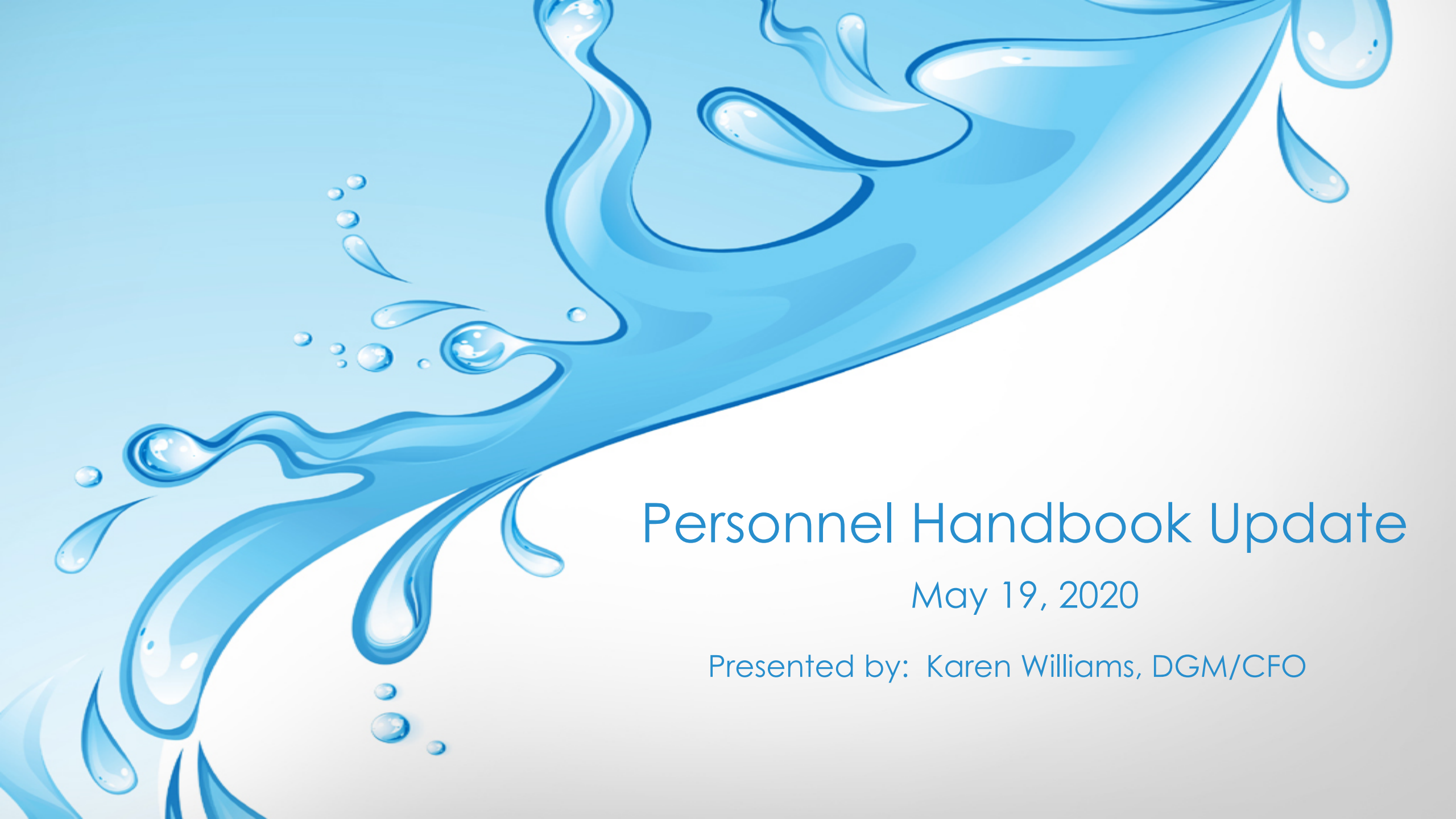


Personnel Handbook Update

May 19, 2020

Presented by: Karen Williams, DGM/CFO

Recommendation

It is recommended that the Commission approve the updated and revised Personnel Handbook.

Personnel Handbook Update

- Current Personnel Handbook was updated and approved September 18, 2012
- Lagerlof LLP was hired to review and update the Personnel Handbook and all personnel-related policies.
- The review found the following:
  - Handbook was fairly comprehensive and generally well done
  - Need to coordinate stand-alone policies with those in the handbook
  - Handbook needs to be organized
  - Handbook needs to be updated to be consistent with current law and current practice

Personnel Handbook Update

What Hasn't Changed

- Content of Personnel Handbook (just updated)
- Employee Benefits are the same as current handbook

Personnel Handbook Update

Changes to the Personnel Handbook

- Created Sections and organized handbook in a logical manner
- Incorporated and consolidated stand-alone policies
- Updated to be consistent with current law
  - Wage and Hour Policies
  - Leave Policies (New Parent Leave 2018)
  - Intern Policy
- Clarified Retiree Medical Benefits section
- Expanded the Personal Appearance Policy

Personnel Handbook Update

Changes to the Personnel Handbook

- Added
  - Reasonable Accommodations - Lactation
  - Working Off-Site Policy (referenced only)
  - Political Activities
  - Smoking/Vaping
  - Workplace Violence
  - Appendix 3 – Reimbursement Caps
- Removed
  - Cell Phone Purchase Policy
  - Travel and Expense Policy (referenced only)
  - Credit Card Policy (referenced only)

Appendix 3 - Reimbursement Caps

Added Appendix 3 for when reimbursement caps are changed only the appendix would need to be brought back for approval

Expense Reimbursement	Current Handbook	Updated Handbook	Change
Medical Cap	Not listed	$1,781.93	No change
Wellness Program	$125.00	$150.00	$25.00
Professional Memberships	$200.00	$300.00	$100.00
Work Boots	$165.00	$175.00	$10.00
Education Reimbursement	$1,400.00	$1,400.00	No change

Recommendation

It is recommended that the Commission approve the updated and revised Personnel Handbook.

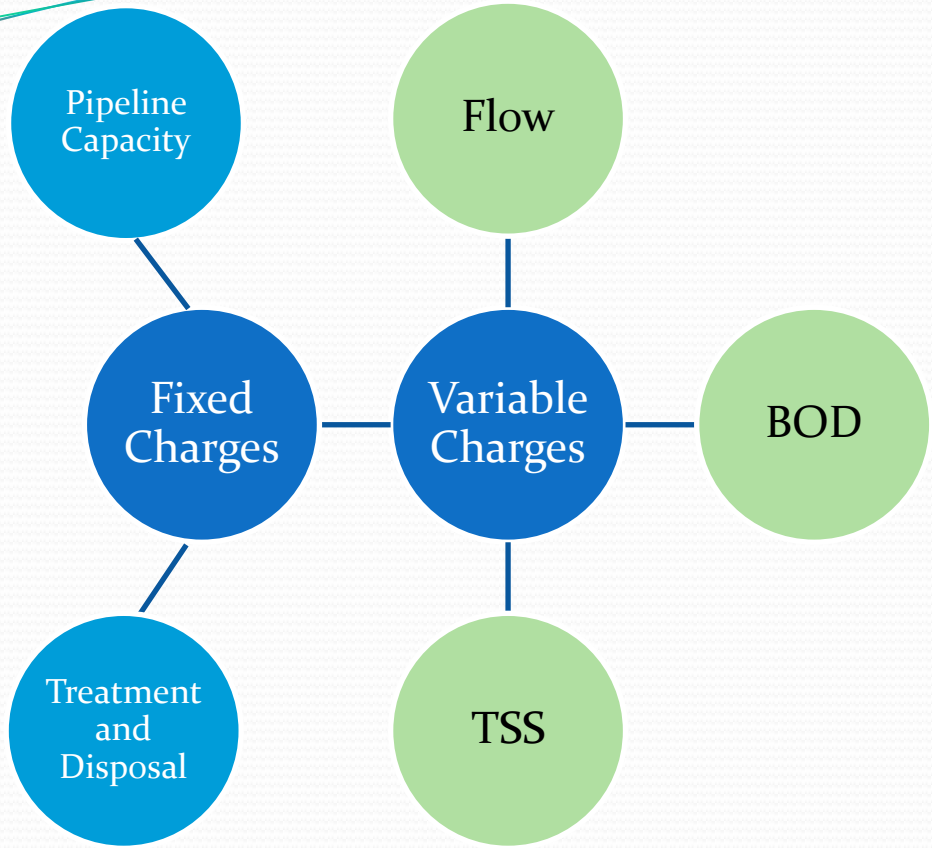

Questions?

Inland Empire Brine Line Rate Resolution FY20-21

Carlos Quintero, Operations Manager
Karen Williams, DGM,CFO
SAWPA Commission| May 19, 2020
Item 6.B.

Recommendation

- That the SAWPA Commission adopt Resolution No. 2020-06 establishing the new Inland Empire Brine Line rates to be effective July 1, 2020 (FY20-21).



