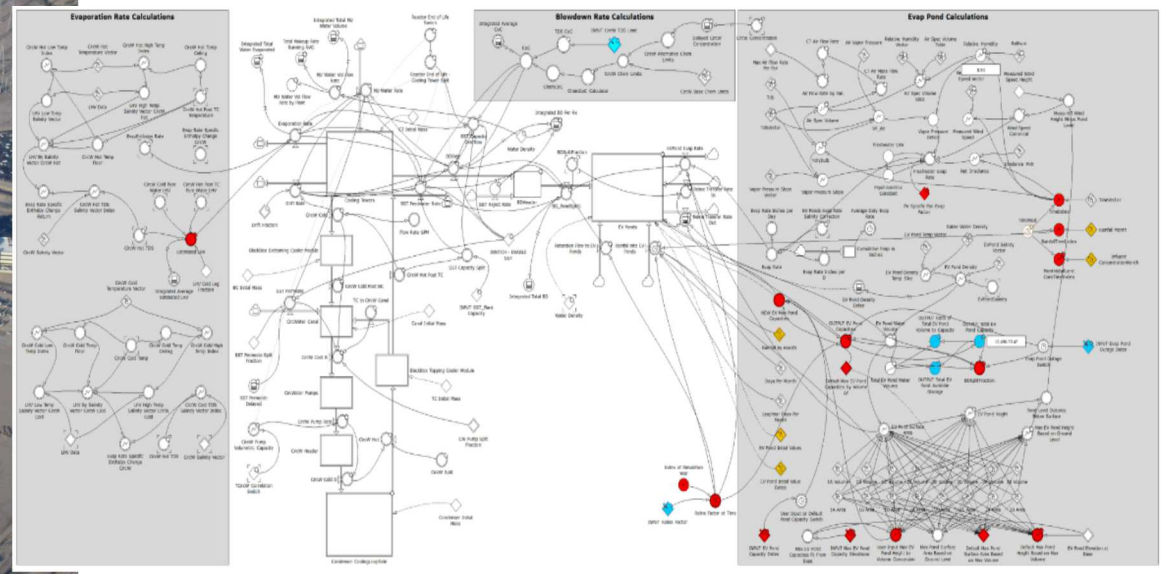
WATER RECYCLING FOR POWER GENERATION AT THE PALO VERDE NUCLEAR PLANT

SAND2020-8452PE

Pat Brady and Bobby Middleton,
Sandia National Laboratories,
Albuquerque, NM
[pvbrady@sandia.gov]

