

[Image]

Bio monitoring of Environmental Status and Trends Program

Contaminant Assessment Process

Final CAP Report for Bitter Lake NWR

[Image]

CAP Information (Contaminants Assessment Process)

A Contaminant Assessment Process or CAP has been conducted for this refuge. A CAP is an information gathering process and initial assessment of a U.S. Fish & Wildlife Service National Wildlife Refuge in relation to environmental contaminants. You will find information in this report on particular contaminants of concern to fish and wildlife resources on the refuge and areas of the refuge of particular interest with regard to these contaminants.

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## Transport Pathways

This section describes all of the surface water, ground water, air and biotic transport pathways pertinent to the refuge. This includes creeks and rivers in the watershed and identifies particular concern with regard to contaminant transportation.

## Surface Water Transport Pathways

Documented Surface Water Pathways:

### o Arroyo del Macho

Location of the watercourse in relation to the Interior Land:

runoff and alluvial waters travel the ephemeral Arroyo del Macho thence to the Salt Creek at the west side of Bitter Lake NWR, North Tract, Salt Creek Wilderness Area.

Description and/or comments about the surface watercourse and its importance to the study:

In the watershed of Arroyo del Macho, there is irrigated agriculture, grazing, and some oil or natural gas exploration and extraction.

### o Bitter Creek

Location of the watercourse in relation to the Interior Land:

Bitter Creek emerges in the Northwest corner of the Middle Tract of Bitter Lake NWR.

Description and/or comments about the surface watercourse and its importance to the study:

Bitter Creek is important ecologically due to the large number of endemic species which utilize the drainage.

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Topography included nearly level upland, steep bluffs, and gently sloping ground adjacent to Bitter Creek. Bitter Creek, a small intermittent stream, flows southward through the west side of the Research Natural Area into Bitter Lake. Streamflow into Bitter Creek is augmented by Dragonfly Spring, Lost River, and Sago Spring. Biologically unique wetlands are associated with Bitter Creek, Sago Spring, Dragonfly Spring, composed of varying communities of native fish, plants, birds, reptiles, and invertebrates. It is believed that the declining water levels in sinkholes reflected declining groundwater levels in the basin which directly influenced spring heads and surface flows of Bitter Creek, Lost River, and Salt Creek. Measured flows in Bitter Creek are generally lacking, and these flows may determine many of the Middle Tract's legal water rights. A legal stipulation set forth conditions associated with the United States' claims to reserved water rights for surface flow in Bitter Creek and associated seeps, essentially a right to in-stream flow. These stipulations included: 1) The Service will monitor the flow at the Bitter Creek Flume for five years (September 1996 through September 2001) and determine the daily mean flows which will be averaged to determine the monthly mean flows. A water recorder is already in place which continuously monitors flow in Bitter Creek, requiring occasional visits to download data. 2) The Service is obligated to provide our data regarding impoundment surface acreage and volume to the State Engineers Office on a yearly basis. On the USGS 7.5 quad topographic map Bitter Creek is mislabelled as Lost River.

o Lost River

Location of the watercourse in relation to the Interior Land:

Lost River emerges in the Northwest corner of the Middle Tract of Bitter Lake NWR.

Description and/or comments about the surface watercourse and its importance to the study:

Lost River is groundwater fed. It emerges at its confluence with Bitter Creek. It is highly vulnerable to groundwater withdrawals and pollution as it supports nearly a dozen rare or federally listed endemic species. On the USGS 7.5 minute quadrangle topographic map the Lost River is mislabelled in place of Bitter Creek

o NPDES Outfall NM00203011, City of Roswell WWTP effluent discharged to Hunter Marsh until 1981

Location of the watercourse in relation to the Interior Land:

Treated (1,2) effluents from the City of Roswell were discharged to Hunter Marsh until 1981. The large red clay pipe is still visible amongst marsh plants. However, the City of Roswell now discharges WWTP effluents (treated 3) to Berrendo Creek, thence to the

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Rio Hondo (through the Lower Tract (former White Ranch)  
thence to the Pecos River.

Description and/or comments about the surface watercourse  
and its importance to the study:

This outfall likely represents a past source of environmental contaminants that are frequently associated with urbanized areas (and not found elsewhere on the refuge) including lead, cadmium, mercury, zinc, PCBs, and various organochlorine and polycyclic aromatic hydrocarbon substances.

o Pecos River

Location of the watercourse in relation to the Interior  
Land:

A portion of the Pecos River is on each tract of the Bitter Lake National Wildlife Refuge. The Pecos River runs through all three units of the refuge, located at the transition zone between the short grass prairie and the Chihuahuan Desert. At its origin, the Pecos River drains crystalline rocks of the southern Rocky Mountains with relatively fresh water quality. Below Fort Sumner, New Mexico, the river enters a naturally saline basin comprised primarily of evaporitic sedimentary rocks, resulting in higher salinity. This area is famous for karst topography and artesian spring systems.

Description and/or comments about the surface watercourse  
and its importance to the study:

The Pecos River above Bitter Lake NWR is used for oil and natural gas exploration and production. Human habitat modifications also have resulted in range reductions and, in some cases, extirpation of native plants and animals. Much of the refuge lies within the historic flood plain of the Pecos River, and prior to upstream dam construction, flood flows would periodically change the river course within the flood plain. Downstream reaches of the river are extremely irrigated and channelized, providing little more than an "irrigation canal" which rapidly sweeps larval fish into Brantley Reservoir where habitat conditions are unfavorable and predatory fish are abundant. Portions of the Pecos River channel on the refuge were also channelized in the past, speeding up water flow and removing the natural diversity within the river channel by isolating portions of the old river channel from the free-flowing Pecos. Protecting levels within the Roswell Basin and the nature and timing of flows in the Pecos are important components of species conservation on and surrounding the Refuge. The nature and timing of flows within the Pecos River have been significantly altered by reservoir operations. Prior to the 1937 base flows of the Pecos through the Refuge rarely dropped below 80 cfs, today they drop below 30 cfs roughly 50% of the time and 10 cfs 20% of the time. Future conservation efforts associated with water on the Refuge should focus on the Pecos River since this is where the least assurance of biologically sound

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hydrology exists.

o Rio Hondo

Location of the watercourse in relation to the Interior Land:

The Rio Hondo flows through the Lower Tract of Bitter Lake NWR. This portion of the refuge is used for croplands to supplementally feed wildlife. The Rio Hondo has riparian vegetation and several unique or rare fauna.

