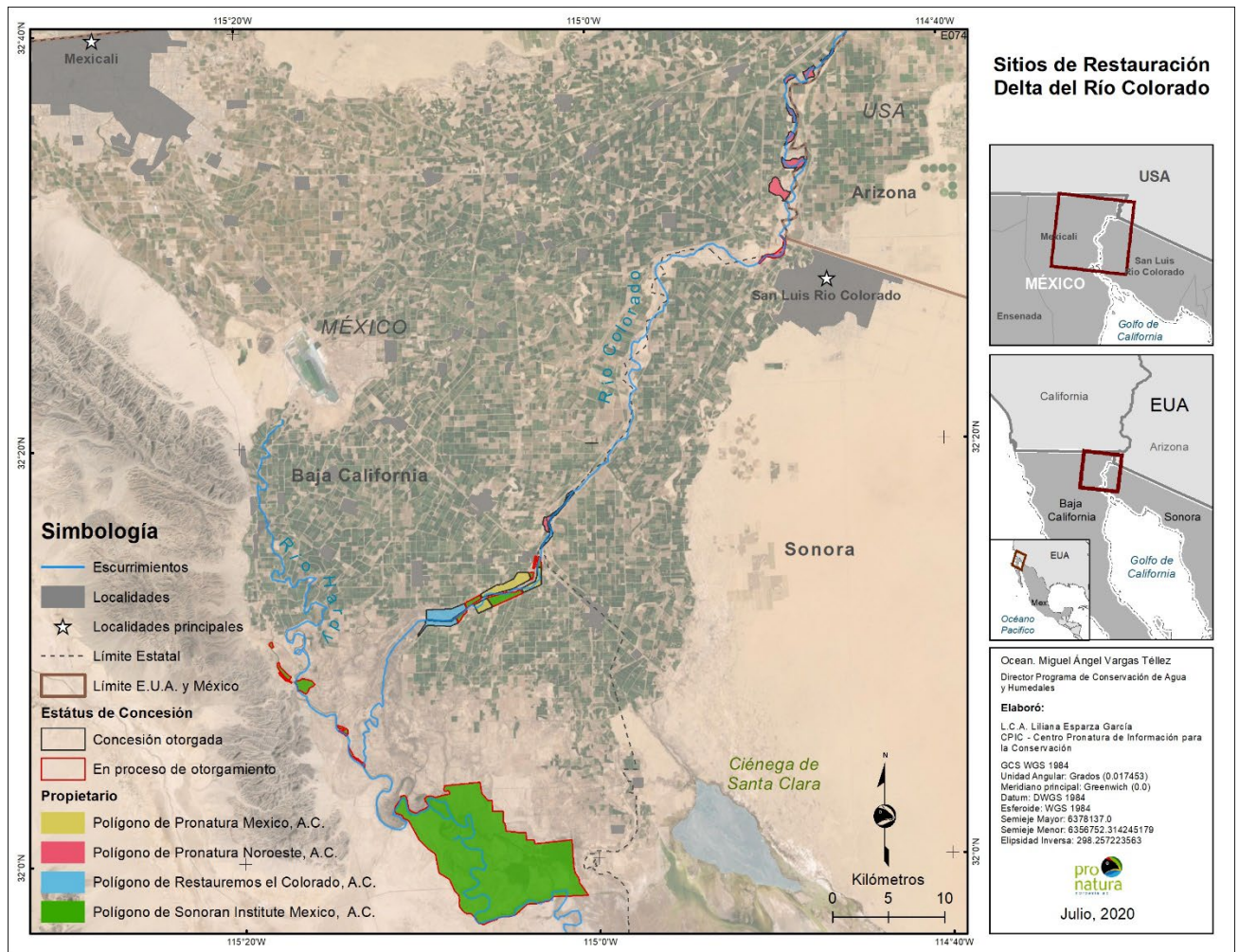
Table 16. Land Concessions per Restoration Site and Monetary Value

			2018		2019	
			MXN	USD	MXN	USD
Cost per square meter of federal zone given under concession			\$3.26	\$0.16	\$3.41	\$0.17
Cost per hectare of federal zone given under concession			\$32,595	\$1,694	\$34,130	\$1,772
	Ha	Acres				
Pronatura Noroeste	354.50	875.99	\$11,554,928	\$600,567	\$12,099,085	\$628,198
Restaremos el Colorado	559.52	1382.60	\$18,237,673	\$947,904	\$19,096,418	\$991,507
<b>Total</b>	<b>914.02</b>	<b>2258.59</b>	<b>\$29,792,601</b>	<b>\$1,548,471<sup>12</sup></b>	<b>\$31,195,503</b>	<b>\$1,619,704</b>
Exchange rate pesos/US dollar			\$19.24		\$19.26	

Sonoran Institute submitted two applications for land concessions where future restoration projects are expected to take place. One application is for land areas in Reach 4 for 426.74 hectares, submitted in 2018. In February of 2019 Sonoran Institute submitted a second application for land concession of several polygons totaling 285.36 hectares in the Rio Hardy region (Reach 6). Both requests are pending approval by CONAGUA.