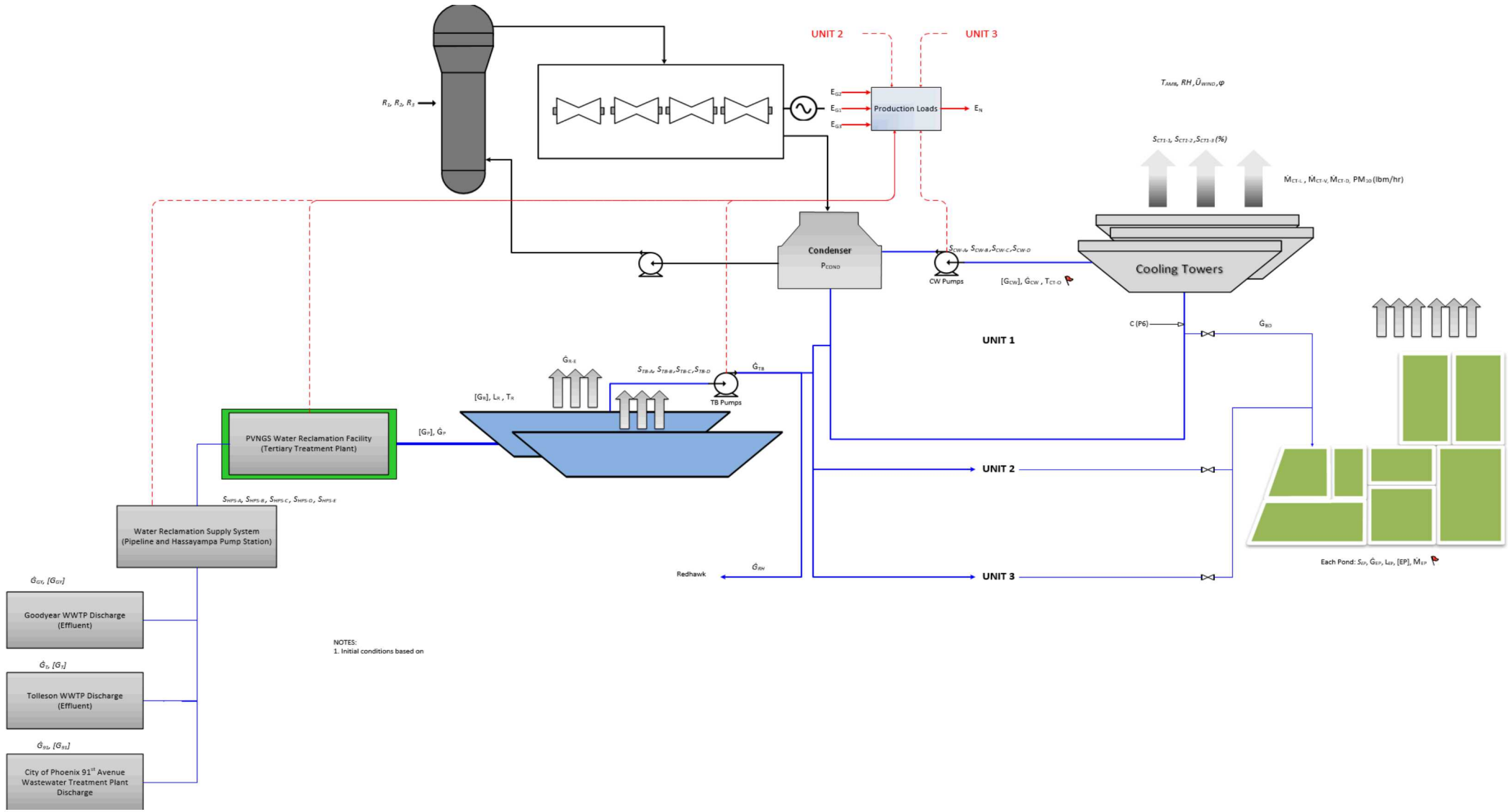


"Modzilla"

August 19, 2020 Noon Seminar, Rocky Mountain Section of the American Water Works Association.

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA-0003525.