Description and/or comments about the surface watercourse and its importance to the study:

The Rio Hondo is perennial, and has numerous point source discharges in its watershed including the communities of Ruidoso, Roswell, Hondo, Pícache.

o Salt Creek

Location of the watercourse in relation to the Interior Land:

Runoff, alluvial ground water, and surface waters travel the Salt Creek to the west side of Bitter Lake NWR, North Tract, Salt Creek Wilderness Area.

Description and/or comments about the surface watercourse and its importance to the study:

In 1937, the Service purchased the land, which at that time still contained ample marshland associated with artesian springs and Salt Creek, a perennial stream. Permitted grazing use of the tract finally ceased in 1955, refuge farming to provide food for waterfowl ceased during the 1960's, and the area was evaluated as a Wilderness Study Area in 1968. With designation as a wilderness in 1970, all permanent refuge structures were demolished and removed, existing ground water rights were transferred to the middle unit of the refuge, and the Service began to manage the Wilderness as a "naturally functioning ecosystem." Three "developments" still exist within the Salt Creek Wilderness. An underground natural gas pipeline, installed along a right-of-way in the early 1940's, crosses the tract diagonally from northeast to southwest, a distribution power line extends along much of the south Wilderness boundary, and an active natural gas well lease occurs in the southwest corner of the area. The two-acre Inkpot RNA is located within the Salt Creek Wilderness on the North Unit of the refuge. The chief feature is the "Inkpot," a vertical-walled sinkhole 150-feet in diameter and 90-feet deep. The Inkpot is located at the edge of the scenic Red Bluffs, a 50-foot Permian escarpment which runs across the north end of the refuge. In 1937, this sinkhole was overflowing and feeding a second, lower sink, which was also full and overflowed through a half-mile stream to a playa lake in the Salt Creek valley floor west of the Pecos River. Water levels in Inkpot have steadily declined and are presently about 18-feet below the

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spill point. Like the other sinkholes in the area, Inkpot formed when artesian water dissolved gypsum deposits causing overlying strata to collapse. Surface runoff enlarged the sink until it connected with channels leading from the artesian aquifer, allowing artesian water to rise in the sink.

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## Ground Water Transport Pathways

### Notes on Ground Water Pathways:

Unlike many other refuges, Bitter Lake National Wildlife Refuge is dependant on the quality and quantity of its groundwater aquifer. Springs from the aquifer have provided habitat for flora and fauna that allowed their persistence in this desert region. The aquifer component is extremely crucial to the understanding of regional wildlife habitat management concerns and should be considered first in any evaluation of pollutant sources, transport and fate.

### Documented Ground Water Pathways:

- o Roswell Artesian Basin

#### Location of the aquifer in relation to the Interior Land:

Bitter Lake National Wildlife Refuge sits at a juncture between the Roswell Artesian Groundwater Basin (Roswell Basin) and the Pecos River (Pecos). These two systems and their interactions account for the diversity of water resources on the Refuge including sinkholes, springs, wetlands, oxbow lakes, and riverine habitats. Protecting levels within the Roswell Basin and the nature and timing of flows in the Pecos are important components of species conservation on and surrounding the Refuge. The Refuge's federally reserved water rights essentially protects ground water levels of the Roswell Basin in the Refuge vicinity. The Roswell Basin historically maintained groundwater levels that were 80 feet above the Refuge's mean topographic surface (mts, 3500 feet). This level dropped to 20 feet above mts in the 1970's and since then has been on the rise towards the current level of 40 feet above mts. The Roswell Basin supplies water for the sinkholes, springs and seeps of the Refuge. A higher groundwater level translates to increased habitat. Much of the Pecos Valley Section is underlain by Permian bedrock units composed of gypsiferous and saline evaporites, limestone and dolomite, mudstone and shale, and sandstone. Dissolution of evaporite and carbonate units is an active geomorphic process affecting landscape evolution in much of the region, and various sizes of solution-subsidence depressions are common landforms. From essentially the headwaters of the Pecos River, the sedimentary rocks of limestones, shales, and sandstones dip off the mountains in an easterly direction to form a large continuous regional aquifer system. The permeability of the aquifers varies considerably depending on the degree of dissolution or fracturing that has taken place. These processes have been most active in the southern part of the area and have

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resulted in the well-known Roswell Artesian Basin.

Description and/or comments about the aquifer and its importance to the study:

Water levels depend on flow in the Roswell Artesian Basin, which in turn depends upon precipitation and water use many miles to the west and south. The principal threat to Bitter Lake NWR waterbodies is the fall of watertables in the Roswell Artesian Basin.

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## Air Transport Pathways

### Notes on Air Pathways:

I thought selecting the directions of wind was moot, and by not selecting certain wind directions, I had precluded my selected them during source identification. I do not have the wind roses for this area, although I could get them from weather web sites, but winds from all directions occur and can carry contamination from any and all directions, so they were all included just prior to end of CAP process.

### Documented Air Pathways:

#### o East

General description of this wind pattern:

No data

Comments about the wind pattern and its importance to the study:

Bitter Lakes Oil Field is directly east of the refuge and contaminants vented from the oil and gas exploration there could potentially re-dissolve in water via wind.

#### o North

General description of this wind pattern:

wind blows north

Comments about the wind pattern and its importance to the study:

I

#### o Northeast

General description of this wind pattern:

these are winds that blow northeast

Comments about the wind pattern and its importance to the study:

No data

o Northwest

General description of this wind pattern:

these are winds that blow northwest

Comments about the wind pattern and its importance to the study:

No data

o South

General description of this wind pattern:

uhh, the weather changes, and air rushes towards a region of lower pressure. (?)