<sup>12</sup> The cost per square meter in the 2018 implementation report has been updated to \$1,694 per hectare.

Figure 44. Federal land concessions in the Colorado River Delta, approved and pending. Source: Pronatura Noroeste.



## 5 WATER DELIVERIES

Water delivery for environmental benefit in the Colorado River Limitrophe and Delta is a joint U.S.-Mexico cooperative program that is being undertaken during the nine-year period of Minute 323. The Environmental Work Group developed a Water Delivery Programmatic Framework, as well as the water delivery section of the 2019 Colorado River Limitrophe and Delta Water Delivery and Restoration Plan. The total volume of water delivered under Minute 323 in 2019 is consistent with these plans. Occasionally, the timing of deliveries was inconsistent with the plan.

Total volume in water year 2019: 13,579,874 m<sup>3</sup> (11,009 acre-feet).

All water supplied in the 2018-2019 water year is from the NGO water trust. There were no federal water deliveries in 2019.



Table 17. – 2019 Water Deliveries to Restoration Sites and to the River Channel

Water Year 2019 (October 1, 2018 – September 30, 2019)			
Modulo	Site and Canal	m <sup>3</sup>	AF
7	Miguel Aleman - Canal Reforma	1,194,048	968
7	Km 27 Conagua - Canal Reforma	545,225	442
8	Chaussé - Alimentador del Sur	4,976,986	4,035
8	Herradura - Alimentador del Sur	1,299,197	1,053
8	Vertedor - Alimentador del Sur	376,790	305
8	Cori - Alimentador del Sur	550,195	446
8	Km 30 - Alimentador del Sur	163,123	132
22	CILA Site - Canal Barrote Margen Izquierda	716,861	581
22	Fase 1 - Canal Barrote Margen Izquierda	939,686	762
22	Vertedor Km 21 - Canal Barrote	1,882,310	1,526
22	Estuary Lateral 27+485 y 22 (Dren Plan de Ayala)	935,453	758
	Total volume delivered	13,579,874	11,009

Figures 45, 46, 47, 48, 49 and 50. Activities related to water delivery and monitoring.



## 6 MONITORING

Scientific research and monitoring in the Colorado River Delta in 2019 were a joint U.S.-Mexico cooperative effort implemented to be consistent with the Environmental Work Group's Monitoring Programmatic Framework and 2019 Monitoring and Science Plan. Monitoring results are reported separately every two years. This report only covers expenditures for monitoring efforts.

The objectives of scientific research and monitoring at restoration sites include:

- measure environmental restoration outcomes and quality;
- develop information to improve environmental restoration outcomes through an adaptive management process; and
- reduce scientific uncertainty, when feasible.

During annual joint meetings, restoration practitioners and binational scientists provide updates on water deliveries, management, and restoration activities and outcomes; 2) discuss monitoring results; 3) compile lessons learned; 4) recommend management improvements; and 5) determine next phases of experimentation and adaptive management based on results.

Monitoring in 2019 was extensive but there were a number of gaps including:

- Foliar cover of trees and shrubs was not measured via drone surveys at Miguel Aleman.
- Post-restoration Soil salinity
- Systematic repeat photography
- Some groundwater level data from SI for Laguna Grande
- Bimonthly instead of monthly groundwater level data from UABC (riparian corridor plus two piezometers in Chaussé and three piezometers in Miguel Alemán)
- Surface water stage and discharge monitoring in the river channel at sites DMS-5 through DMS-12, DMS-16, DMS-17

Table 18. 2019 Monitoring Accounting for Minute 323 (USD)

Monitoring activity	Funding source			Total
	MX <sup>13</sup>	US <sup>14</sup>	NGO	
Hydrology	\$56,957	\$96,034	\$52,787	\$205,778
Vegetation	\$0	\$172,346	\$15,000	\$187,346
Wildlife	\$32,000	\$43,400	\$114,558	\$189,958
Estuary	\$0	\$23,011 <sup>15</sup>	\$151,635	\$174,646
Social	\$0	\$9,744	\$5,850	\$15,594
Management	\$8,471	\$591,280	\$19,200	\$610,480
<b>Total Monitoring</b>	<b>\$97,428</b>	<b>\$935,815</b>	<b>\$359,030</b>	<b>\$1,383,802</b>