Brine Line Rate Components:

- Flow
  - Per Million Gallons
- Biochemical Oxygen Demand (BOD)
  - Per 1,000 lbs
- Total Suspended Solids (TSS)
  - Per 1,000 lbs
- Fixed Charges for Pipeline and Treatment and Disposal Capacity Owned
  - Per Million Gallons/Day

Brine Line Expenses

OCSD Treatment and Disposal	OCSD SARI Line O&M	SSMP Implementation
Pre-treatment Program	Capital Improvements	Water Quality Sampling
Billing	Engineering	Management

Brine Line Approved Budgeted Expenses

Category	FY19-20	FY20-21	Change (%)	Change ($)
OCSD Treatment and Disposal	3,023,600	3,303,505	9.26	279,900
OCSD SARI O&M	75,000	80,000	6.67	5,000
Engineering	575,586	625,953	8.75	50,366
Water Quality Sampling	105,000	110,000	4.76	5,000
Management / Support	1,243,993	1,336,243	7.42	92,250
SSMP Implementation	2,045,099	2,113,432	3.34	68,333
Pretreatment Program	1,159,597	1,213,049	4.61	53,452
Non-operating expenses	2,895,027	2,835,027	-2.07	(60,000)
TOTAL	11,122,902	11,617,209	4.4	494,307

Proposed Brine Line Rates

Options	Flow (MG)	BOD - 1,000 lbs	TSS – 1,000 lbs	Fixed Pipe	Fixed T&D
Current rates FY19-20	$979	$316	$442	$6,398	$12,985
July 1, 2020 – December 31, 2020 (Proposed)	$979	$316	$442	$6,398	$12,985
January 1, 2021 – June 30, 2021 (Proposed)	$1,018	$329	$460	$6,654	$13,505

Rate increase (%) from FY19-20

Options	Flow (MG)	BOD - 1,000 lbs	TSS – 1,000 lbs	Fixed Pipe	Fixed T&D
Current rates FY19-20	$979	$316	$442	$6,398	$12,985
July 1, 2020 – December 31, 2020 (Proposed)	0%	0%	0%	0%	0%
January 1, 2021 – June 30, 2021 (Proposed)	4%	4.1%	4.1%	4%	4%

Impact to revenue

Rate Period	Impact to revenue
No rate increase (July 1, 2020 – December 31, 2020)	($290,852)
Rate increase (January 1, 2021 – June 30, 2021)	$0
TOTAL	($290,852)

Indirect Dischargers

- Currently using a 2 tier system:
  - Brine (< 100 mg/L)
  - Non-Brine (≥ 100 mg/L)
  - Charges based on a per gallon base for brine tier and a per gallon base plus pounds of BOD and pounds of TSS for non-brine tier.

Rates for Indirect Dischargers

Option	Brine Tier (< 100 mg/L) / gallon	Non-Brine Tier* (≥ 100 mg/L) / gallon	BOD/lb	TSS/lb
Current (FY19-20)	$0.015	$0.015	$0.75	$0.716
7/1/20 – 12/31/20	$0.015	$0.015	$0.75	$0.716
1/1/21 – 6/30/21	$0.016	$0.016	$0.78	$0.745

**Non-brine tier charges the flow component plus any pounds of BOD and TSS.*

Proposed Capacity Pool Lease Rates

Rate Period	Flow (per gallon)	Additional BOD (per lb)	Additional TSS (per lb)
Current (FY19-20) [250 mg/L BOD/TSS]	$0.00253	$0.3923	$0.2405
7/1/20 – 12/31/20	$0.00253	$0.3923	$0.2405
1/1/20 – 6/30/21	$0.00263	$0.4080	$0.2501

Proposed Treatment & Disposal Surcharge Rates

Rate Period	Flow (per gallon)	BOD (per lb)	TSS (per lb)
Current (FY19-20)	$0.0020	$0.3923	$0.2405
7/1/20 – 12/31/20	$0.0020	$0.3923	$0.2405
1/1/20 – 6/30/21	$0.0021	$0.4080	$0.2501

Proposed Permit Fees

Type of Permit	FY19-20 Fee	Proposed FY20-21 Fee
Direct Discharger	$600	$600
Indirect Discharger	$300	$300
Emergency Permits	$1,100	$1,100
Liquid Waste Hauler	$250	$250

BRINE LINE RESERVES

Karen Williams, Assistant General Manager/CFO

SAWPA Future CIP

- Reach 4D Corrosion Rehabilitation
- Reach 4A Pine Avenue Siphon Protection / Replacement
- Reach V Baker Street Protection
- Reach V Indian Truck Trail Protection
- Reach V Air / Vacuum Valves Modification/Relocation
- Reach 4D Mission Tunnel Rehabilitation
- Reach V Access / Condition Study / Rehabilitation
- Reach IV Condition Study / Rehabilitation
- Capacity Management
- Hydraulic “Choke Points”
- OCSD Future CIP

Risks to System

- Portions of the system are aging
- Corrosion
- Unknown condition due to limited access to parts of the system
- Catastrophic failure due to earthquake
- Failure due to flooding / erosion / development

Reserve Balance as of March 31, 2020

Reserve Account	03/31/2020
Pipeline Repair/Replacement Reserve	$22,125,566
OCSD Rehabilitation Reserve	3,690,111
OCSD Future Capacity Reserve	1,809,234
Self-Insurance Reserve	4,311,780
Flow Imbalance Reserve	87,444
Debt Service Reserve	3,317,311
Capacity Management Reserve	11,817,079
Rate Stabilization Reserve	1,013,845
Operating Reserve	3,779,138
Total Reserves	**$51,951,508**

Reserve Balance Projected EOY

Reserve Account	FYE 2020	FYE 2021
Pipeline Repair/Replacement Reserve	$15,467,521	$15,728,983
OCSD Rehabilitation Reserve	3,591,892	3,591,892
OCSD Future Capacity Reserve	1,761,077	1,761,077
Self-Insurance Reserve	4,224,343	4,324,343
Flow Imbalance Reserve	85,103	85,103
Debt Service Reserve	3,928,308	3,417,032
Capacity Management Reserve	11,502,545	11,502,545
Operating Reserve	3,133,547	3,133,547
Total Reserves	**$43,694,336**	**$43,544,522**

Budgeted Contributions to Reserves

Category	FYE 2020	FYE 2021	Difference	% Difference
Pipeline Repair/Replacement	$1,435,478	$1,810,491	$375,013	26.12%
Self-Insurance	100,000	100,000	0	0.00%
Debt Service	1,708,750	1,708,750	0	0.00%
Total Contributions	$3,244,338	$3,619,241	$375,013	11.56%

Brine Line Operating Reserve

The Brine Line Operating Reserve was established to cover temporary cash flow deficiencies that occur as a result of timing differences between the receipt of operating revenues and expenditure requirements.

- Balance as of 03/31/20 - $3,770,138
- Target Level – Funding shall be targeted at a minimum amount equal to 90 days (i.e., 25%)
- Events and Conditions Prompting the Use of the Reserve – This reserve is utilized as needed to pay outstanding Brine Line Enterprise expenditures prior to receipt of anticipated operating revenues.
- Target level for:
  - FYE 2020 $2,056,969
  - FYE 2021 $2,195,544

Rate Stabilization Reserve

Established to mitigate the effects of occasional shortfalls in revenue. Revenue shortfalls result from a number of events such as weather factors (wet weather or drought events and natural disasters), increased water conservation, poor regional economic conditions, and unplanned or unexpectedly large rate adjustments/increases.

- Balance as of 03/31/2020 - $1,013,845
- Target Level – There is no minimum balance for this reserve. This will be looked at as part of the Asset Criticality Assessment.
- Events and Conditions Prompting the Use of the Reserve – This reserve is utilized as needed to pay revenue shortfalls that result from conditions described above.

Pipeline Replacement Reserve

Established to provide capital replacement funding as the Brine Line system's infrastructure (pipe) deteriorates over its expected useful life.

- Balance as of 03/31/2020 - $22,125,566
- FYE 2021 Contribution of $1,810,491
- Target Level – The most recent Brine Line Financial Study and Rate Model have identified a minimum target balance of $10.0 million for this reserve. Target minimum and maximums will be developed during the asset criticality assessment.
- Events and Conditions Prompting the Use of the Reserve – This reserve account is used to pay for approved Capital Improvement Projects, emergency replacement, and in certain circumstances, one-time operating expenditures related to specific projects. (Funding would be provided through use of this reserve rather than rate increases.)

Capital Project Funding – Use of Reserves

Project	FYE 2020	FYE 2021
Brine Line Protection	$5,041,923	$1,466,878
Reach IV-D Corrosion Repairs	76,211	82,151
Total	**$5,118,134**	**$1,549,029**

Capital Projects

- Fund 320 Brine Line Protection
  - OCSD Rock Removal Project
  - Protection from stormwater/erosion
  - Reach IV-D MAS modifications
  - Alcoa Dike protection/relocation

- Fund 327 Reach IV-D Corrosion Repair
  - Evaluation of pipeline corrosion

CIP versus Reserve Contributions

Project	FYE 2020	FYE 2021
Pipeline Replacement Reserve Beg. Balance	$22,597,372	$18,914,716
Contributions to Reserve	1,435,478	1,810,491
Use of Reserves for CIP	(5,118,134)	(1,549,029)
Pipeline Replacement Reserve Balance	**$18,914,716**	**$19,176,178**
Net Change from Contributions/Use	**($3,682,656)**	**$261,462**

OCSD Rehabilitation Reserve

This reserve was established to fund SAWPA's share of capital costs associated with its proportionate share of capacity right ownership in the SARI Line maintained by OCSD.

- Balance as of 03/31/2020 - $3,690,111
- Target Level – The most recent Financial Study has identified a minimum target level of $1.75 annually (adjusted for inflation). This needs to be reviewed based on OCSD CIP.
- Events and Conditions Prompting the Use of the Reserve – This reserve is utilized as needed to pay when due SAWPA's share of OCSD SARI Line capital costs.