Comments about the wind pattern and its importance to the study:

The Navajo Refining Company, 501 E. Main Street, Artesia, New Mexico is an oil and natural gas refinery that has documented air emission.

o Southeast

General description of this wind pattern:

these are winds that blow Southeast

Comments about the wind pattern and its importance to the study:

No data

o Southwest

General description of this wind pattern:

these are winds that blow Southwest

Comments about the wind pattern and its importance to the study:

No data

o West

General description of this wind pattern:

these are winds that blow west

Comments about the wind pattern and its importance to the study:

No data

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Biotic Transport Pathways

Documented Biotic Pathways:

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o Interior Least terns

Locations on the Interior Land used extensively by this species:

Unit 15, Unit 16, Bitter Lake

Description and/or comments about this species and its importance to the study:

It is possible that mercury, PCB, and DDT burdens brought with the interior least terns, as found in their eggs, might be reflective of contaminant exposure outside of the refuge. For instance, DDT was found in eggs but not in any other media sampled from the refuge, therefore, we suspect that exposure was within 2 weeks but the source could have been along its migration path. In the case of this species, the migration path includes all of South and Central America, and North America below the refuge.

o Sandhill Cranes and other waterfowl

Locations on the Interior Land used extensively by this species:

South Tract, refuge Croplands and Impoundments at the Middle Tract of Bitter Lake NWR used extensively by cranes, geese, ducks, and other birds.

Description and/or comments about this species and its importance to the study:

During 1937, the Fish and Wildlife Service acquired two key waterfowl habitat areas in New Mexico, Bitter Lake in the Pecos Valley and Bosque del Apache in the Rio Grande Valley. These two refuges were established along the principal remaining feeding and nesting grounds for waterbirds, marshbirds, and shorebirds on the main flyways. Bitter Lake NWR continues to be an important wintering area for sandhill cranes and snow geese, and has become increasingly important as a refuge for numerous species threatened with extinction. The volume of birds that migrate from such a distance could influence the amount of nutrients, heavy metals, and organic contaminants that would be deposited by their feces and enter the refuge aquatic ecosystems and affect them.

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Contaminant Source Information

Total Contaminant Source Listing

The following list presents sites evaluated for the potential risk to trust resources utilizing this refuge. Click on the site to view a contaminant source report.

Tri Site List for Contaminant Sources:

\*ASSOCIATED MILK PRODUCERS INC -- 88201SSCTD56000

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\*NAVAJO REFINING CO -- 88210NVJRF501EA

PCS/NPDES Site List for Contaminant Sources:

\*FORT SUMNER TOWN OF -- NM0023477  
\*ROSWELL NEW MEXICO -- NM0020311  
\*RUIDOSO-RUIDOSO DOWNS WWTP-LINCOLN COUNTY -- NM0029165

CERCLIS Site List for Contaminant Sources:

\*ROSWELL 5TH AND MAIN -- NM0000192682

AIRS Site List for Contaminant Sources:

\*AGAVE ENERGY/BITTER LAKE C. S. \_\_\_\_\_274M4 -- NM0770380  
\*AGAVE ENERGY/ISLER COMP STA \_\_\_\_\_464 -- NM0770389  
\*AGAVE ENERGY/RED BLUFF No. 1 C. S. \_\_\_\_\_309M2 -- NM0770381  
\*AGAVE ENERGY/RED BLUFF No. 2 C. S. \_\_\_\_\_411M1 -- NM0770383  
\*AGAVE ENERGY/RED BLUFF No. 3 C. S. \_\_\_\_\_412M2 -- NM0770384  
\*AGAVE ENERGY/RED BLUFF No. 4 C. S. \_\_\_\_\_413M1 -- NM0770385  
\*AGAVE ENERGY/RED BLUFF No. 5 C. S. \_\_\_\_\_414M2 -- NM0770386  
\*AGAVE ENERGY/RED BLUFF No. 6 C. S. \_\_\_\_\_415M1 -- NM0770387  
\*AGAVE ENERGY/ROUNDTOP COMP STA \_\_\_\_\_0529R1 -- NM0770374  
\*AGAVE ENERGY/SALT CREEK C. S. \_\_\_\_\_358M1 -- NM0770382  
\*CITY OF ROSWELL -- NM0059098  
\*COLLEGE CLEANERS -- NM0924881  
\*COMPRESSOR SYSTEMS/CAT G399 TALE \_\_\_\_\_1266 -- NM0830479  
\*CREATIVE PULTRUSIONS \_\_\_\_\_710 -- NM0770391  
\*DEXTER NATIONAL FISH HATCHERY -- NM0890838  
\*EL PASO NATL GAS/ROSWELL COMP STA \_\_\_\_\_P128 -- NM0770375  
\*KLASSIC CLEANERS -- NM0924797  
\*LIQUID ENERGY/WHITE RANCH \_\_\_\_\_PSD356M1 -- NM0059068  
\*MID-AMERICA PIPELINE/MESA \_\_\_\_\_921M3 -- NM0807306  
\*MID-AMERICA PIPELINE/WHITE LAKES \_\_\_\_\_889M1 -- NM0807303  
\*MORGAN PECOS DUMP -- NM0853797  
\*NAVAJO REFINING/ROSWELL FUEL TERMIN\_1531 -- NM0903047  
\*NEW MEX MILT INST -- NM0059074  
\*NEW MEX MILT INSTIT -- NM0059076  
\*ROSWELL CITY LANDFILL -- NM0813031  
\*SHOREHAM/DIABLO COMP STA \_\_\_\_\_958M1 -- NM0814948  
\*SHOREHAM/LONGO COMP STA \_\_\_\_\_1464 -- NM0886086  
\*TEXAS-NM PIPELINE/ROSWELL PUMP STA \_\_\_\_\_645 -- NM0770390  
\*TRANSWESTERN PIPE LINE COMPRESSOR STA No. 9 -- NM0927244  
\*TRANSWESTERN PIPE/ROSWELL C. S. (No. 9)\_P154 -- NM0770377  
\*WASTE MANAGEMENT--ROSWELL CITY LANDFILL -- NM0813041  
\*YATES PETROL/PATHFINDER AMINE \_\_\_\_\_848M1 -- NM0814355