<sup>13</sup> Funds provided by CONAGUA and the University of Baja California (UABC)

<sup>14</sup> Funds provided by U.S. Bureau of Reclamation or as in-kind from the U.S. Geological Survey

<sup>15</sup> Funds provided by the U.S. Fish and Wildlife Service under the North American Wetlands Conservation Act

## 6.1 HYDROLOGY

Table 19. Hydrology Monitoring 2019 Funds Expended and Funding Sources per commitments in Minute 323

Monitoring Parameter	Responsible Entity	Funding Source			Total 2019 Expenditure (USD)
		MX	US	NGO	
Groundwater depth and elevation (monthly)	UABC	\$56,957	\$0	\$0	\$165,155
	SI	\$0	\$77,717	\$26,514	
	PN	\$0	\$577	\$3,390	
Surface and groundwater quality (freshwater)	SI Hardy River and estuary	\$0	\$4,750	\$21,182	\$25,932
Water deliveries: surface water stage and flow rate at each water delivery point (daily or more)	SI	\$0	\$12,990	\$1,700	\$14,690
Total		\$56,957	\$96,034	\$52,786	\$205,777

Figure 51. Measuring groundwater levels in the CILA restoration site



Figure 52. Measuring flows in a canal in the Herradura restoration site.



## 6.2 VEGETATION

In 2019, Sonoran Institute implemented vegetation indicator monitoring at all the restoration sites, which includes: average foliar cover of woody species and target restoration species (annual via ground surveys and drones); total vegetation volume (annual); canopy height of mesquite (annual). Sonoran Institute, Pronatura Noroeste and Restauremos el Colorado also conduct vegetation implementation monitoring, which consists of monitoring plant survival at restored areas during the first two years. Implementation monitoring includes plant density, survival, and growth twice per year during the first two years of site establishment as well as water delivery monitoring and is included in the restoration eligibility criteria. Vegetation implementation monitoring is reported under restoration activities.

In 2019, the United States Geological Survey (USGS) implemented the following tasks:

- Conducted historical analysis of vegetation index (VI) data using NDVI and scaled NDVI as well as EVI and other VIs as input to an evapotranspiration (ET) algorithm. Produced VI and ET for individual restoration areas using Landsat and MODIS spatial resolutions for years 2013 to present.
- Analyzed time-series VI and ET trends between 2000-2019 and focused on years prior to the pulse and after the pulse.
- Analyzed the time-series VI and ET trends using annual, monthly and seasonal divisions to evaluate a new phenology assessment metric (PAM).
- Populated the Vegetation Index and Phenology (VIP) server with the information from the VIs and the ET based on the selected VIs for the riparian corridor's seven reaches.
- Interpreted and reported on tree growth and mortality data from pilot study in Limitrophe, collect and interpreted new pilot data from four CILA Site restoration parcels, and prepared summary report.

Table 20. Vegetation monitoring 2019 Funds Expended and Funding Sources per commitments in Minute 323

Monitoring Activity	Implementing organization	2019 funding source (Minute 323 only) <sup>16</sup>		2019 Expenditure (USD)
		US	NGOs	
INDICATOR vegetation monitoring: Average foliar cover of woody species and target restoration species (annual via ground surveys and drones); total vegetation volume (annual); canopy height of mesquite (annual).	SI	\$48,346	\$0	\$48,346
Remote sensing data acquisition, processing, storage, and analysis for ET quantification for riparian zones in 7 reaches and restoration areas.	USGS	\$0	\$15,000	\$15,000
Assess relationship between historical flow records and tree ring growth in the Limitrophe to provide information on drought tolerance thresholds of native species, which will serve to inform restoration site water management.	USGS	\$124,000	\$0	\$124,000
<b>Total vegetation monitoring</b>		<b>\$172,346</b>	<b>\$15,000</b>	<b>\$187,346</b>

<sup>16</sup> Mexican cost share is shown in Table 21 (p. 29) for hydrology activities