Water Reclamation Facility Flow Path

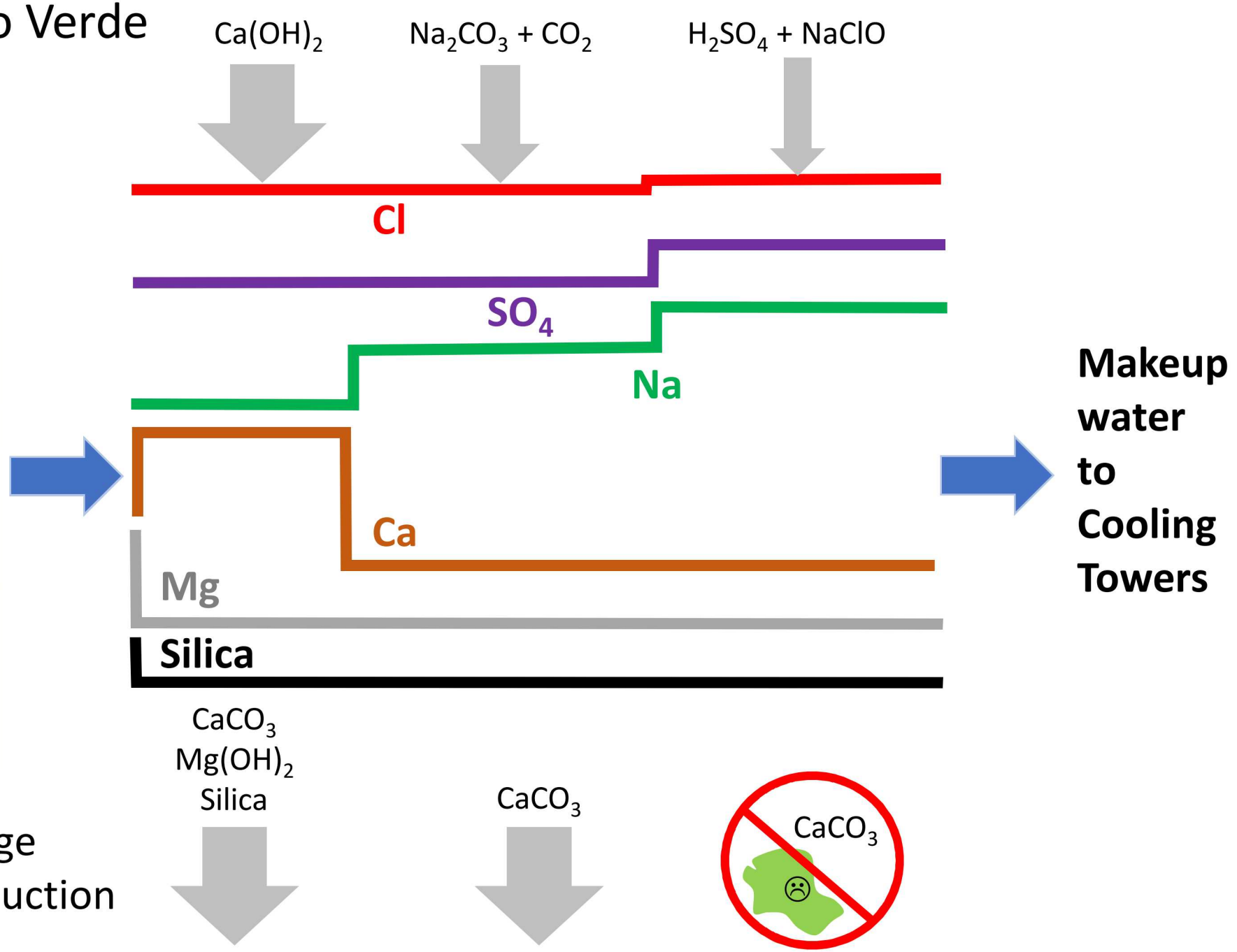


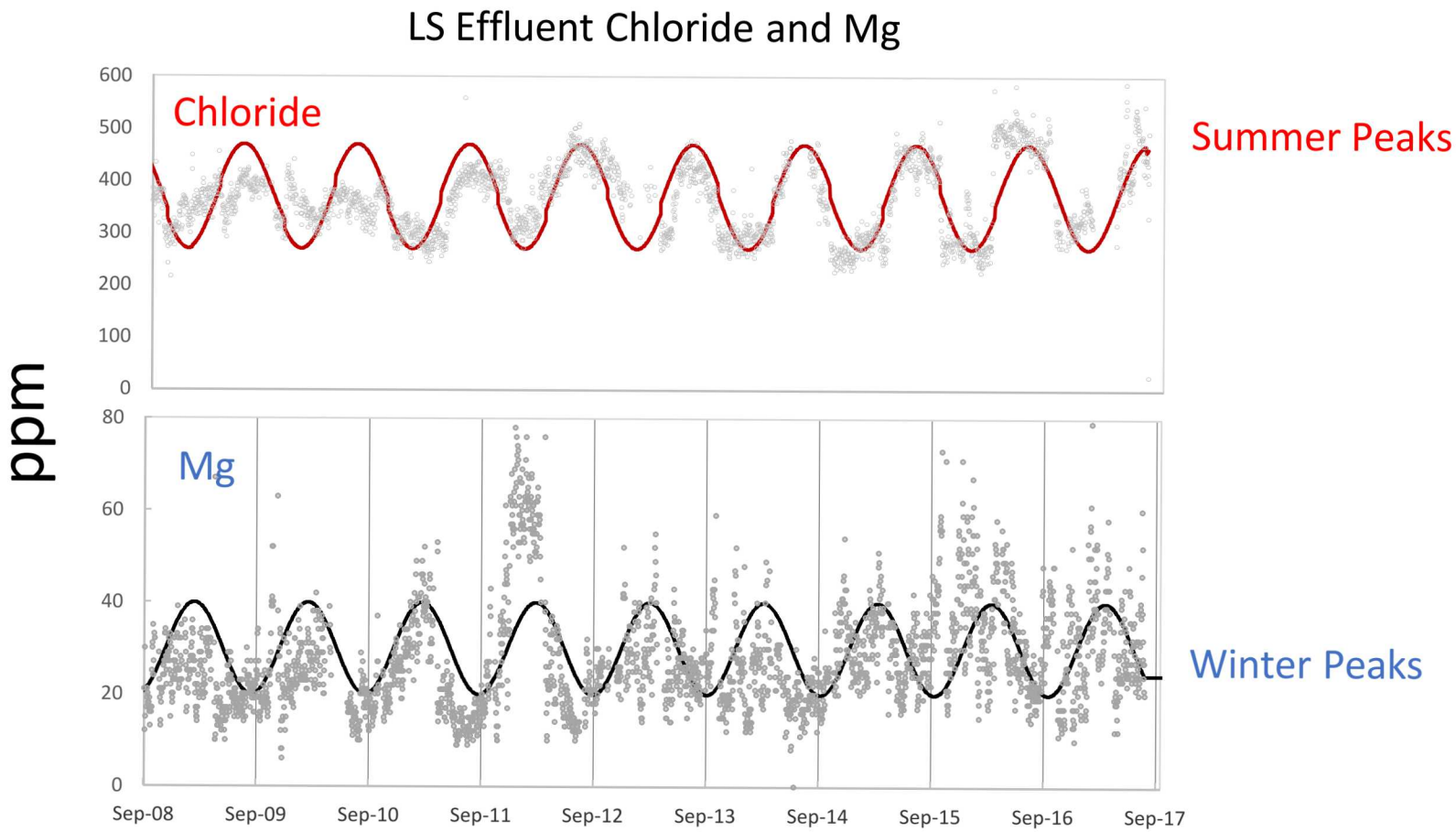
NOTES:
1. Initial conditions based on