RCRIS Site List for Contaminant Sources:

\*ATCHISON TOPEKA & SANTA FE RY CO -- NM0000992362  
\*COCA COLA BOTTLING -- NMD986682631  
\*COLLEGE CLEANERS INC -- NMR000000448  
\*CORROSION TECHNOLOGY INC -- NMD986674299  
\*DOWELL DIV OF DOW CHEM -- NMD980809065  
\*EASTERN NM MEDICAL CENTER-NORTH -- NM0000050443  
\*FOUR SEASONS CLEANERS -- NMD986673143  
\*JAPAN AIRLINES -- NMD986682433  
\*KLASSIC CLEANERS -- NMR000000273  
\*MOBIL PIPE LINE CO CATO STATION -- NMD000642959  
\*NEW MEXICO STATE HWY DEPT -- NMD982288599  
\*ONE HOUR MARTINIZING -- NMD986673127  
\*PATRIOT AVIATION SERVICES -- NMR000001834  
\*ROSEWELL RADIOLOGY ASSOC PA -- NMD040404667

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- \*ROSWELL AIC -- NMD986675981
- \*ROSWELL COMPRESSOR STATION -- NMR000002089
- \*SCHLUMBERGER WELL SVCS -- NMD013800370
- \*SHERWIN WILLIAMS CO -- NMD000812263
- \*SPS ROSWELL SERVICE CENTER -- NMD981589401
- \*SUN OIL CO NEW MEXICO H STATE -- NMD000747576
- \*SUN OIL CO NEW MEXICO J STATE -- NMD000740183
- \*SUN OIL CO NEW MEXICO STATE H SWD -- NMD000740191
- \*SUN OIL CO STATE TRACT -C- -- NMD000747717
- \*SUN OIL CO WOODMAN-FEDERAL -- NMD000747469
- \*TRANSPORTATION MFG CORP -- NMD981144140
- \*TRANSWESTERN PIPELINE CO-BELL LAKE PLNT -- NMD005927991
- \*TRANSWESTERN PIPELINE CO STA 9 -- NMD986676955

OTHER (User-Identified) Site List for Contaminant Sources

- \*Santa Rosa Reservoir
- \*Sumner Lake
- \*Terrero Mine in the Upper Pecos River Watershed

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 Contaminant Sites Summarized by Transport Pathway

Surface Water Transport Pathways:

Streams and Their Associated Contaminant Sites Entered in CAP Database:

Name of Transport Pathway	Associated Contaminant Sites
Arroyo del Macho	<ul style="list-style-type: none"> <li>* MOBIL PIPE LINE CO CATO STATION -- NMD000642959</li> <li>* ROSWELL COMPRESSOR STATION -- NMR000002089</li> <li>* RUI DOSO-RUI DOSO DOWNS WWTP-LINCOLN COUNTY -- NM0029165</li> <li>* SUN OIL CO NEW MEXICO H STATE -- NMD000747576</li> <li>* SUN OIL CO NEW MEXICO STATE H SWD -- NMD000740191</li> </ul>
Bitter Creek	<ul style="list-style-type: none"> <li>* ATCHISON TOPEKA &amp; SANTA FE RY CO -- NM0000992362</li> <li>* COCA COLA BOTTLING -- NMD986682631</li> <li>* COLLEGE CLEANERS INC -- NMR000000448</li> <li>* DOWELL DIV OF DOW CHEM -- NMD980809065</li> <li>* MOBIL PIPE LINE CO CATO STATION -- NMD000642959</li> <li>* ROSWELL 5TH AND MAIN -- NM0000192682</li> <li>* ROSWELL COMPRESSOR STATION -- NMR000002089</li> <li>* SCHLUMBERGER WELL SVCS -- NMD013800370</li> <li>* SUN OIL CO NEW MEXICO H STATE -- NMD000747576</li> <li>* TRANSWESTERN PIPELINE CO STA 9 -- NMD986676955</li> </ul>
Lost River	<ul style="list-style-type: none"> <li>* ASSOCIATED MILK PRODUCERS INC -- 88201SSCTD56000</li> </ul>

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- \* ATCHISON TOPEKA & SANTA FE RY CO -- NM0000992362
- \* COCA COLA BOTTLING -- NMD986682631
- \* COLLEGE CLEANERS INC -- NMR000000448
- \* CORROSION TECHNOLOGY INC -- NMD986674299
- \* DOWELL DIV OF DOW CHEM -- NMD980809065
- \* MOBIL PIPE LINE CO CATO STATION -- NMD000642959
- \* PATRIOT AVIATION SERVICES -- NMR000001834
- \* ROSWELL 5TH AND MAIN -- NM0000192682
- \* ROSWELL COMPRESSOR STATION -- NMR000002089
- \* SCHLUMBERGER WELL SVCS -- NMD013800370
- \* SUN OIL CO NEW MEXICO H STATE -- NMD000747576
- \* SUN OIL CO NEW MEXICO STATE H SWD -- NMD000740191
- \* SUN OIL CO STATE TRACT -C- -- NMD000747717
- \* SUN OIL CO WOODMAN-FEDERAL -- NMD000747469
- \* TRANSWESTERN PIPELINE CO STA 9 -- NMD986676955

NPDES Outfall NM00203011, City of Roswell WWTP effluent discharged to Hunter Mar

- \* ROSWELL NEW MEXICO -- NM0020311

NPDES Outfall NM00203011, City of Roswell WWTP effluent discharged to Hunter Marsh until 1981