Figures 53 and 54. Vegetation monitoring



### 6.3 WILDLIFE 2019 FUNDS EXPENDED AND FUNDING SOURCES

Table 21. Wildlife monitoring expenditures and funding sources

Monitoring Activity	Implementing organization	2019 Funding Source			2019 Expenditure (USD)
		MX	US	NGOs	
Marsh bird abundance and composition (3x/yr.)	PN	\$0	\$0	\$24,426	\$24,426
Riparian bird abundance and diversity (3x/yr.)	PN	\$8,000	\$0	\$31,082	\$39,082
Shorebird abundance and diversity (2x/yr.)	PN	\$0	\$0	\$0	\$0
Colonial nesting water bird abundance and productivity in the Estuary (2x/yr.)	PN	\$0	\$0	\$14,656	\$14,656
Water bird abundance and diversity in the Hardy River and Estuary (4x/yr.)	PN	\$10,000	\$0	\$19,312	\$29,312
Monitoring Avian Productivity and Survivorship (MAPS) - bird banding (3 sites, 10 banding events)	PN	\$14,000	\$0	\$25,082	\$39,082
Monitoring of Overwintering Survival (MoSI) - bird banding (3 sites, 5 pulses)	PN	\$0	\$0	\$0	\$0
Analysis to correlate birds to vegetation	USGS	\$0	\$43,400	\$0	\$43,401
Total wildlife monitoring		\$32,000	\$43,400	\$114,559	\$189,959

The study area for bird monitoring is located within the floodplain of the Colorado River in Baja California and Sonora, Mexico, from Morelos Dam downstream to the confluence of the Colorado with the Hardy River. The floodplain traverses the Mexicali Valley toward the Sea of Cortez and is confined by flood control levees on both banks. This study area includes the main stem of the Colorado River in Mexico, secondary streams, and backwater lagoons, as well as the dry sections of the floodplain, covering 17,630 ha (43,564 Ac) and extending for 95 river kilometers (59.03 mi).

In 2019 Pronatura Noroeste monitored bird metrics such as marsh bird surveys, riparian standardized point counts, census of water bird colonies, Hardy River and estuary point counts, MAPS and MoSI.

The USGS led the planning and development of data compilation and analysis of bird occurrence and abundance in relation to vegetation and environmental variables at multiple scales and reviewed available bird survey data and associated spatial and vegetation data and worked on the 4-year plan.

Figure 55. Juan Butron Y Carlos Medina doing the call response survey at south of Hardy River



Figure 56. Bird banding at the Miguel Alemán Restoration Site



Figure 57. Juan Butron measures the water table level at the Miguel Aleman



Figure 58. Cattle Egret Chick



Figure 59. Monitoring in the upper part of the estuary during the winter of 2019.



Figure 60. Northern Shoveler (*Spatula clypeata*). - One of the most abundant duck species in the estuary

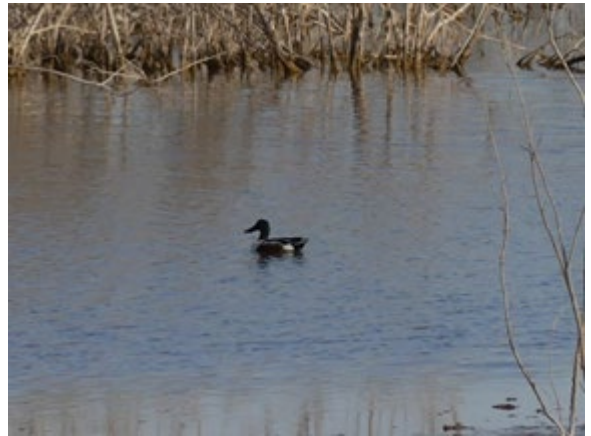


Figure 61. Bird banding (MoSI) in Laguna Grande, February 2019.



Figure 62. Abert's Towhee (*Melospiza aberti*) during the Monitoring of Overwintering Survival (MoSI) in Laguna Grande.



**6.4 ESTUARY MONITORING**  
**2019 FUNDS EXPENDED AND FUNDING SOURCE:**

Table 22. Funds expended in monitoring activities in 2019 and funding source (all implemented by Sonoran Institute)

Monitoring Activity	2019 Funding Source (Minute323 only) <sup>17</sup>		2019 Expenditure (USD)
	US <sup>18</sup>	NGOs	
Estuarine vegetation cover and composition (>=annual)	\$23,011	\$151,635	\$174,646
Zooplankton abundance and diversity (2/yr)			
Post-larval shrimp species presence (2/yr)			
Surface water quality in estuary (T, DO, EC)			
Analysis and interpretation of estuary monitoring data			
Surface flow and groundwater monitoring in estuary			
<b>Total</b>	<b>\$23,011</b>	<b>\$151,635</b>	<b>\$174,646</b>

In October 2019, two piezometers were constructed and instrumented with pressure transducers (Levellogger Edge Model 3001 from Solinst) in the Estuary Pz-12 (677,355.58 E; 3,546,852.933 N) and Pz-13 (680,125.37 E; 3,548,195.61 N).

In September 2019, two Discharge Measurement Stations in the upper part of the Hardy River (monitored with SonTek FlowTracker 2), DDT and PTD were enabled and instrumented with pressure transducers (Levellogger Edge Model 3001 from Solinst). At these same points, two multi-parameter probes were also installed to monitor water quality (YSI Model EXO 1 of Xylem Inc.).