Lime Softening at Palo Verde

Input Water

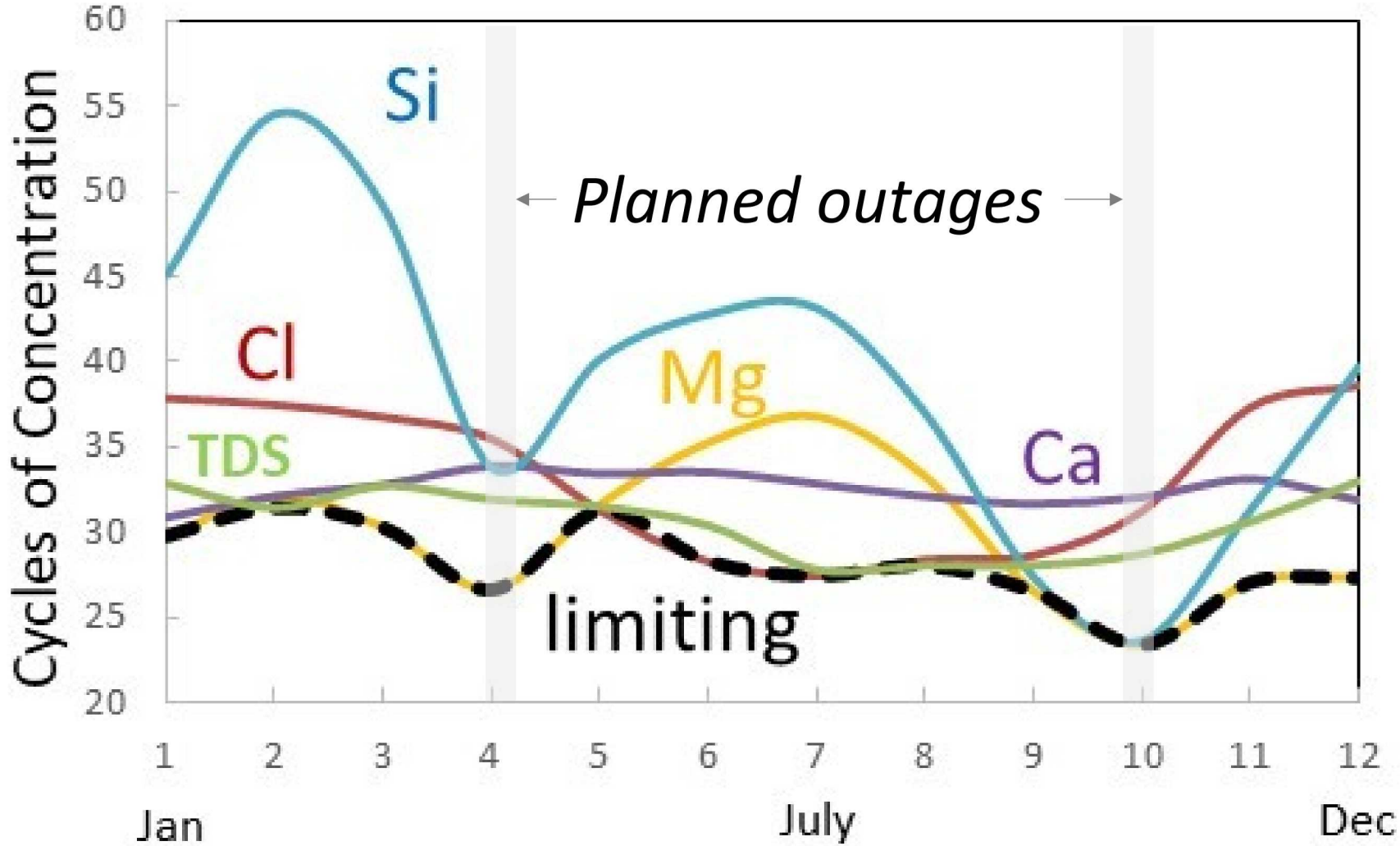
	Aug.	Jan.
Temp, °C	30	26
pH	7	7
TDS [all in mg/L]	1540	1230
Chloride	420	270
Sodium	350	190
Sulfate	169	181
Calcium [as $CaCO_3$]	210	210
Alkalinity [as $CaCO_3$]	163	166
Magnesium [as $CaCO_3$]	125	129
Silica	17	17