None listed

Pecos River

- \* ASSOCIATED MILK PRODUCERS INC -- 88201SSCTD56000
- \* ATCHISON TOPEKA & SANTA FE RY CO -- NM0000992362
- \* EASTERN NM MEDICAL CENTER-NORTH -- NM0000050443
- \* JAPAN AIRLINES -- NMD986682433
- \* MOBIL PIPE LINE CO CATO STATION -- NMD000642959
- \* NEW MEXICO STATE HWY DEPT -- NMD982288599
- \* ONE HOUR MARTINI ZING -- NMD986673127
- \* PATRIOT AVIATION SERVICES -- NMR000001834
- \* ROSWELL 5TH AND MAIN -- NM0000192682
- \* ROSWELL COMPRESSOR STATION -- NMR000002089
- \* SCHLUMBERGER WELL SVCS -- NMD013800370
- \* SUN OIL CO NEW MEXICO H STATE -- NMD000747576
- \* SUN OIL CO NEW MEXICO STATE H SWD -- NMD000740191

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- \* SUN OIL CO STATE TRACT -C- -- NMD000747717
- \* SUN OIL CO WOODMAN-FEDERAL -- NMD000747469
- \* TRANSWESTERN PIPELINE CO STA 9 -- NMD986676955
- \* Terrero Mine in the Upper Pecos River Watershed

Rio Hondo

- \* ASSOCIATED MILK PRODUCERS INC -- 88201SSCTD56000
- \* EASTERN NM MEDICAL CENTER-NORTH -- NM0000050443
- \* FORT SUMNER TOWN OF -- NM0023477
- \* JAPAN AIRLINES -- NMD986682433
- \* NEW MEXICO STATE HWY DEPT -- NMD982288599
- \* ONE HOUR MARTINIZING -- NMD986673127
- \* PATRIOT AVIATION SERVICES -- NM000001834
- \* ROSWELL NEW MEXICO -- NM0020311
- \* RUIDOSO-RUIDOSO DOWNS WWTP-LINCOLN COUNTY -- NM0029165
- \* SCHLUMBERGER WELL SVCS -- NMD013800370
- \* SUN OIL CO NEW MEXICO STATE H SWD -- NMD000740191
- \* SUN OIL CO STATE TRACT -C- -- NMD000747717
- \* SUN OIL CO WOODMAN-FEDERAL -- NMD000747469
- \* TRANSPORTATION MFG CORP -- NMD981144140
- \* TRANSWESTERN PIPELINE CO-BELL LAKE PLNT -- NMD005927991

Salt Creek

None listed

Ground Water Transport Pathways

Aquifers and Their Associated Contaminant Sites Entered in CAP Database:

Name of Transport Pathway	Associated Contaminant Sites
Roswell Artesian Basin	<ul style="list-style-type: none"> <li>* ASSOCIATED MILK PRODUCERS INC -- 88201SSCTD56000</li> <li>* ATCHISON TOPEKA &amp; SANTA FE RY CO -- NM0000992362</li> <li>* COCA COLA BOTTLING -- NMD986682631</li> <li>* COLLEGE CLEANERS INC -- NM000000448</li> <li>* CORROSION TECHNOLOGY INC -- NMD986674299</li> <li>* DOWELL DIV OF DOW CHEM -- NMD980809065</li> <li>* EASTERN NM MEDICAL CENTER-NORTH -- NM0000050443</li> <li>* FORT SUMNER TOWN OF -- NM0023477</li> <li>* FOUR SEASONS CLEANERS -- NMD986673143</li> <li>* JAPAN AIRLINES -- NMD986682433</li> <li>* KLASSIC CLEANERS -- NM000000273</li> <li>* MOBIL PIPE LINE CO CATO STATION -- NMD000642959</li> </ul>

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 \* NAVAJO REFINING CO -- 88210NVJRF501EA  
 \* NEW MEXICO STATE HWY DEPT -- NMD982288599  
 \* ONE HOUR MARTINI ZING -- NMD986673127  
 \* PATRIOT AVIATION SERVICES -- NMR000001834  
 \* ROSEWELL RADIOLOGY ASSOC PA --  
 NMD040404667  
 \* ROSWELL 5TH AND MAIN -- NM0000192682  
 \* ROSWELL AIC -- NMD986675981  
 \* ROSWELL COMPRESSOR STATION -- NMR000002089  
 \* ROSWELL NEW MEXICO -- NM0020311  
 \* RUIDOSO-RUIDOSO DOWNS WWTP-LINCOLN COUNTY  
 -- NM0029165  
 \* SCHLUMBERGER WELL SVCS -- NMD013800370  
 \* SHERWIN WILLIAMS CO -- NMD000812263  
 \* SPS ROSWELL SERVICE CENTER -- NMD981589401  
 \* SUN OIL CO NEW MEXICO H STATE --  
 NMD000747576  
 \* SUN OIL CO NEW MEXICO J STATE --  
 NMD000740183  
 \* SUN OIL CO NEW MEXICO STATE H SWD --  
 NMD000740191  
 \* SUN OIL CO STATE TRACT -C- -- NMD000747717  
 \* SUN OIL CO WOODMAN-FEDERAL -- NMD000747469  
 \* TRANSPORTATION MFG CORP -- NMD981144140  
 \* TRANSWESTERN PIPELINE CO-BELL LAKE PLNT --  
 NMD005927991  
 \* TRANSWESTERN PIPELINE CO STA 9 --  
 NMD986676955

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 Air Transport Pathways

Wind Directions and Their Associated Contaminant Sites Entered in CAP Database:

Direction of Wind	Associated Contaminant Sites
East	* AGAVE ENERGY/RED BLUFF No. 5 C. S. _____414M2 -- NM0770386 * EASTERN NM MEDICAL CENTER-NORTH -- NM0000050443 * FOUR SEASONS CLEANERS -- NMD986673143 * KLASSIC CLEANERS -- NMR000000273 * NAVAJO REFINING CO -- 88210NVJRF501EA * NEW MEXICO STATE HWY DEPT -- NMD982288599 * ONE HOUR MARTINI ZING -- NMD986673127 * PATRIOT AVIATION SERVICES -- NMR000001834 * ROSEWELL RADIOLOGY ASSOC PA -- NMD040404667 * ROSWELL 5TH AND MAIN -- NM0000192682 * ROSWELL AIC -- NMD986675981 * ROSWELL NEW MEXICO -- NM0020311 * SCHLUMBERGER WELL SVCS -- NMD013800370 * SPS ROSWELL SERVICE CENTER -- NMD981589401 * SUN OIL CO STATE TRACT -C- -- NMD000747717 * SUN OIL CO WOODMAN-FEDERAL -- NMD000747469 * TRANSWESTERN PIPELINE CO-BELL LAKE PLNT -- NMD005927991
North	None listed
Northeast	None listed