<sup>17</sup> Mexican cost share is shown in Table 21 (p. 29) for hydrology activities

<sup>18</sup> U.S. funding provided by the U.S. Fish and Wildlife Service under the North American Wetlands Conservation Act.



Figure 63. Map of hydrology monitoring sites in the lower Delta and upper Estuary.

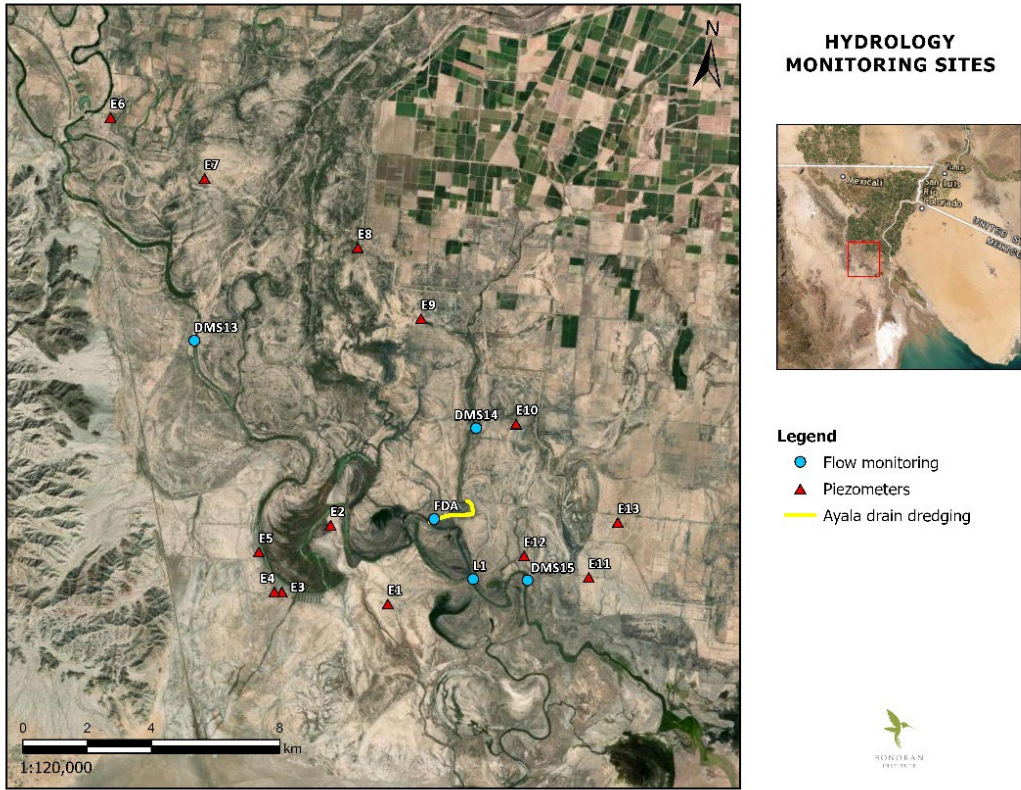


Figure 64. Map of hydrology monitoring sites in the lower Delta

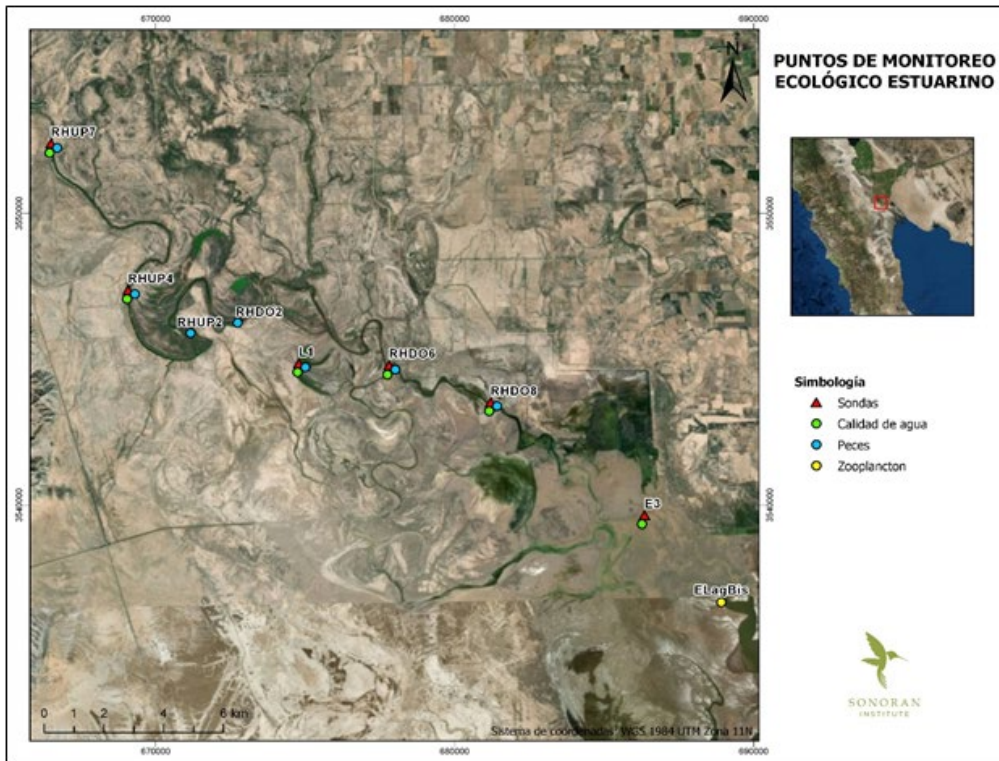


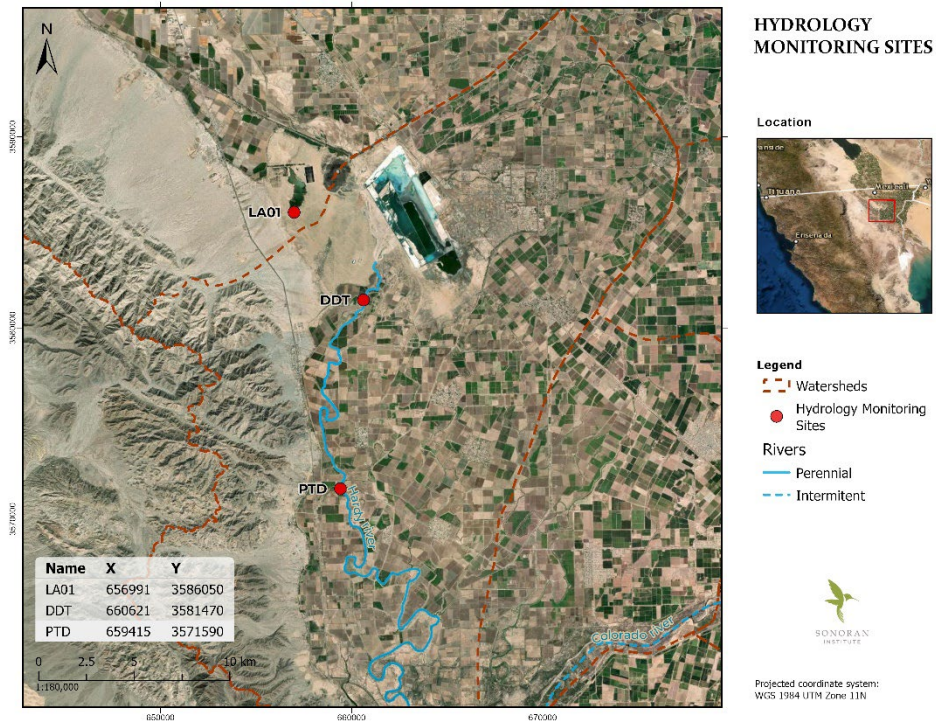
Figure 65. Monitoring in the lower Hardy River.



Figure 66. Zooplankton monitoring in the estuary.



Figures 67. Location of Discharge Measurement Stations on Hardy River.



Two multiparameter probes were placed--one at the RHUP7 site and another at RHDO8--for continuous measurement of the temperature, salinity, and water level parameters.

Figure 68. Estuary piezometer drilling, 2019



Figure 69. Downloading data from sensors installed in the estuary, 2019.



Figures 70. Measuring groundwater levels in the estuary, 2019.



Figures 71, 72, and 73. Water quality monitoring in the Estuary, 2019



Figures 74 y 75. Measuring water flows in the Hardy River, 2019.



## 6.5 DATABASE CONSTRUCTION AND MANAGEMENT

In 2019, a database was developed to provide a repository of information on monitoring and restoration with respect to vegetation, birds and water. USGS, IBWC, CILA, UABC, the Bureau of Reclamation, and the Nature Conservancy led this effort in coordination with the Environmental Work Group. A process was developed for planning, discussions, and selection of a database platform, established a pilot relational database structure<sup>19</sup>,

<sup>19</sup> A relational database focuses on the relation between stored data elements

and initiated a preliminary plan for workflow including definitions of roles and responsibilities. USGS funding for database work was \$112,823 (Table 25).