Debt Retirement Reserve

This reserve was initially established with funds received from SAWPA's member agencies for the purchase of pipeline capacity (30 MGD) in the Brine Line system to provide future funding on debt service payments for SRF loans required to build the Brine Line system. Treasury-strips were purchased with maturities to match annual principal and interest payments due on the long-term debt associated with the State loans. This reserve will be maintained and/or adjusted at levels set forth in future "bond covenants" or other debt obligation instruments as approved by the SAWPA Commission.

- Balance as of 03/31/2020 - $3,317,311

Debt Retirement Reserve

- Target Level – The minimum balance in this reserve should be sufficient to cover anticipated debt service payments as they come due. The balance in this reserve should reflect debt service obligations for which existing or projected revenues are insufficient to cover scheduled principal and interest payments.
- Events and Conditions Prompting the Use of the Reserve – This reserve is utilized to pay when due debt service payments on SAWPA's obligations.

Debt Service Payments

Debt	2020	2021
Reach V Construction – SRF Loan 1 – 4	$1,126,278	$1,126,278
Reach IV-A & B Capital Repair – SRF Loan	1,044,273	1,044,273
Reach V Capital Repair – SRF Loan	664,476	664,476
Total Debt Service Payments	**$2,835,027**	**$2,835,027**

Debt Service Funding

Debt	Interest Rate	Final Payment	Funding Source
Reach V Construction	2.7%	10/05/21	T-Strips/Investments
Reach IV-A & B Capital Repair	2.6%	12/29/32	Rates
Reach V Capital Repair	1.9%	03/31/48	Rates

$1,708,749 from rates

Debt Service Covenants of Financing Agreement

- Debt Test
  - Net revenues must be 1.2 times the highest year of debt service
    - $2,050,500 minimum net revenues
  - Net revenues must be 1.1 times all debt
    - $3,118,530 minimum net revenues
  - FYE 2021 Budget Net Revenues are $3,619,241 (only have $500,711 difference)

- Reserve Fund
  - Must be equal to 1 year's debt service
    - $1,708,750

OCSD Future Capacity Reserve

This reserve is established to provide future funding as it becomes necessary for SAWPA to purchase additional treatment capacity (minimum 1 MGD increments) in the OCSD treatment plant facility. As incremental treatment capacity purchases are made from member agencies, funds will be deposited into this reserve account which can then be used to purchase treatment capacity from OCSD.

- Balance as of 03/31/2020 - $1,809,234
- Target Level – There is no minimum balance for this reserve.
- Events and Conditions Prompting the Use of the Reserve – This reserve may only be utilized to purchase additional treatment capacity in the OCSD plant as approved by the SAWPA Commission.

Self Insurance Reserve

This reserve was originally established to provide insurance liability, and worker's compensation claims. The reserve level, combined with SAWPA's existing insurance policies, should adequately protect SAWPA and its member agencies in the event of a loss or claim.

- Balance as of 03/31/2020 - $4,311,780
- FYE 2021 Contribution of $100,000
- Target Level
- Events and Conditions Prompting the Use of the Reserve – This reserve shall be utilized to cover out-of-pocket insurance losses experienced by SAWPA. Any reimbursement received by SAWPA from the insurance company as a result of submitted claim shall be deposited back into the reserve as replenishment for the loss.
- Contribution to Reserves – Contributions of $100,000, annually.

Self Insurance Reserve

Insurance Policies:

- Commercial Property, General Liability, Umbrella Excess, and Auto
  - Through CalMutuals JPRIMA
  - $5,000 deductible per incident
  - Pipelines not covered

- Environmental Legal Liability (Pollution)
  - Through Aspen Specialty Insurance Company
  - $25,000 deductible per incident
  - $5,000,000 limit of liability per incident
  - Actual cost of pipeline damage not covered

Capacity Management Reserve

This reserve is established to set aside 100% of the funding derived from pipeline capacity sales to provide funds for future capacity needs within the Brine Line. As the pipeline reaches capacity, other alternatives will be needed to ensure the ability to discharge and achieve salt balance within the Santa Ana Watershed.

- Balance as of 03/31/2020 - $11,817,079
- In 2006, sold additional pipeline capacity of 2.568 MGD
  - WMWD purchased 1.0 MGD for $3,750,000
  - EMWD purchased 1.568 MGD for $5,880,000
- $9,630,000 total sales (2006)
- $266,755 EnerTech capacity lease fees (2009)
- $1,920,324 interest earnings

Capacity Management Reserve

- Target Level – Given the nature of this reserve, there is no required minimum or maximum level. 100% of the funding derived from pipeline capacity sales should be deposited and maintained in this reserve.
- Events and Conditions Prompting the Use of the Reserves – This reserve is to be utilized to cover cost required to manage capacity within the pipeline, including costs to further concentrate Brine Line flows, reduction of flows to meet capacity needs, additional pipeline capacity, additional CIP, and other changes as appropriate.

Flow Imbalance Reserve

This reserve is established to set aside funds in the event that a meter error occurs and the discharger is over-billed. Each month, meter readings are read for each discharger and the total for all dischargers is compared to the total at meter S-01. When the total for all dischargers exceeds the total at meter S-01, the difference will be calculated at the current flow rate and contributed to the reserve account.

No budgeted contributions to this reserve.

- Balance as of 03/31/2020 - $87,444
- Initially established by adding $1.00 to the flow rate for 2 years.
- Target Level – Based on SAWPA's practice, a minimum of $50,000 should be maintained for this reserve.
- Event and Conditions Prompting the Use of the Reserve – This reserve is utilized to refund dischargers in the event that a meter error occurs and the discharger is over-billed.

Rate Model - Reserves

- Brine Line Rate Model Updated in 2018 by Raftelis
- Raftelis recommended additional studies to determine Pipeline Replacement Reserve Min and Max
  - Assess the replacement cost of the brine line
    - Completed – Estimated value is $350 million
  - Conduct an asset criticality assessment

Recommendation

- That the SAWPA Commission adopt Resolution No. 2020-06 establishing the new Inland Empire Brine Line rates to be effective July 1, 2020 (FY20-21).

Questions??

Reserve Balance Projected EOY

Reserve Account	FYE 2020	FYE 2021
Pipeline Repair/Replacement Reserve	$15,467,521	$15,728,983
OCSD Rehabilitation Reserve	3,591,892	3,591,892
OCSD Future Capacity Reserve	1,761,077	1,761,077
Self-Insurance Reserve	4,224,343	4,324,343
Flow Imbalance Reserve	85,103	85,103
Debt Service Reserve	3,928,308	3,417,032
Capacity Management Reserve	11,502,545	11,502,545
Operating Reserve	3,133,547	3,133,547
Total Reserves	**$43,694,336**	**$43,544,522**

OCSD – SAWPA Rates (FY15 through FY21)

OCSD - SAWPA Rates	FY 14-15	15-16	16-17	17-18	18-19	19-20	20-21 (P)
Flow OCSD (per MGD)	$182.74	$178.94	$175.17	$175.68	$187.00	$221.00	$221
Flow SAWPA	$777.00	$817.00	$858.00	$901.00	$946.00	$979.00	$1,018
BOD OCSD (per 1,000 lbs)	$290.16	$284.12	$278.14	$278.96	$285.00	$320.00	$320
BOD SAWPA	$295.00	$301.00	$307.00	$307.00	$307.00	$316.00	$335
TSS OCSD (per 1,000 lbs)	$404.60	$396.19	$387.85	$388.99	$410.00	$472.00	$472
TSS SAWPA	$411.00	$420.00	$429.00	$429.00	$429.00	$442.00	$469

OCSD – SAWPA Rate Increase (FY15 through FY21)

OCSD - SAWPA Rates	FY 14-15	15-16	16-17	17-18	18-19	19-20	20-21 (P)
Flow OCSD	12.39%	-2.08%	-2.11%	0.29%	6.44%	18.18%	0%
Flow SAWPA	5.57%	5.15%	5.02%	5.01%	4.99%	3.49%	4%
BOD OCSD	16.34%	-2.08%	-2.10%	0.29%	2.17%	12.28%	0%
BOD SAWPA	10.90%	2.03%	1.99%	0.00%	0.00%	2.93%	4%
TSS OCSD	9.30%	-2.08%	-2.11%	0.29%	5.40%	15.12%	0%
TSS SAWPA	4.05%	2.19%	2.14%	0.00%	0.00%	3.03%	4%

OCSD – SAWPA Rates (FY15 through FY20)

OCSD - SAWPA Rates	FY 14-15	15-16	16-17	17-18	18-19	19-20	20-21 (P)
Flow OCSD (per MG)	$182.74	$178.94	$175.17	$175.68	$187.00	$221.00	$221.00
Increase from previous FY	12.39%	-2.08%	-2.11%	0.29%	6.44%	18.18%	0%
Flow SAWPA	$777.00	$817.00	$858.00	$901.00	$946.00	$979.00	$1,018
Increase from previous FY	5.57%	5.15%	5.02%	5.01%	4.99%	3.49%	4%
BOD OCSD (per 1,000 lbs)	$290.16	$284.12	$278.14	$278.96	$285.00	$320.00	$320.00
Increase from previous FY	16.34%	-2.08%	-2.10%	0.29%	2.17%	12.28%	0%
BOD SAWPA	$295.00	$301.00	$307.00	$307.00	$307.00	$316.00	$329.00
Increase from previous FY	10.90%	2.03%	1.99%	0.00%	0.00%	2.93%	4/1%
TSS OCSD (per 1,000 lbs)	$404.60	$396.19	$387.85	$388.99	$410.00	$472.00	$472.00
Increase from previous FY	9.30%	-2.08%	-2.11%	0.29%	5.40%	15.12%	0%
TSS SAWPA	$411.00	$420.00	$429.00	$429.00	$429.00	$442.00	$460.00
Increase from previous FY	4.05%	2.19%	2.14%	0.00%	0.00%	3.03%	4.1%