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Northwest

None listed

South

- \* AGAVE ENERGY/RED BLUFF No. 5 C. S. \_\_\_\_\_414M2  
-- NMO770386
- \* EASTERN NM MEDICAL CENTER-NORTH --  
NM0000050443
- \* FOUR SEASONS CLEANERS -- NMD986673143
- \* KLASSIC CLEANERS -- NMR000000273
- \* NAVAJO REFINING CO -- 88210NVJRF501EA
- \* NEW MEXICO STATE HWY DEPT -- NMD982288599
- \* ONE HOUR MARTINI ZING -- NMD986673127
- \* PATRIOT AVIATION SERVICES -- NMR000001834
- \* ROSEWELL RADIOLOGY ASSOC PA --  
NMD040404667
- \* ROSWELL 5TH AND MAIN -- NM0000192682
- \* ROSWELL AIC -- NMD986675981
- \* SCHLUMBERGER WELL SVCS -- NMD013800370
- \* SPS ROSWELL SERVICE CENTER -- NMD981589401
- \* SUN OIL CO STATE TRACT -C- -- NMD000747717
- \* SUN OIL CO WOODMAN-FEDERAL -- NMD000747469
- \* TRANSWESTERN PIPELINE CO-BELL LAKE PLNT --  
NMD005927991

Southeast

None listed

Southwest

- \* AGAVE ENERGY/RED BLUFF No. 5 C. S. \_\_\_\_\_414M2  
-- NMO770386
- \* ASSOCIATED MILK PRODUCERS INC --  
88201SSCTD56000
- \* CORROSION TECHNOLOGY INC -- NMD986674299
- \* EASTERN NM MEDICAL CENTER-NORTH --  
NM0000050443
- \* FOUR SEASONS CLEANERS -- NMD986673143
- \* KLASSIC CLEANERS -- NMR000000273
- \* MOBIL PIPELINE CO CATO STATION --  
NMD000642959
- \* NEW MEXICO STATE HWY DEPT -- NMD982288599
- \* ONE HOUR MARTINI ZING -- NMD986673127
- \* PATRIOT AVIATION SERVICES -- NMR000001834
- \* ROSEWELL RADIOLOGY ASSOC PA --  
NMD040404667
- \* ROSWELL 5TH AND MAIN -- NM0000192682
- \* ROSWELL AIC -- NMD986675981
- \* ROSWELL COMPRESSOR STATION -- NMR000002089
- \* SCHLUMBERGER WELL SVCS -- NMD013800370
- \* SHERWIN WILLIAMS CO -- NMD000812263
- \* SPS ROSWELL SERVICE CENTER -- NMD981589401
- \* SUN OIL CO STATE TRACT -C- -- NMD000747717
- \* SUN OIL CO WOODMAN-FEDERAL -- NMD000747469
- \* TRANSPORTATION MFG CORP -- NMD981144140
- \* TRANSWESTERN PIPELINE CO-BELL LAKE PLNT --  
NMD005927991

West

None listed

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Biotic Transport Pathways

Biota and Their Associated Contaminant Sites Entered in CAP Database:

Biota Name

Associated Contaminant Sites

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Interior Least terns           \* NEW MEXICO STATE HWY DEPT -- NMD982288599  
                                  \* ROSWELL AIC -- NMD986675981  
                                  \* SCHLUMBERGER WELL SVCS -- NMD013800370  
                                  \* TRANSWESTERN PIPELINE CO-BELL LAKE PLNT  
                                  -- NMD005927991

Sandhill Cranes and other   None listed  
waterfowl

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Field Reconnaissance

Notes on Field Reconnaissance:

No. We have not gone out a surveyed each one of these POTENTIAL contaminant sources.

Field Reconnaissance Sites

This is a list of the areas that have been visited for a field reconnaissance. Select an area name to view the details of the site.

No sites listed.

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Field Report

No field reports listed.

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Potentially Contaminated Areas

The purpose of this section is to determine the areas where sampling activities will be conducted. The purpose of sampling in these areas is to confirm the presence of contaminants or their effects, or to collect baseline information to support potential natural resource damage assessments. Select one of the PCAs to view a PCA report.

List of Potentially Contaminated Areas

\* Irrigated agriculture in Arroyo del Macho watershed

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PCA Reports:

\* Irrigated agriculture in Arroyo del Macho watershed

Location:

no address

Description of site:

No data

Rationale for selecting this site:

Jim Brooks informed me that there is irrigated agriculture

Bitter Lake NWR CAP.txt  
in the Arroyo del Macho watershed that may affect it as well as Salt Creek.

Level of contamination that applies to this area:

Level 3 - Known contaminant sources, suspected contaminant presence, no documented contaminant problems or habitat degradation

Contaminant classifications linked to this site:

Dissolved Solids  
Heavy Metals  
Nutrients - other than sewage  
Organochlorines  
Organophosphates  
Other Pesticides  
Phosphorus  
Salts  
Sediments  
Selenium  
Total Nitrogen  
Total Solids  
Trace Elements  
Turbidity  
Water Quality Parameters

Pathways that allow contaminant(s) to reach the area:

Surface Water:

Arroyo del Macho  
Salt Creek

Ground Water:

Roswell Artesian Basin

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#### Areas Subject to Spills

This section presents a list of areas on the refuge particularly subject to potential spills. Select one of the BSAs to view a BSA report.

List of Areas:

- \*Bitter Creek
- \*Hunter Marsh
- \*Lake St. Francis
- \*Pecos River at a variety of sites
- \*Rio Hondo
- \*Unit Impoundments

---

Area Reports:

- \* Bitter Creek

Location:

Bitter Lake NWR CAP.txt  
upper portion of the Middle Tract on Bitter Lake NWR

Description of site:

Bitter creek is spring fed by Dragonfly springs, Sago Springs, the Lost River, and a small surface watershed.

