2021 Annual Operating Plan
April 1 Runoff Forecast

April 15-16, 2021
Definitions 1.1

• Native/natural Rio Grande water: water that comes directly from the Rio Grande Basin

• San Juan-Chama water: water imported from San Juan Basin of Colorado River into Rio Grande Basin through San Juan-Chama Project

• Rio Grande Compact: agreement between Colorado, New Mexico, and Texas apportioning Rio Grande water between the three states
Definitions 1.2

• Compact debit – results when actual delivery falls below scheduled delivery of the Rio Grande Compact
• Article VII restrictions: restricts storage of Rio Grande water at El Vado when Rio Grande Project storage in Elephant Butte and Caballo is less than 400,000 ac-ft, except for P&P needs or relinquishment credit
• cfs – cubic feet per second (flowrate)
• Acre-foot – volume of water needed to cover one acre to depth of one foot
• Hydrograph – graph of flowrate over time
Definitions 1.3

• MRGCD – Middle Rio Grande Conservancy District
• The City/Water Authority – Albuquerque Bernalillo County Water Utility Authority (ABCWUA)
• NRCS – Natural Resources Conservation Service
• Supplemental water – water leased by Reclamation to augment flows in support of Rio Grande Silvery Minnow as outlined in 2016 Biological Opinion
• P&P – Prior & Paramount lands of the six Middle Rio Grande Pueblos
Definitions 1.4

• EBID – Elephant Butte Irrigation District
• EP1 – El Paso County Water Improvement District No. 1
• HCCRD – Hudspeth County Conservation & Reclamation District
• IBWC – International Boundary and Water Commission, US Section
• 1906 Convention – Convention between the United States and Mexico, signed May 21, 1906
• OA – 2008 Operating Agreement for the Rio Grande Project, between EBID, EP1, Reclamation
Map of Reclamation's Albuquerque Area Office Projects
What Drives the Process

- Volume forecast from NRCS
- Based on snowpack, soil moisture, climate forecast
- Choose similar year based on similar volume
- Actual hydrograph vs. average hydrograph
- Can tweak timing of hydrograph to best match forecasted conditions (warm spring vs. cool spring)
- Inflows/outflows based on nature and policies
- Article VII restrictions
- Flood control and channel capacity
- Timing of water deliveries
- Demand curves from water users
Using NRCS/NWS Forecasting
In the Model(s)…

DEFAULT: CLOSEST HISTORIC YEAR
DAILY TIMESTEP HYDROGRAPH
SHAPE, SHIFTED TO MATCH VOLUME

NRCS/NWS VOLUME

March July

NRCS/NWS

March July

Rest of year

BUILDING STRONG®
Similar Year Hydrographs

Rio Chama @ La Puente

Flow (cfs)

2012: 119,740
1990: 113,891
2020: 81,506 (acre-feet)
# Reservoirs by Agency and Water Source

<table>
<thead>
<tr>
<th>Operated By:</th>
<th>Reclamation</th>
<th>Corps</th>
<th>Water Supply</th>
<th>Recreation</th>
<th>Flood Control</th>
<th>Sediment Control</th>
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<tbody>
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<td>Dams:</td>
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2020: The Year in Review
Heron Reservoir Inflow

Flow [cfs]

Modeled Inflow
Actual Inflow
Heron Reservoir Outflow

![Graph showing modeled and actual outflow for different dates, with peak values around 800 cfs and a general decrease over time.](image-url)
Heron Reservoir Storage
El Vado Reservoir Inflow

Modeled Inflow
Actual Inflow
El Vado Reservoir Outflow

Modeled Outflow

Actual outflow

Flow [cfs]
El Vado Reservoir Storage

![Graph showing the modeled and actual storage levels over time. The graph displays two lines: one representing modeled storage (green) and the other representing actual storage (dotted green). The x-axis represents dates from March 1, 2020, to November 30, 2020, while the y-axis represents storage in acre-feet (ac-ft). The storage levels fluctuate throughout the period, with modeled storage generally following the trend of actual storage but with slight variations.](image-url)
Abiquiu Reservoir Inflow

![Graph showing Abiquiu Reservoir Inflow with modeled and actual inflow data from March 31, 2020, to November 30, 2020. The graph indicates fluctuating flow rates with peaks and troughs, and the labels for the x-axis are 3/31/2020, 4/30/2020, 5/31/2020, 6/30/2020, 7/31/2020, 8/31/2020, 9/30/2020, 10/31/2020, and 11/30/2020. The y-axis represents flow in cfs (cubic feet per second).]
Abiquiu Reservoir Outflow