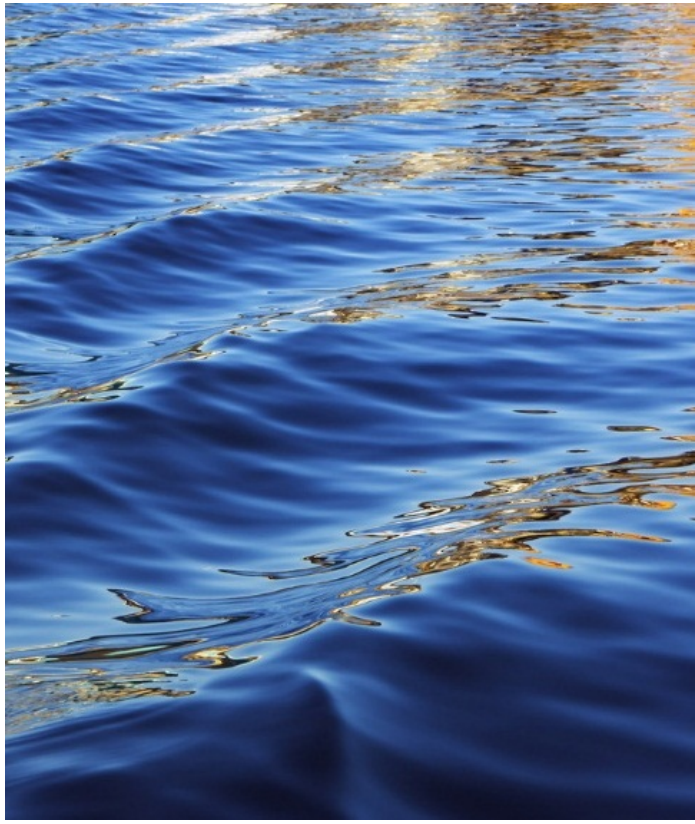
Weather Modification Feasibility Study

SAWPA

Feasibility Review

- State of Water in the Western USA
- SAWPA Climatology
- Seeding Methods & Design
- Precipitation & Streamflow Estimates
- Conclusion

State of Water in the Western USA



USA TODAY

NEWS HAPPENS AT NIGHT, TOO

WHERE'S MY STIMULUS CHECK?

Why you can't track

STAYING APART, TOGETHE

It's hard right no

[News] Sports Entertainment Life Money Tech Travel Opinio

KSL.com News Sports Brandview TV Radio Live Obituaries Weather 66°

Forbes Billionaires Innovation Leadership Money Busines

EDITORS' PICK | 36,425 views | Apr 20, 2020, 11:55am EDT

US Drought Could Last A Century As We Now Enter A Megadrought, Study Finds

Los Angeles Times

SUBSCR $1 for

CLIMATE & ENVIRONMENT

n U.S. 'megadrought' the

Smithsonian MAGAZINE SUBSCRIBE SMARTNEWS HISTORY SCIENCE INGENUITY ARTS & CULTURE TRAVEL

The American West May Be Entering a 'Megadrought' Worse Than Any in Historical Record

A new study of ancient climate has a dire warning about today's dry conditions

States has experienced four

CBS NEWS NEWS CORONAVIRUS SHOWS LIVE

Megadrought emerging in western U.S. could be the worst in 1,200 years, study finds

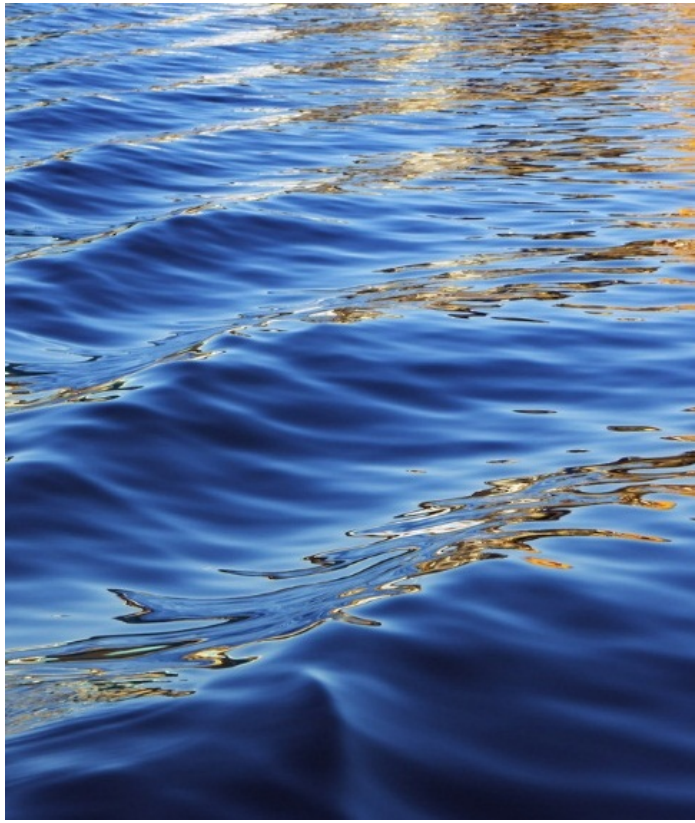
BY JEFF BERARDELLI

APRIL 17, 2020 / 9:30 AM / CBS NEWS

Take-Aways

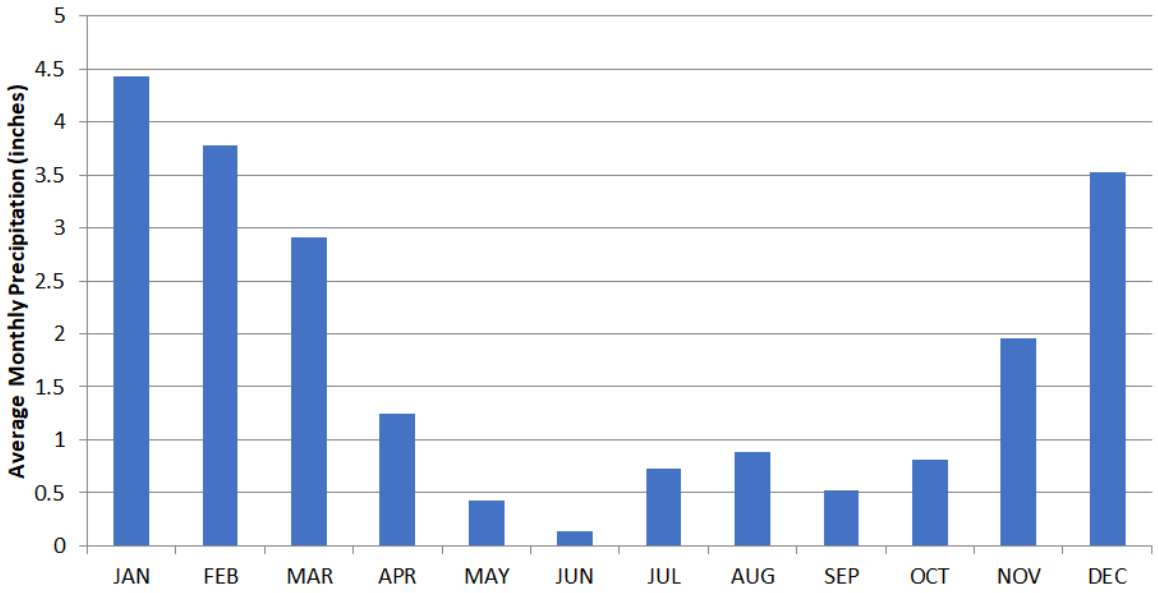
- Climate change is happening
- No need for fear if we prepare
  - Conservation Efforts
  - Infrastructure Improvements
  - Regulatory Changes
  - Scientific Advancements