Rationale for selecting this site:

Bitter Creek contains a unique assemblage of fauna

Level of contamination that applies to this area:

Level 2 - Known contaminant sources and contaminant presence, no documented contaminant problems or habitat degradation

Contaminant classifications linked to this site:

Alkalinity  
Calcium  
Salts  
Sediments  
Selenium  
Trace Elements  
Water Quality Parameters

Pathways that allow contaminant(s) to reach the area:

Surface Water:

Bitter Creek  
Lost River

Ground Water:

Roswell Artesian Basin

Air:

East; North; Northeast; Northwest; South; Southeast;  
Southwest; West;

\* Hunter Marsh

Location:

on Bitter Lake NWR

Description of site:

marsh

Rationale for selecting this site:

O'Brien found contamination there in 1986, so we went and selected it again in 1996, and it was still there, in addition to other contaminants not scanned for at the time. Like PCBs and PAHs.

Level of contamination that applies to this area:

Level 1 - Known contaminant sources and documented

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contamination problems and/or habitat degradation

Contaminant classifications linked to this site:

Aluminum  
Cadmium  
Calcium  
Chromium  
Heavy Metals  
Iron  
Lead  
Mercury  
Organochlorines  
Petroleum Products  
Polycyclic Aromatic Hydrocarbons  
Polychlorinated Biphenyls  
Salts  
Sediments  
Selenium  
Trace Elements  
Zinc

Pathways that allow contaminant(s) to reach the area:

Surface Water:

NPDES Outfall NM00203011, City of Roswell WWTP effluent discharged to Hunter Mar

\* Lake St. Francis

Location:

on Bitter Lake NWR upper Middle Tract

Description of site:

Sinkhole in gypsum deposits

Rationale for selecting this site:

Sinkhole has likely existed for 1000s of years, and while people have used this lake, the native flora and faunal assemblage has remained. Although at one time connected to other sinkholes by ditches, the surface watershed is likely small and insignificant compared to the groundwater pathway

Level of contamination that applies to this area:

Level 2 - Known contaminant sources and contaminant presence, no documented contaminant problems or habitat degradation

Contaminant classifications linked to this site:

Airborne Particulates  
Cadmium  
Calcium  
Dissolved Solids  
Salts  
Selenium  
Trace Elements  
Water Quality Parameters

Zinc

Pathways that allow contaminant(s) to reach the area:

Ground Water:

Roswell Artesian Basin

Air:

East; North; Northeast; Northwest; South; Southeast;  
Southwest; West;

\* Pecos River at a variety of sites

Location:

all Bitter Lake NWR connects to portions of the Pecos River.

Description of site:

Large river ecosystem

Rationale for selecting this site:

Large river ecosystem

Level of contamination that applies to this area:

Level 1 - Known contaminant sources and documented  
contamination problems and/or habitat degradation

Contaminant classifications linked to this site:

Alkalinity  
Aluminum  
Ammonia  
Cadmium  
Calcium  
Chloride  
Dissolved Solids  
Heavy Metals  
Mercury  
Nutrients - other than sewage  
Organochlorines  
Petroleum Products  
Polycyclic Aromatic Hydrocarbons  
Salts  
Sediments  
Selenium  
Suspended Solids  
Trace Elements  
Turbidity  
Water Quality Parameters

Pathways that allow contaminant(s) to reach the area:

Surface Water:

Pecos River  
Rio Hondo  
Salt Creek

Ground Water:

Roswell Artesian Basin

Air:

East; North; Northeast; Northwest; South; Southeast;  
Southwest; West;

\* Rio Hondo

Location:

Rio Hondo, tributary to the Pecos River, crosses Bitter Lake NWR on the Lower Tract.

Description of site:

The Rio Hondo is a perennial stream that received Roswell and Ruidoso waste water from their municipal treatment plants.

Rationale for selecting this site:

This site has not been sampled, but should be as it supports a riparian habitat for native and rare species. It also collects runoff from the City of Roswell

Level of contamination that applies to this area:

Level 3 - Known contaminant sources, suspected contaminant presence, no documented contaminant problems or habitat degradation

Contaminant classifications linked to this site:

Alkalinity  
Ammonia  
Calcium  
Chloride  
Dissolved Solids  
Fecal Coliforms  
Free Chlorine  
Heavy Metals  
Mercury  
Nutrients - other than sewage  
Oil and Grease  
Organochlorines  
Organophosphates  
Other Inorganics  
Other Organics  
Other Pesticides  
Petroleum Products  
Phosphorus  
Polycyclic Aromatic Hydrocarbons  
Polychlorinated Biphenyls  
Salts  
Sediments  
Selenium  
Settleable Solids  
Sewage  
Synthetic Pyrethroids  
Total Coliforms  
Total Nitrogen

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Total Solids  
Trace Elements  
Turbidity  
Urea and other Organic Nitrogen Compounds  
Water Quality Parameters  
Zinc

Pathways that allow contaminant(s) to reach the area:

Surface Water:

Rio Hondo

Ground Water:

Roswell Artesian Basin

Air:

East; North; Northeast; Northwest; South; Southeast;

\* Unit Impoundments

Location:

on Bitter Lake NWR Middle Tract

Description of site:

these impoundments were made early during the refuge establishment. They were actually created over existing sinkholes near the Pecos River.

Rationale for selecting this site:

Endangered species use these lakes for feeding and nesting. It is also a major waterfowl area.