![Abiquiu Reservoir Outflow Graph]

- **Modeled Outflow**
- **Actual outflow**
Abiquiu Reservoir Storage
Cochiti Reservoir Inflow
Cochiti Reservoir Outflow

![Cochiti Reservoir Outflow Chart]

- **Flow [cfs]**
  - Modeled Outflow (solid red line)
  - Actual outflow (dotted red line)

Date Ranges:
- 3/31/2020 to 11/30/2020
Cochiti Reservoir Storage

![Graph showing Cochiti Reservoir Storage with modeled and actual storage over time.](image-url)
Elephant Butte Reservoir Inflow
Elephant Butte Reservoir

Modeled Outflow
Actual outflow
Caballo Reservoir Inflow

[Graph showing modeled and actual inflow data from March 31, 2020, to November 30, 2020. The x-axis represents dates, and the y-axis represents flow in cfs.]
Caballo Reservoir Outflow

![Caballo Reservoir Outflow Graph]

- **Modeled Outflow**
- **Actual outflow**
Caballo Reservoir Storage
2020 Rio Grande Project Operations

- Irrigation releases – March 13 to September 25
- Caballo released 592,862 ac-ft
- Bonita Lateral – 1,138 ac-ft
- HCCRD – 45,792 ac-ft
Current Snow Conditions
SNOTEL Locations
Rio Chama Snow Data

Chamita SNOTEL 2020-21
Elev. 8400'

Snow Water Equivalent & Precip (in.)

- 20-21 SWE Data
- Avg. SWE
- 20-21 Precip.
- Avg. Precip.
Rio Chama Snow Data
(continued)

![Graph showing snow water equivalent and precipitation trends from 11/2/2020 to 5/2/2021. The graph is titled "Cumbres SNOTEL Site 2020-21 Elev. 10,400’" and includes data points for daily snow water equivalent and corresponding precipitation. The graph compares average snow water equivalent, average precipitation, and actual snow water equivalent and precipitation over the period.]
Rio Chama Snow Comparison

![Graph showing Rio Chama Basin SWE comparison between years 19-20, 20-21, and average, with peaks and valleys over the months of November through June.](image-url)
Similar Snowpack Years

Chama Basin Total SWE
Current Year vs Average and Similar Years

Mar-Jul Runoff Volumes (ac-ft)
- 2013 - 65,937
- 1996 - 95,191
- 2012 - 119,740
- 1988 - 164,822
- 2007 - 196,060
- 2003 - 143,907
- 2020 - 81,506
Rio Grande Snow Data

Upper Rio Grande SNOTEL 2020-21
Elev. 9,400'

Snow Water Equivalent & Precip (in.)

- ‘20-21 SWE data
- Avg. SWE
- ‘20-21 Precip. data
- Avg. Precip.

Date
11/2/2020
12/2/2020
1/2/2021
2/2/2021
3/2/2021
4/2/2021
5/2/2021

Amount
0
2
4
6
8
10
12
Rio Grande Snow Data
(continued)

Beartown SNOTEL 2020-21
Elev. 11,600'

Snow Water Equivalent & Precip (in.)

0 5 10 15 20 25 30


'20-21 SWE data
Avg. SWE
'20-21 Precip. data
Avg. Precip.
## Sangre de Cristo Snow Data

### Elk Cabin SNOTEL 2020-21

**Elev. 8,210’**

<table>
<thead>
<tr>
<th>Date</th>
<th>Snow Water Equivalent &amp; Precip (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/2/2020</td>
<td>0</td>
</tr>
<tr>
<td>11/16/2020</td>
<td>0</td>
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<tr>
<td>11/30/2020</td>
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<tr>
<td>12/14/2020</td>
<td>0</td>
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<td>12/28/2020</td>
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<td>1/1/2021</td>
<td>0</td>
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<tr>
<td>1/15/2021</td>
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<td>6</td>
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<td>4/23/2021</td>
<td>8</td>
</tr>
<tr>
<td>5/7/2021</td>
<td>10</td>
</tr>
</tbody>
</table>

### Graph

The graph shows the snow water equivalent (SWE) and precipitation (Precip) data for Elk Cabin SNOTEL 2020-21. The data is collected at an elevation of 8,210 feet. The graph compares the 2020-21 SWE data, average SWE, 2020-21 precipitation, and average precipitation over the period from November 2020 to May 2021.
Sangre de Cristo Snow Data
(continued)