SAWPA Climatology



Precipitation Trends

Seasonality



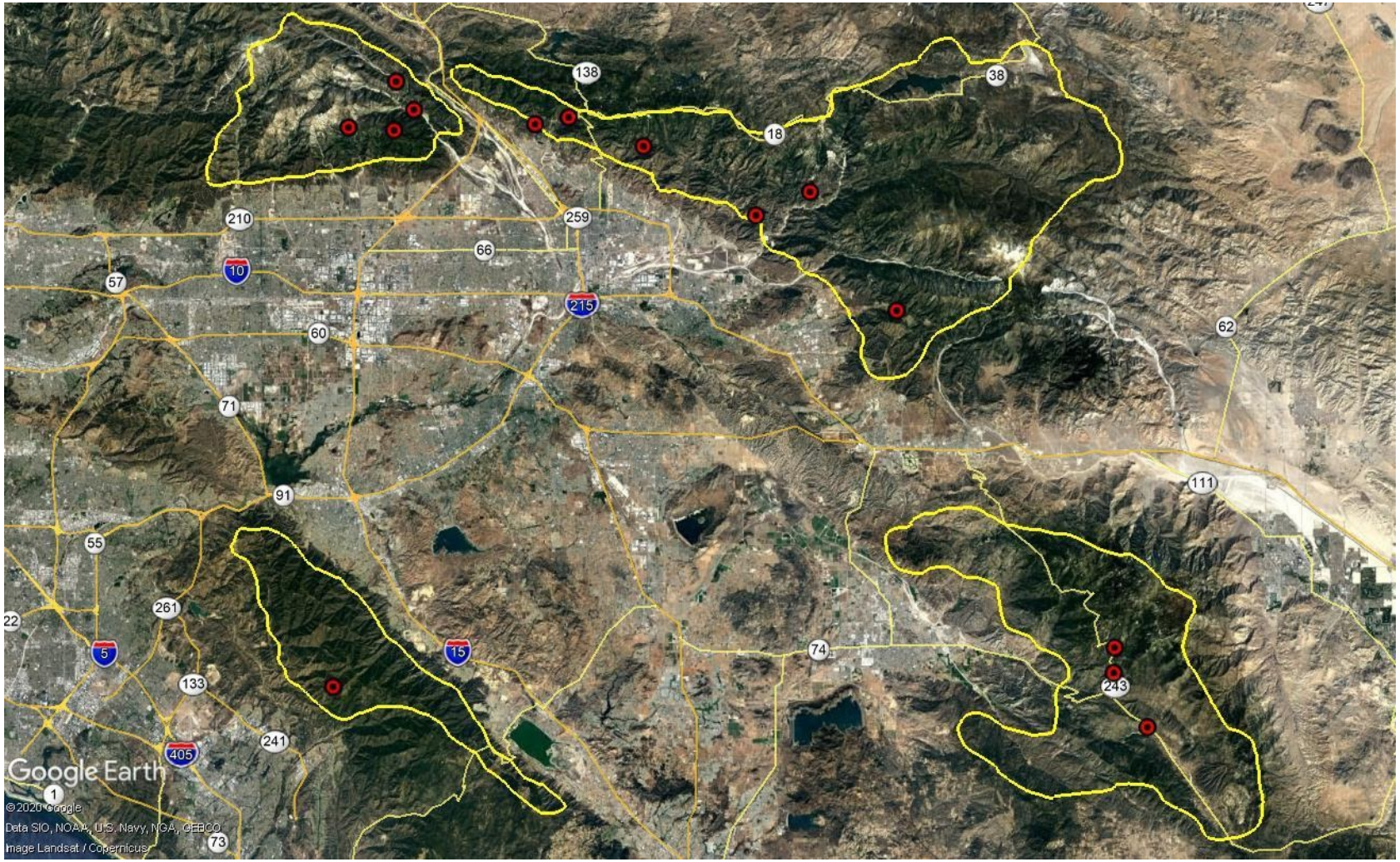
Big Bear Lake 1961-2019 monthly precipitation

Elevation

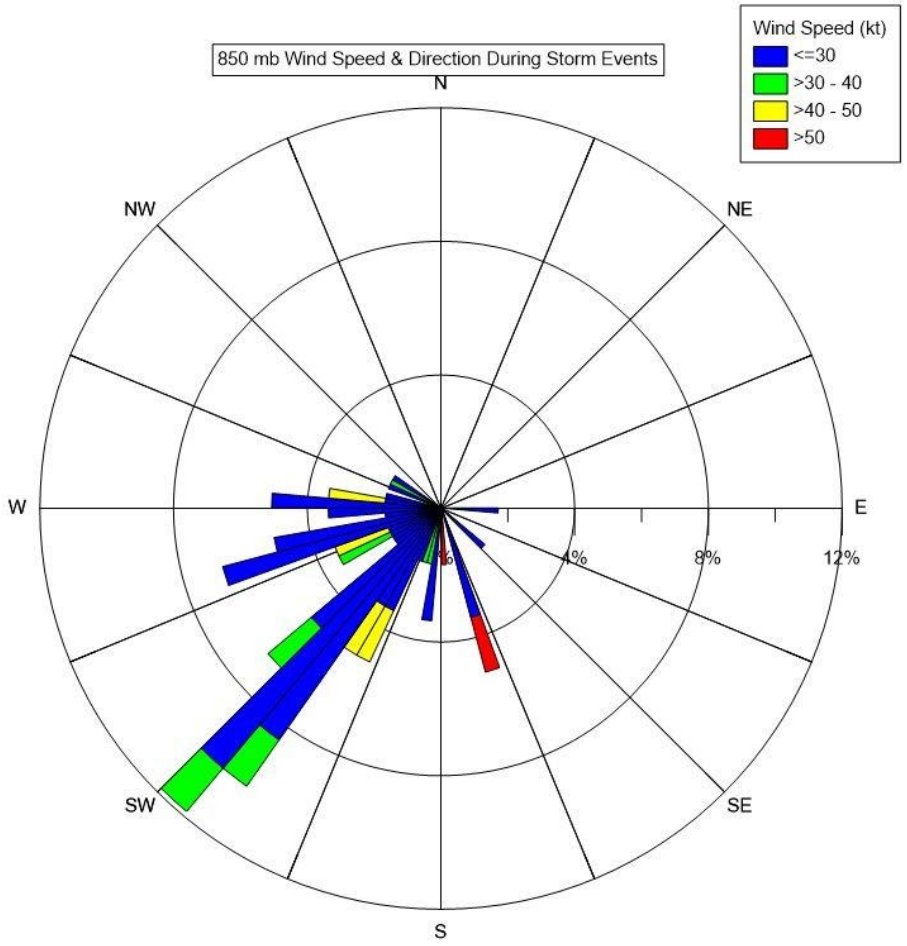
There is a strong correlation between elevation and average precipitation. Mountainous areas (above 2,000-3,000 feet) experience 20-40 inches of precipitation per year. Lower elevation coastal areas receive about 10-20 inches of precipitation per year.

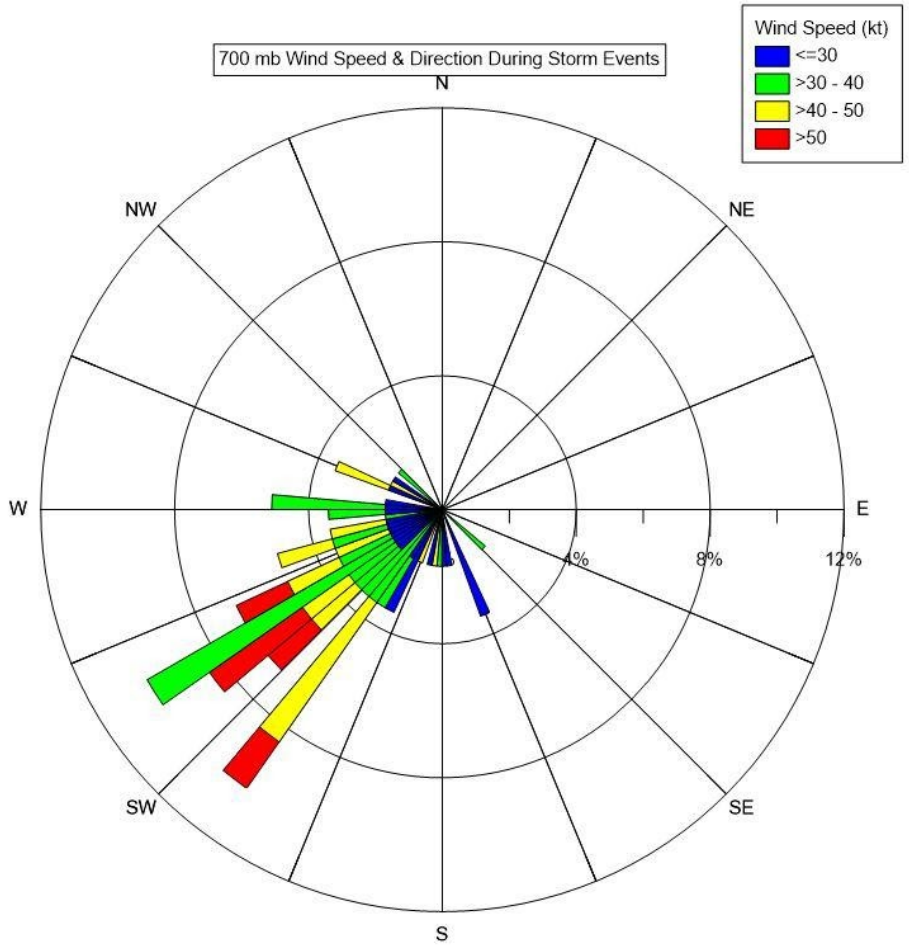
Most snowfall occurs above 5,000ft with areas above 7,000 ft often receiving greater than 100 inches annually (retaining 25-35 inches of snowpack).