Level of contamination that applies to this area:

Level 2 - Known contaminant sources and contaminant presence, no documented contaminant problems or habitat degradation

Contaminant classifications linked to this site:

Alkalinity  
Calcium  
Heavy Metals  
Salts

Pathways that allow contaminant(s) to reach the area:

Surface Water:

Bitter Creek  
Pecos River

Ground Water:

Roswell Artesian Basin

Bi otic:

Interior Least terns  
Sandhill Cranes and other waterfowl

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Narrative Report of Contaminant Issues

Problem Narrative:

During Summer 1996, the New Mexico Ecological Services Field Office collected 139 biological or substrate samples and 27 filtered water samples for a variety of inorganic and organic chemical analyses. Of those collected, thirty-three samples were soil or sediment, eighty-seven were samples of animal tissue (fish, avian eggs, aquatic invertebrates), nineteen were samples of aquatic plants, and twenty-seven were samples of water. Our objectives were 1) to identify any chemicals in the food web or environment that may reduce the reproductive success of nesting interior least terns, and 2) provide baseline data concerning the contaminants in wildlife at Bitter Lake National Wildlife Refuge in southeastern New Mexico. Whole fish samples were also collected from the Pecos River in 1992 and are discussed below.

**Organic Compounds:** We scanned water, sediment, and fish for aliphatic compounds (long chain oils, waxes), polycyclic aromatic hydrocarbons (PAHs, coal resins, semi-volatiles), and organochlorine compounds (PCB, DDT, DDE, Dieldrin, etc). No organic chemicals were detected in water, but many organic chemicals were found in the sediments, and some fish collected at Hunter Marsh. The remaining areas of Bitter Lake NWR were not significantly contaminated. Organochlorine compounds and other chemicals were found in sediments in concentrations as high as 10 parts per million wet weight (ppmww), which could impact invertebrate communities and the wildlife that forage there regularly. A diet that is <0.1 ppmww total PCBs is considered protective of wildlife. Hunter Marsh contains contaminated sediments, invertebrates, and fish that would be safe (according to the USFDA) for people to eat, but when consumed regularly by local wildlife could result in adverse health effects. The source, extent, and nature of organic chemical pollution should be further evaluated and will be later this year.

In fish collected from the Pecos River, only p,p-DDE, was also found in fish tissues (0.5 ppm wet weight), but at concentrations not considered being elevated. These results combined with the lack of detection of the parent compound DDT, or presence of the less persistent compound, o,p-DDE, suggests that extensive weathering of these organochlorine compounds suggests that inputs have ceased.

We also collected bird eggs from nesting avocets, snowy plovers, and addled tern eggs. We followed the standard laboratory procedures for the collection of raptor/bird egg samples prepared by Peter Bente of Fairbanks, Alaska, in November 1994. We calculated the Radcliffe index, which is a measure of egg shell thickness based on the formula:

$$\text{Radcliffe Index} = \text{eggshell mass (g)} / (\text{egg length [mm]} \times \text{egg girth [mm]})$$

Figure 1 identifies the Radcliffe Index for each egg measurable. An index >1 is good. Less than 1 indicates an increased risk of incubation failure. Not that people should eat the wild bird eggs found at Bitter Lake NWR as food, but if they did, the eggs would exceed the recommended safe threshold (<1 ppmww) for all DDT, DDE, DDD organochlorine pesticide residues as food. The snowy plover egg from Bitter Lake had 2.3 ppmww with a Radcliffe index of 0.5. The avocets

had 0.7 ppmww with an average Radcliffe index of 1.2. The tern eggs had a Radcliffe eggshell index of 0.6. Eggshell thickness was markedly reduced in tern and plover eggs and could be correlated with organochlorine or mercury burden.

Inorganic Compounds: We analyzed water, sediment, and biological tissues for 17 elements. Aluminum, cadmium, lead, selenium and mercury were elevated in water samples. Aluminum, boron, mercury, selenium, and zinc were the only elements in either plants, invertebrates, fish, or eggs that exceeded some thresholds of concern. The Pecos pupfish had greater concentrations of aluminum, arsenic, barium, nickel, vanadium than other fish species sampled. Lake St. Francis contained biota that had greater concentrations of copper, selenium, and zinc than at other sites. Hunter Marsh contained biota that had greater concentrations of cadmium, iron, lead, and mercury than at other sites. Fish collected from the Pecos River in 1992 had concentrations of copper, mercury, selenium, and zinc that were elevated compared to fish sampled nationwide.

### Mercury in Eggs

Figure 2 depicts the dry weight concentrations of mercury in eggs. Several trends are evident. Avocets may not migrate as far as terns and plovers. Avocets also feed at a different trophic level (e.g., on plants and invertebrates from mudflats and shorelines) than do terns (are at a greater trophic level and feed on small fish). These conditions may partially explain the relatively reduced mercury burden in the avocet eggs compared to tern and plover eggs. Avocets may receive a reduced exposure to mercury in their diet (according to where the avocets feed), or from their ability to reduce their mercury burden prior to egg laying (e.g., due to a larger body size or loss of mercury through molting feathers). Concentrations of mercury in avocets eggs were undetectable and are therefore represented in Figure 2 as a negative value (<0.050 ppm dry weight).

Note that for tern and snowy plover eggs laid in 1996 mercury burden was somewhat greater than in 1997. Also note that certain eggs laid in June 1997 had elevated mercury burdens compared to other eggs in the same clutch. It is possible that these birds arrive with a higher mercury burden than they accumulate at Bitter Lake NWR. For instance, mercury concentrations generally declined from early in the summer (when the terns first arrive in May/June) to later in the summer (e.g., July). Therefore, we suspect that mercury exposure is greater to terns from foods outside the Refuge than from the Refuge. During migration, terns may be feeding on oceanic fish that contain higher mercury concentrations than when the terns obtain fish from feeding at Bitter Lake NWR during nesting. Mercury concentrations in eggs above 1 ppm begin to adversely effect the behavior of some fledglings with long-term exposure. Mercury is not beneficial to bird metabolism and can cause central nervous system damage thereby changing behavior (staggering, slow learning, and reduced growth). In 1986, 2 dead tern fledglings were found at the nearby salt ponds had 1.6 and 3.1 ppm. If we assume that the 1996 embryo/egg data are comparable to the 1986 fledgling data, then mercury burdens have been reduced over time. This would follow national and global trends towards declining mercury deposited into the environment during this same time frame.