Wesner Springs SNOTEL 2019-20
Elev. 11,120'

Snow Water Equivalent & Precip (in.)
Western U.S. River Basin Streamflow Forecast
Monsoon Season Temperature Outlook
Monsoon Season Precipitation Outlook

Three-month outlook precipitation probability 3.5 month lead valid JAS 2021 made 18 Mar 2021
U.S. Drought Monitor – New Mexico

U.S. Drought Monitor
New Mexico
April 6, 2021
(Released Thursday, Apr. 8, 2021)
Valid 8 a.m. EDT

Intensity:
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on area-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to http://droughtmonitor.unl.edu/notice.php

Author:
Deborah Ballato
National Drought Mitigation Center
droughtmonitor.unl.edu

U.S. Drought Monitor
New Mexico
March 31, 2020
(Released Thursday, Apr. 2, 2020)
Valid 8 a.m. EDT

Intensity:
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
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- D4 Exceptional Drought

The Drought Monitor focuses on area-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to http://droughtmonitor.unl.edu/notice.php

Author:
David Sigmar
Western Regional Climate Center
droughtmonitor.unl.edu
2021 Water Operations Modeling
Major Assumptions, Input, and Results

• April 1st 70% exceedance forecast
• Storage of water for Prior & Paramount lands
• Article VII restrictions all year
• No native storage for MRGCD nor release of SJCP water
• MRGCD started irrigation April 1, using reduced demand curve
• Irrigation limited to P&P in late July or August
• Reclamation has ~1,200 ac-ft supplemental water, expects additional ~12,000 depending on SJCP shortage
## April Forecast Data

<table>
<thead>
<tr>
<th>Location</th>
<th>2020 Percent</th>
<th>2021 Percent</th>
<th>April 1 50% / 70% Probability Volume, ac-ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rio Grande nr Del Norte</td>
<td>69%</td>
<td>71%</td>
<td>365,000 / 310,000</td>
</tr>
<tr>
<td>El Vado Reservoir Inflow</td>
<td>56%</td>
<td>52%</td>
<td>116,000 / 97,000</td>
</tr>
<tr>
<td>Rio Grande at Otowi</td>
<td>53%</td>
<td>58%</td>
<td>415,000 / 345,000</td>
</tr>
<tr>
<td>Nambe Reservoir Inflow</td>
<td>77%</td>
<td>43%</td>
<td>2,800 / 2,100</td>
</tr>
<tr>
<td>Jemez blw Jemez Dam</td>
<td>39%</td>
<td>18%</td>
<td>6,200 / 4,000</td>
</tr>
<tr>
<td>Rio Blanco @ Diversion</td>
<td>65%</td>
<td>74%</td>
<td>40,000 / 35,000</td>
</tr>
<tr>
<td>Navajo River @ Diversion</td>
<td>62%</td>
<td>69%</td>
<td>45,000 / 39,000</td>
</tr>
</tbody>
</table>
Historic Mar-Jul Flow Volumes at Otowi

March-July Volumes at Otowi
(2021 - NRCS forecast volumes)

April Forecast - (Mar-Jul vol)
50% probability: 415,000 ac-ft
90% probability: 255,000 ac-ft
10% probability: 620,000 ac-ft
30-year average: 720,000 ac-ft
Heron Reservoir
Proposed 2021 Heron Operations
El Vado Reservoir
Proposed 2021 El Vado Operations

[Graph showing flow, inflow, outflow, and storage over time from 4/1/2021 to 12/1/2021]
El Vado Dam Construction Update

- On track to begin construction in 2022 with installation of geomembrane over steel faceplates and grouting inside dam
- Currently finishing final designs and final contracting steps
- Reclamation will attempt to maintain water operations to extent possible during three years of construction
- Reclamation not considering modifications to inlet tower as they do not align with Safety of Dams project
Abiquiu Lake
Proposed 2021 Abiquiu Operations
Estimated Hydrograph at Embudo
Rio Grande main stem
Cochiti Lake
Estimated Hydrograph at Central

2021 Flow at Central Ave Gage
Estimated Hydrograph at San Acacia

2021 Flow at San Acacia Gage

Flow [cfs]
2021 Rio Grande Project Operations
Elephant Butte Projected Levels

2021 Elephant Butte Elevation

Elevation (ft)
Proposed Caballo Operations

Inflow
Outflow
Storage

Flow [cfs]
Storage [ac-ft]
Article VII Restrictions: In or Out?

2021 Rio Grande Project Usable Storage

Storage [ac-ft]

0  400,000

Questions / Comments