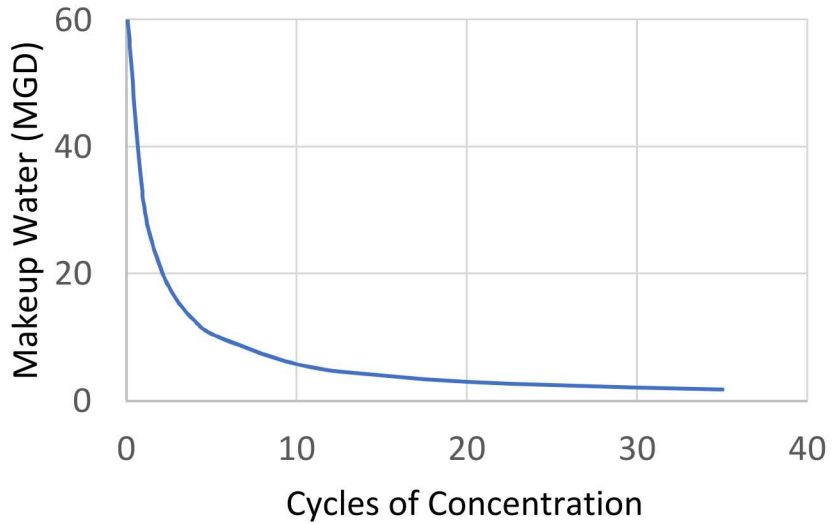

LS Effluent Chloride and Mg
ppm
Chloride
Mg
600
500
400
300
200
100
0
80
60
40
20
0
Sep-08
Sep-09
Sep-10
Sep-11
Sep-12
Sep-13
Sep-14
Sep-15
Sep-16
Sep-17
Summer Peaks
Winter Peaks

Blowdown Triggers [ppm] and Why?

TDS	30,000	Air permit
Mg	750	Silica scale
Cl	12,000	Corrosion
Ca	2,500	$CaCO_3$ scale
Silica	155	Silica scale
Sulfate	9,000	$CaSO_4$ scale