Designation of Target Areas

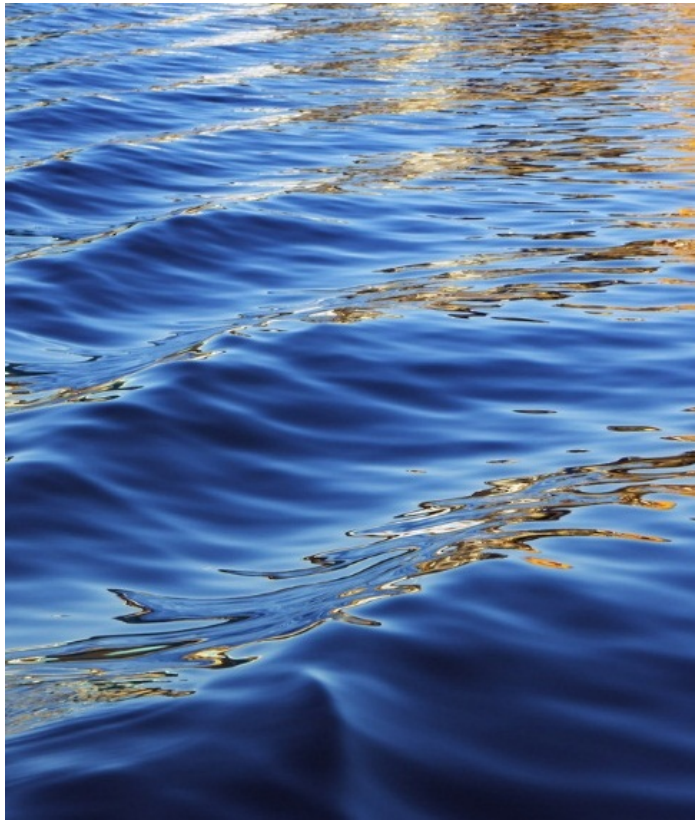


Understanding Storm Winds and Movement





Seeding Methods & Design



Ground Based Seeding Methods

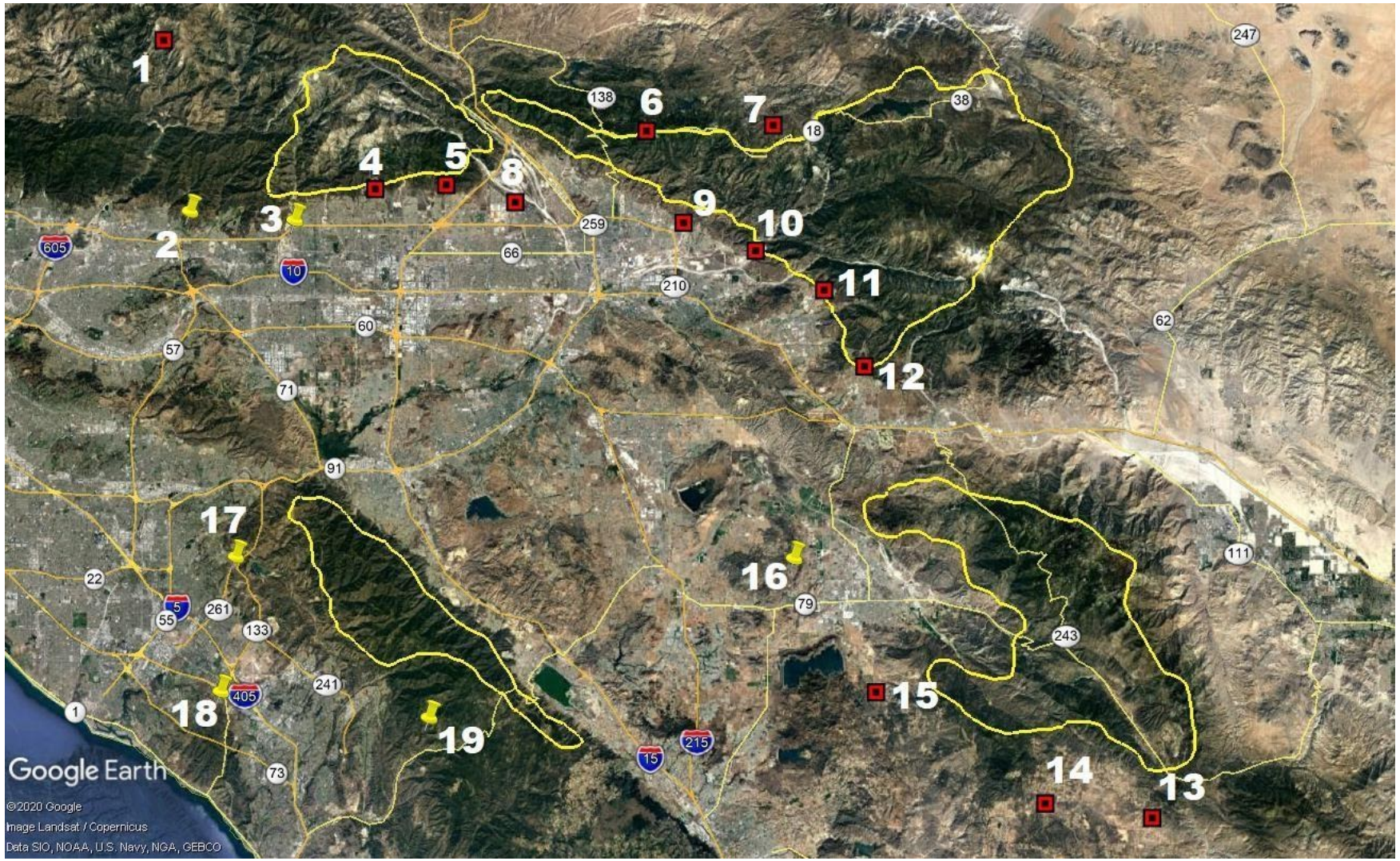
CNG's (Cloud Nuclei Generators)

- Ideal for orographic lift (winds caused by land barriers)
- Create a continuous plume
- Inexpensive to install and operate

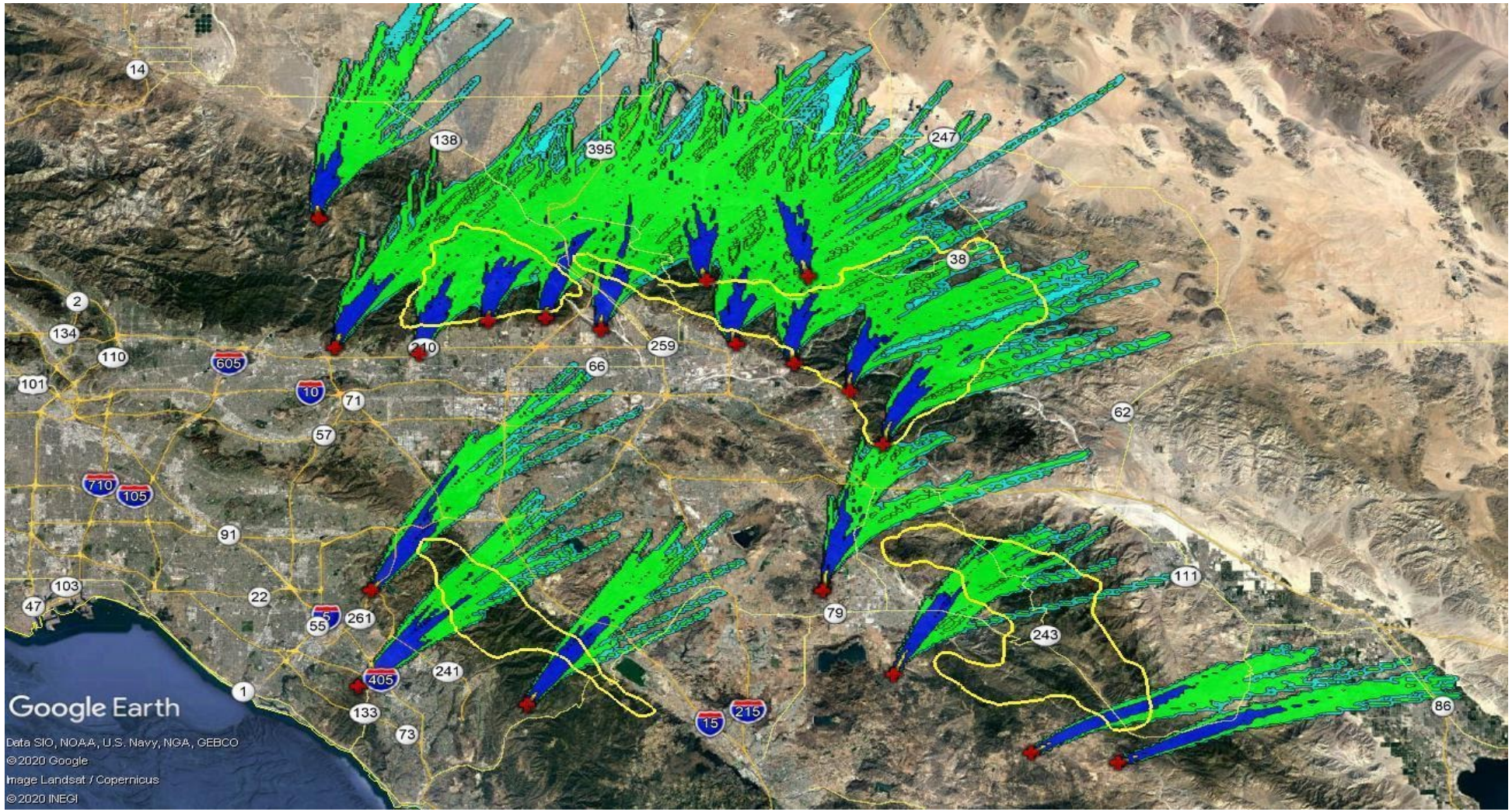
AHOGS (Automated High Output Ground Seeding) Systems

- Depend on strong convective storm attributes (turbulence)
- Deliver a higher concentration of Silver Iodide – rapid release
- Operated remotely