## 6.6 SOCIAL

### Community Engagement in 2019

In 2019, Pronatura Noroeste (PNO) carried out 111 environmental education activities in 5 strategic lines of action: 1) Environmental education workshops; 2) Tree planting; 3) guided visits; 4) participation in environmental events and 5) promotion of citizen science. These activities involved the participation of 3,629 people. Pronatura Noroeste also promoted reforestation and donation of 8,116 native trees in the region benefitting communities and the environment.

Sonoran Institute (SI) carried out 81 environmental education activities: 1) Environmental education workshops; 2) Restoration site guided visits; 3) Sábados familiares en Laguna Grande, 4) participation in environmental events and 5) tree plantings. These activities involved the participation of 2,805 people.

Table 23. Community engagement in the Colorado River Delta, 2019

Category	Pronatura Noroeste		Sonoran Institute		Total	
	Participants	# Events	Participants	# Events	Participants	# Events
Talks and workshops	1,886	64	1255	28	3,141	92
Restoration site visits	219	11	963	40	1,182	51
Participation in Expos	354	6	300	4	654	10
Tree plantings	1,086	27	90	1	1,176	28
Sábados Familiares en Laguna Grande	0	0	197	8	197	8
Citizen science	84	3	0	0	84	3
<b>Total</b>	<b>3,629</b>	<b>111</b>	<b>2,805</b>	<b>81</b>	<b>6,434</b>	<b>192</b>

Figures 76, 77, 78 and 79 – Outreach activities by PNO in 2019

Tree planting at community park in Ejido Lagunitas, San Luis Río Colorado, Sonora



Volunteers planting trees at Miguel Alemán Phase III



Northern Arizona University visiting PNO nurseries



Promoting native tree donations at Health Fair in Ejido Mesa Rica1, San Luis Río Colorado, Sonora



Figures 80, 81, 82, and 83 – Outreach activities by SI in 2019

Children identifying wildlife in Laguna Grande



School visits at Laguna Grande



Visitors at Laguna Grande



Environmental education activities in schools.



### Socio-ecological survey

In 2019, Sonoran Institute conducted a socio-ecological survey to assess the perception of communities in the Mexicali Valley region on the impacts generated by restoration and conservation actions in the upper estuary of the Colorado River Delta. The survey was implemented in 13 different communities in the Mexicali Valley with 238 survey participants. The Carlos Slim-WWF Alliance funded this project. Additionally, Sonoran Institute continued to collect participant data to highlight the reach of the diverse engagement strategies. The following two figures provide an example of the data collected over the years.

Figure 84. Number of people engaged by group, 2014-2019. Source: Sonoran Institute, October 2019.