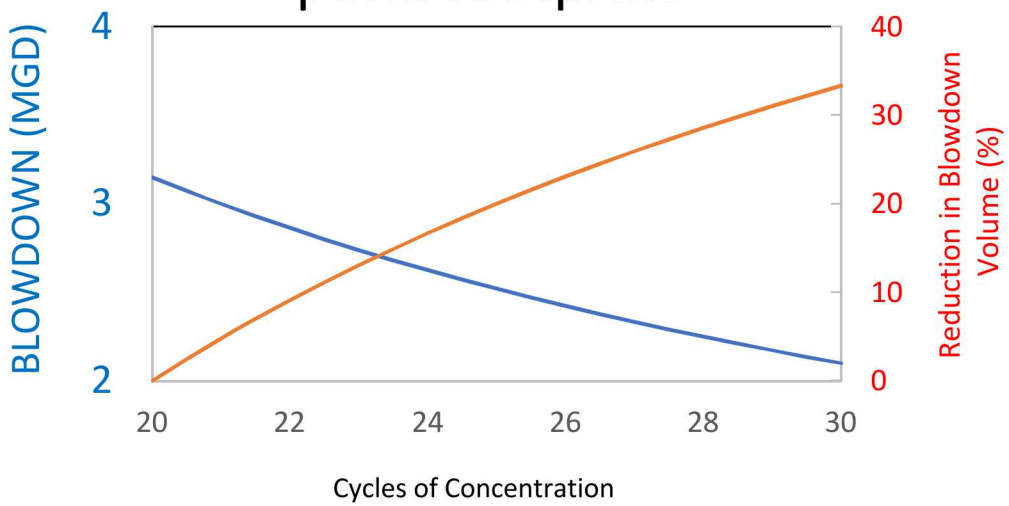


CoC = Cycles of Concentration before blowdown

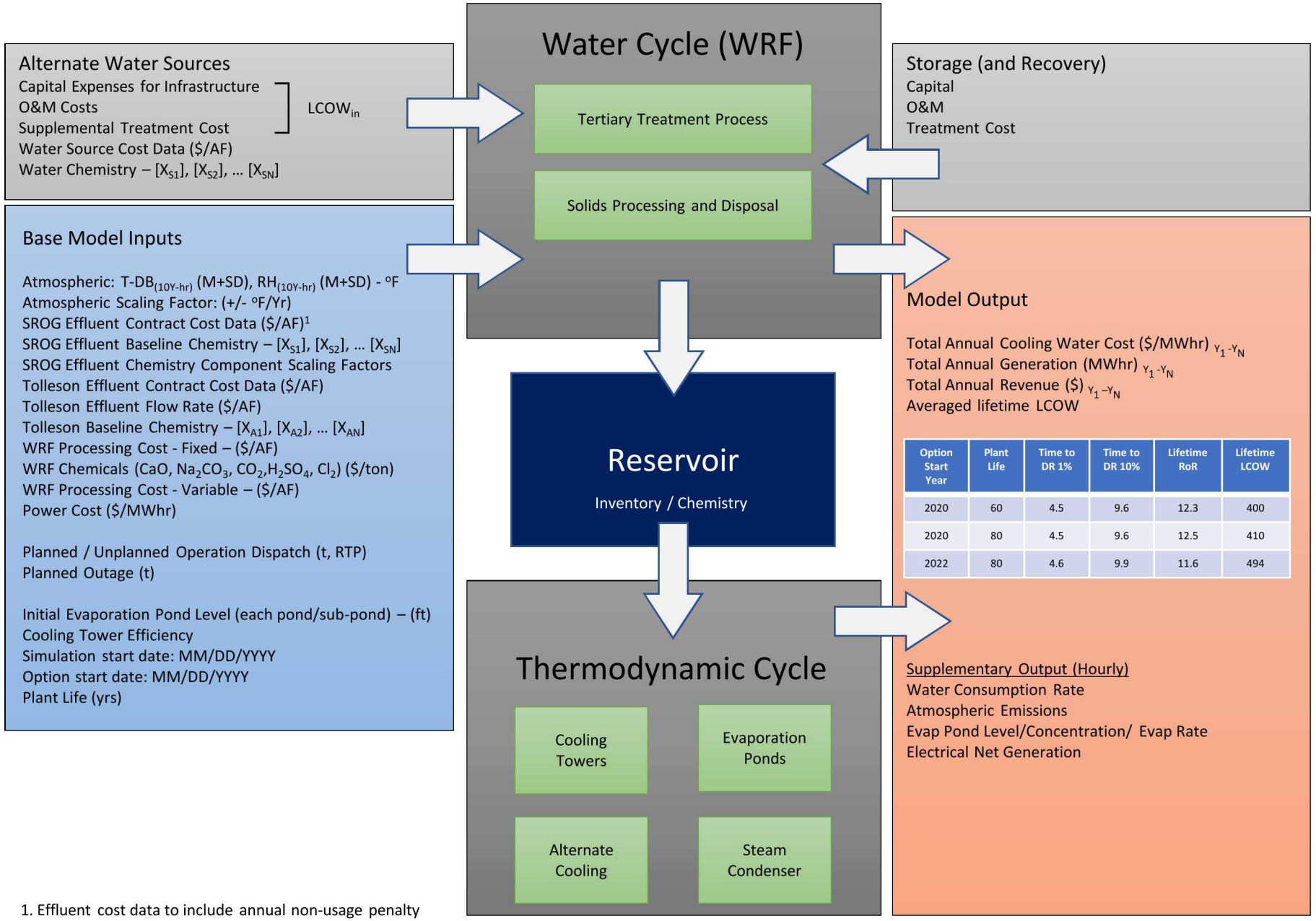


Increasing CoC's saves ~ 1% of water

Increasing CoC's can save > 20% pond footprint



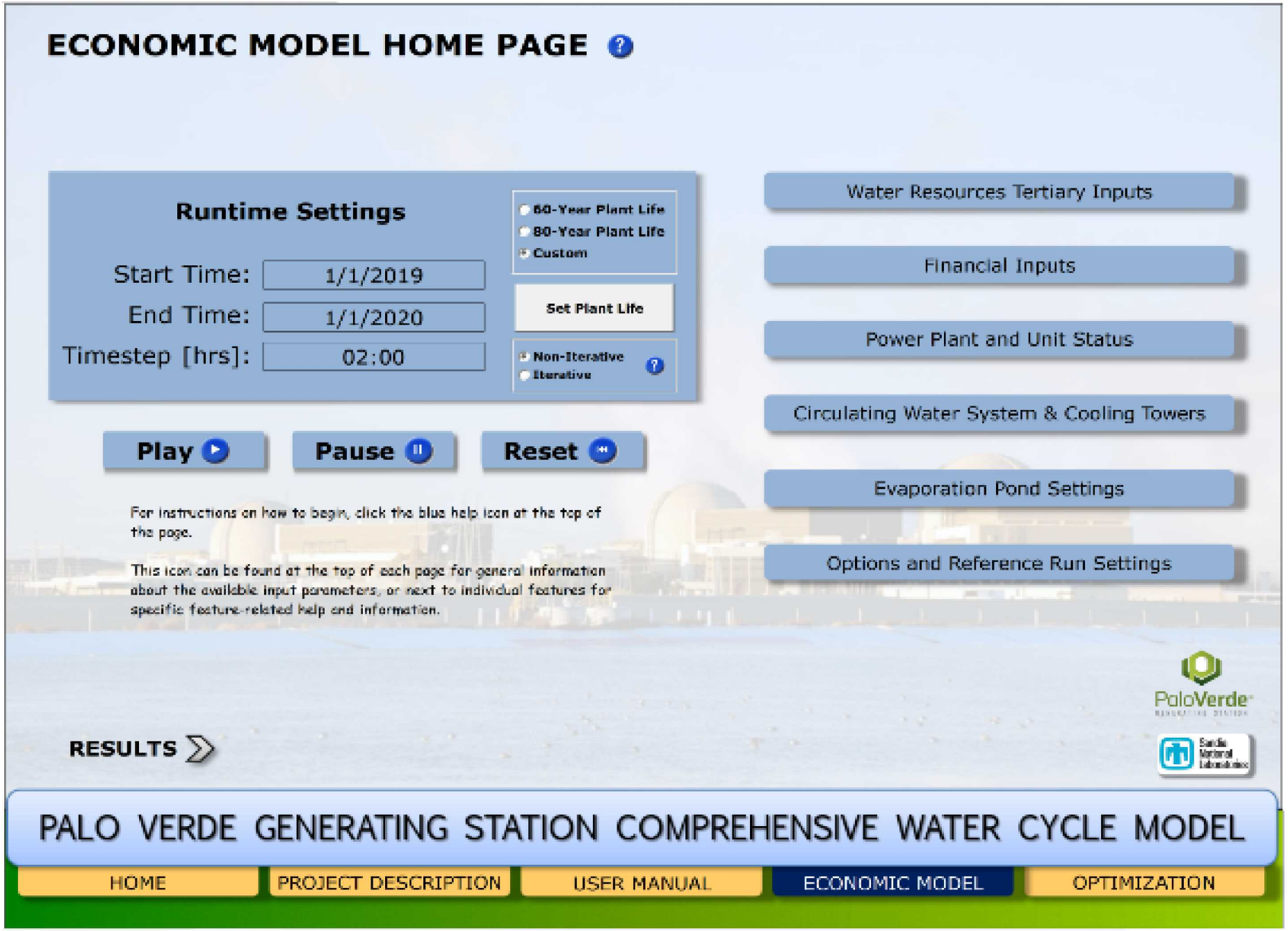
Parameterization of *Modzilla*



Option Start Year	Plant Life	Time to DR 1%	Time to DR 10%	Lifetime RoR	Lifetime LCOW
2020	60	4.5	9.6	12.3	400
2020	80	4.5	9.6	12.5	410
2022	80	4.6	9.9	11.6	494

1. Effluent cost data to include annual non-usage penalty

Sample Input



Sample Outputs

Example: Side-stream RO of Blowdown [Thanks to Prof. Kerry Howe, UNM]