Ground Based Seeding Locations



Ground Based Seeding Dispersion Model



Aerial Seeding

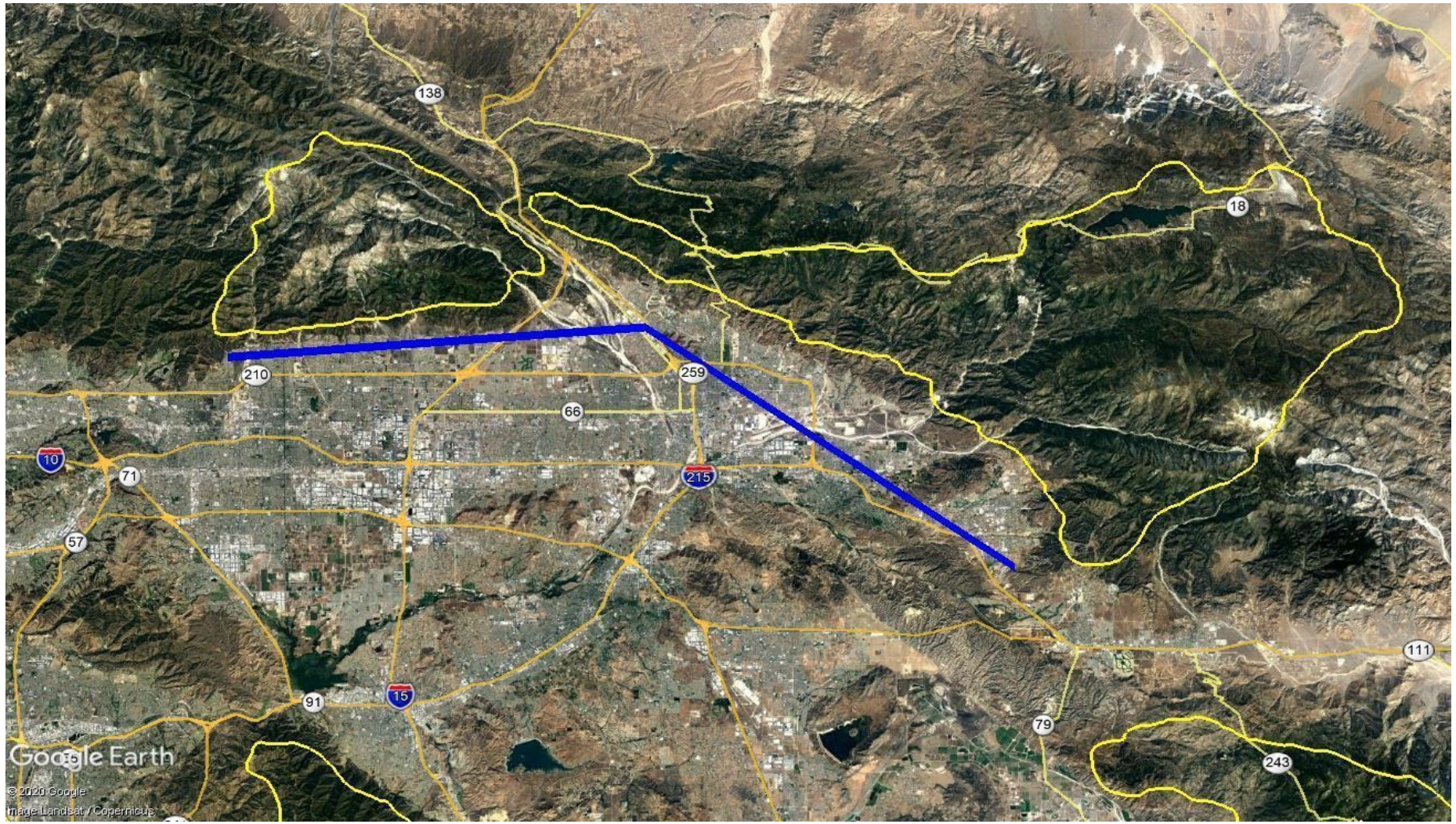
Technical Feasibility

- Unlike commercial air traffic that quickly leaves an area of high traffic, cloud seeding aircraft occupy the same airspace for an extended period of time
- Flight tracks for the eastern target areas are more likely to receive FAA approvals during times of high traffic, and during periods of storm activity.

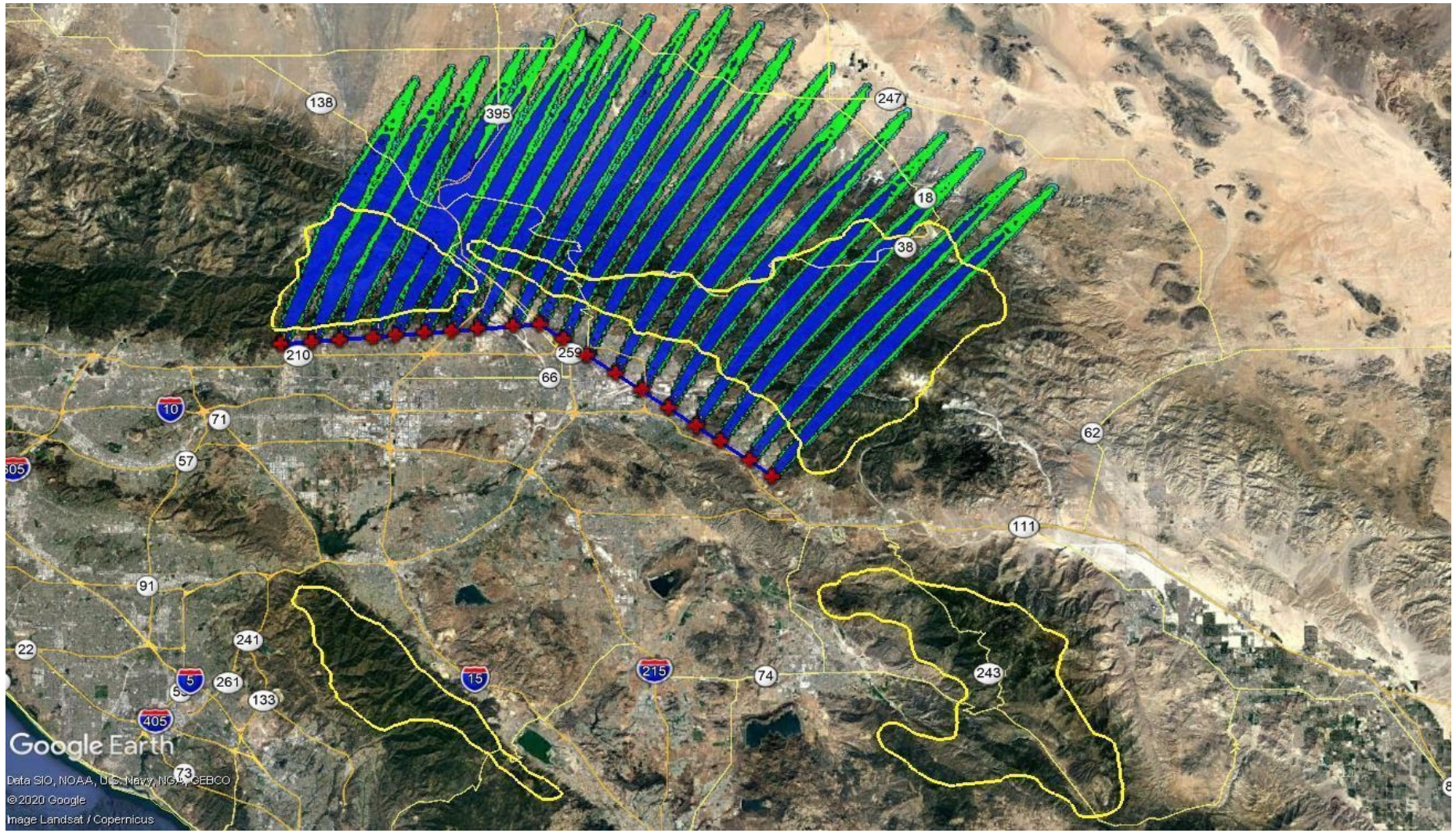
Economic Feasibility

- Land barriers must be of an appropriate size to benefit from aerial seeding
- Annual runoff must support the investment of an aerial component
- Preference should be given to areas with greater potential increases