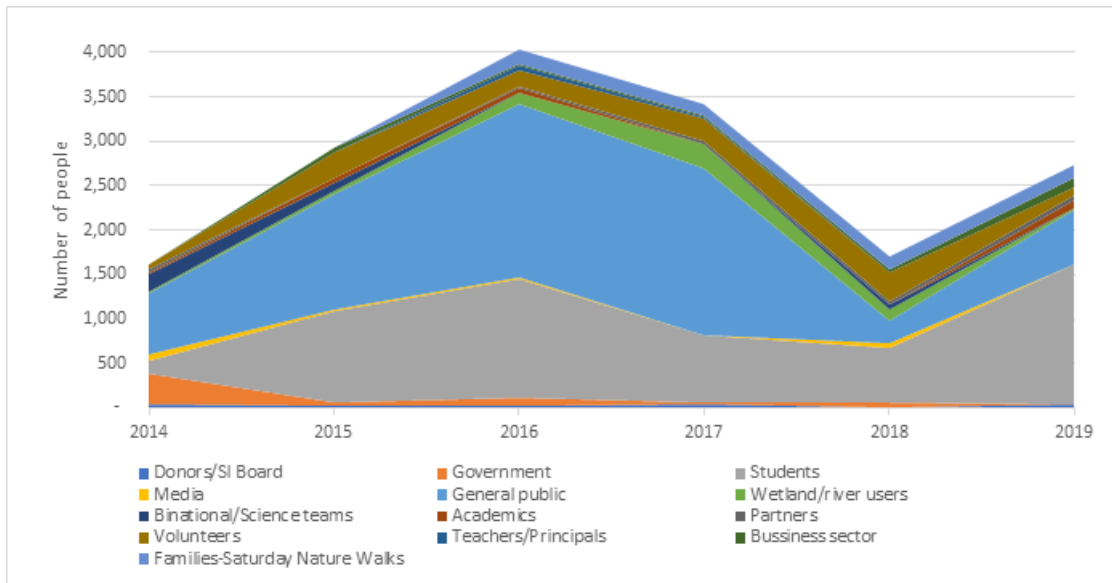
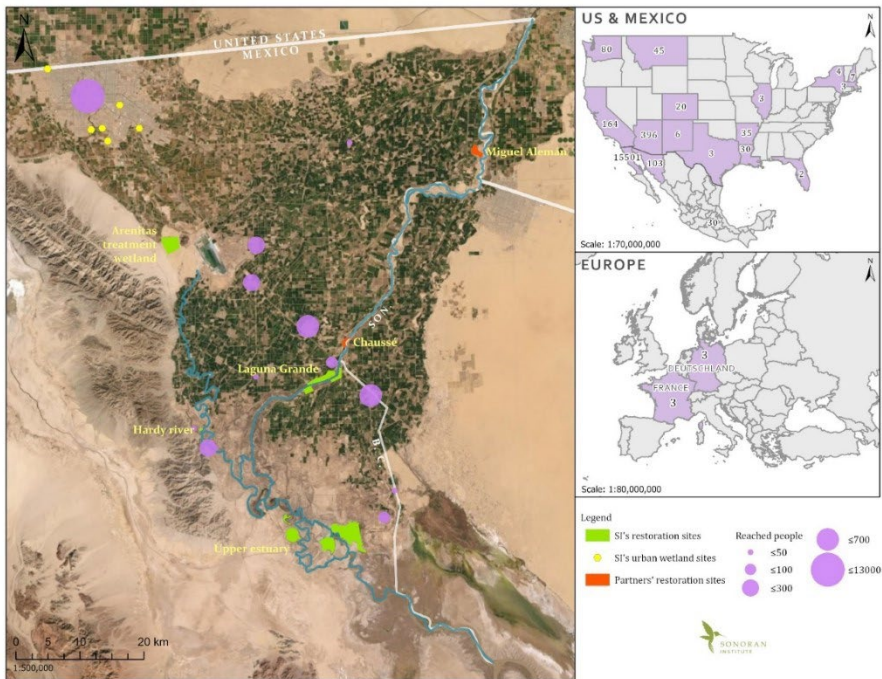


Figure 85. Number of people reached (2014-2019) via the Adopt the River program, by place of origin. Source: Sonoran Institute, October 2019.

Source: Sonoran Institute, October 2019.



To begin collecting demographic data on organized visitation/events (one of the social metrics proposed to the binational group), Sonoran Institute adjusted existing data collection forms. Data for Saturday Nature Walks was collected, analyzed and its collection process was evaluated. A similar process will be carried out for other data forms.



## FUNDS EXPENDED

The USGS conducted social monitoring consisting of literature review, review of existing data, introductions and meetings with several key members of the binational team and presented before the binational groundwater science meeting on the topic of stakeholder engagement.

Table 24. Social science monitoring and funding source

Activity	Funding source		2019 expenditure (USD)
	US	NGO	
USGS Social science	\$9,744	\$0	\$9,744
SI Socioecological survey	\$0	\$5,850	\$5,850
Total	\$9,744	\$5,850	\$15,594

## 6.7 MANAGEMENT

Management of the binational science effort consisted of reporting, coordination, accounting, hiring and training field crews, meetings, reviews, conference calls, framework development, 2019 plan development, proposals, translations, field trips, and data interpretation for adaptive management.

Table 25. Management of the binational science effort and funding source

Management of the Binational Science Effort	Funding Source			2019 Expenditure (USD)
	MX	US	NGO	
UABC	\$8,471	\$0	\$0	\$8,471
UA	\$0	\$117,460	\$0	\$117,460
USGS	\$0	\$290,000	\$0	\$290,000
TNC	\$0	\$52,902	\$0	\$52,902
SI	\$0	\$18,095	\$19,200	\$37,295
Construction, Evaluation, and Initial Management of the Database	\$0	\$112,823	\$0	\$112,823
Total	\$8,471	\$591,280	\$19,200	\$618,951

## 7 ENVIRONMENTAL WORKGROUP

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Table 26. EWG Meeting dates and locations in 2019

Date	Location	Field visit
25 April	San Diego, CA	
15-16 May	Mexicali, BC	Adaptive management workshop and field tour with science team
27 June	Imperial Beach, CA	
17-18 October	Tijuana, BC	

Figure 86. Environmental Work Group



### Plans and reports delivered to Minute Oversight Group in 2019

- Minute 323 Environmental Work Group 2018 Implementation Report
- 2020 Restoration and Water Delivery Plans
- Review Draft Restoration Programmatic Framework
- Review Draft Monitoring Programmatic Framework