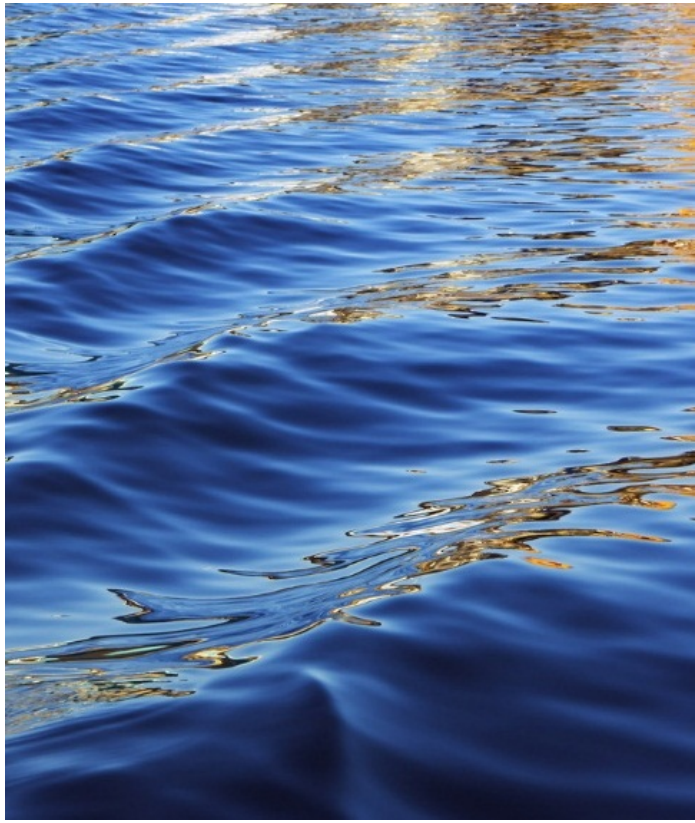
Aerial Seeding Flight Path



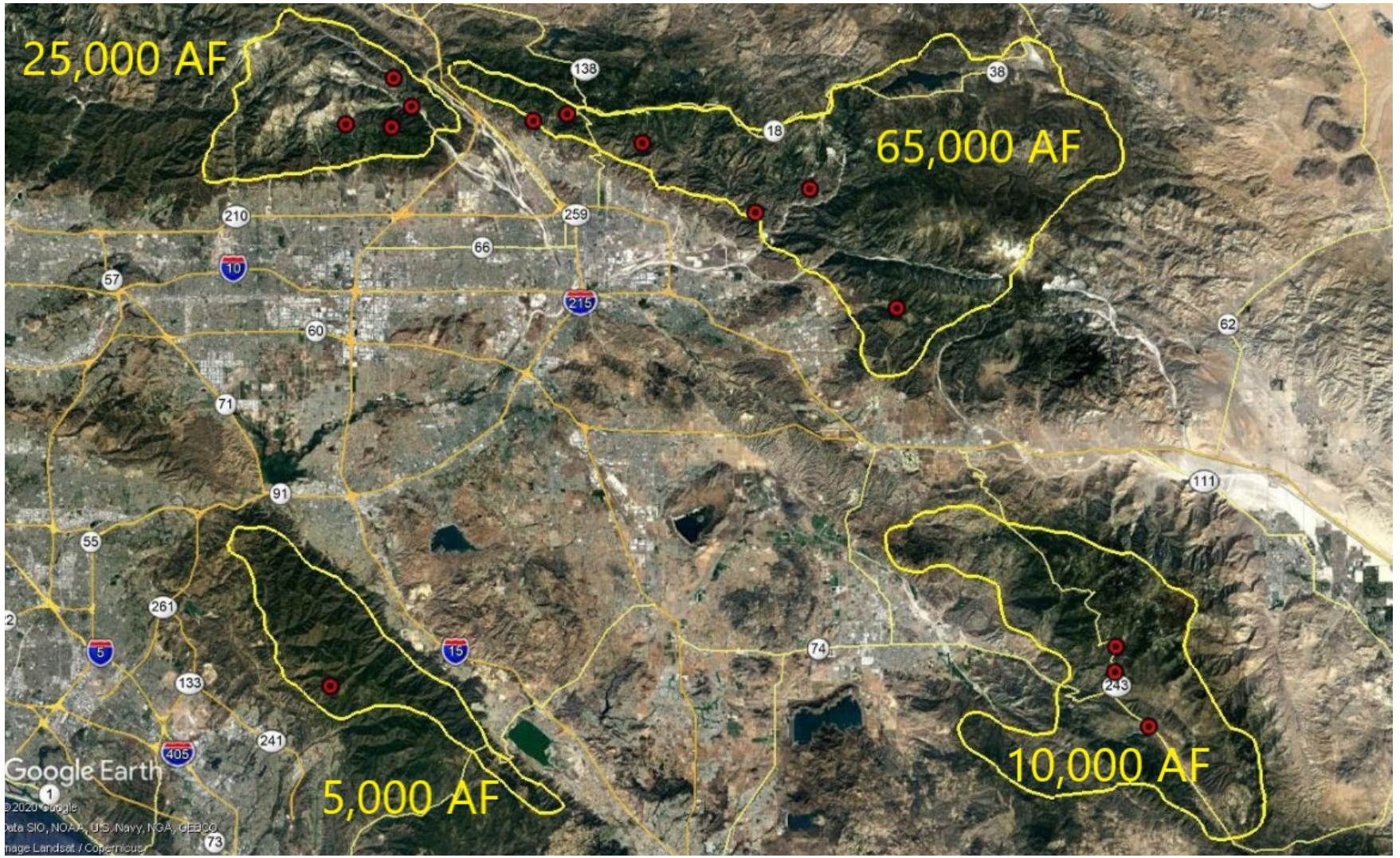
Aerial Seeding Dispersion Model



Precipitation & Streamflow Estimates



Estimated Annual Streamflow



Estimated Increases in Seasonal Precipitation

Target Area	Seasonal Increase (inches)	Percent Increase
NW	0.41	3.5%
NE (ground only)	0.49	4.1%
NE (air & ground)	0.89	7.3%
SW	0.59	3.7%
SE	0.49	4.5%

- 58 storms over 5 seasons were considered, 47 of the 58 were found to be seedable
- Of the seedable events 21% were considered seedable by aircraft only, and 79% were found to be seedable by aircraft or ground based systems
- Estimated seasonal increases to precipitation were determined for each target area by adding the potential increase for each individual storm event

Estimated Increases in Seasonal Streamflow

Target Area	Average Natural Streamflow (AF)	Expected Average Streamflow Increase (AF)
NW	25,000	2,043
NE (ground only)	65,000	4,330
NE (air & ground)	65,000	7,772
SW	5,000	447
SE	10,000	1,373

- Regressions (mathematical models) between **precipitation** and **streamflow** were developed based on long-term data sets from various time periods, some beginning as early as the 1920s.
- The R-value for the derived regressions were all close to .8 suggesting a strong correlation between precipitation and runoff for all 4 target areas. (80% confidence threshold)
- The estimated precipitation increases derived from the former portion of the study were applied to the mathematical models for each target area, to determine the effective increases in streamflow.

Total Projected Increases

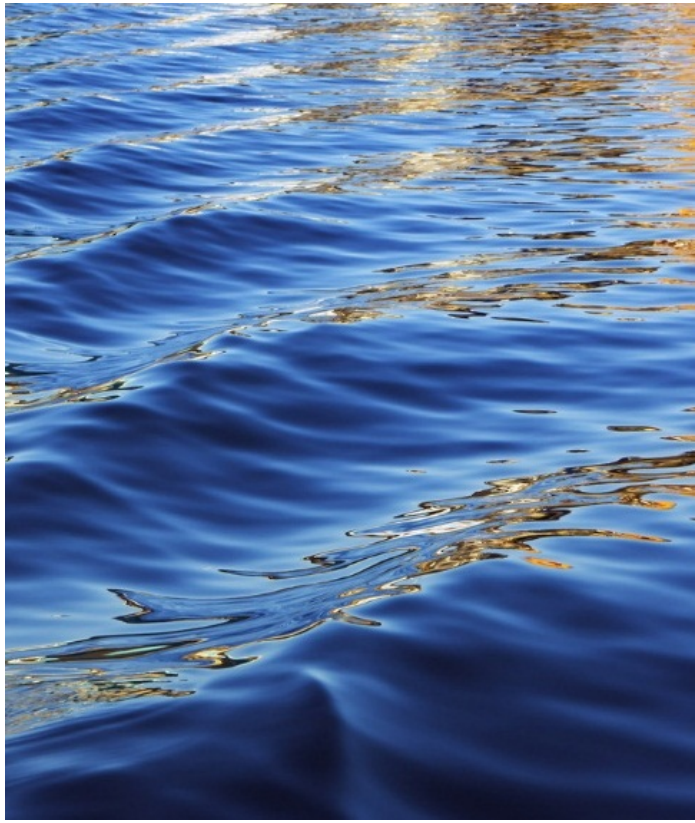
Target Area	Seasonal Precip. Increase (inches)	Percent Increase	Avg. Natural Streamflow (AF)	Streamflow Increase (AF)	Percent Increase
NW	0.41	3.5%	25,000	2,043	8.2%
NE (ground)	0.49	4.1%	65,000	4,330	6.7%
NE (air & ground)	0.89	7.3%	65,000	7,772	12.0%
SW	0.59	3.7%	5,000	447	9.0%
SE	0.49	4.5%	10,000	1,373	13.7%
			TOTAL	**11,635**	**11.1%**

These estimates are largely conservative. Calculating increases from cloud seeding activity is not an exact science, we have decades of research, but every storm is unique. As the purpose of this study is determine economic and technical feasibility, we felt an obligation to err on the side of caution.

Areas where we chose to be conservative:

- We do not have access to runoff data for all natural streams and waterways. Rather than adding a reasonable increase to each target area for untracked runoff, we assumed runoff only occurs in waterways with active gauges.
- Research performed in the 1970's suggests rainfall increases of 20% are achievable when seeding organized convective bands. Though we agree a 20% increase is fathomable, circumstances would have to be truly ideal in order to achieve such dramatic results, are projections were significantly more modest.

Conclusion



Preliminary Benefit to Cost Assessment

- Depending on the method of seeding, the combined total estimated runoff increase from the four target areas is between 8,393 AF and 11,835 AF for an "average year."
- With a typical retail value around $1,000/AF. The additional runoff from cloud seeding would be valued between $8,000,000 and $12,000,000 (if fully allocated).
- Based on these values we predict a benefit to cost ratio upwards of 15:1 far greater than ASCE 2016 Guidelines of at least a 5:1 benefit to cost ratio.
- More specific estimates will be made under Task 4 when detailed estimated costs for a program are prepared.

We attest to the strong potential gain from a well executed weather modification program and endorse a continuation in the feasibility study.