THE SALTON SEA

THE BEST DAYS ARE ~~BEHIND~~ AHÊAD OF US

an **E2EDEN, LLC** proposal

EXEC SUMMARY

V2.0 ??

CALIFORNIA
High-Speed Rail Authority

CONVENTIONAL SOLUTIONS TO AN ENVIRONMENTAL DISTASTER

- The Salton Sea is drying up at a rapid rate, threatening not only the local environment, but now risking the health and livelihood of cities further afield.

- The issue has now forced the state's hands.
  All current proposals risk a rerun of the California High Speed Rail debacle with a conventional, costly overland canal, blasted through the terrain, acquiring all the land rights along the way, to import ocean water from Mexico.

versus

HOME BREWED INNOVATION

INNOVATION – GETTING MORE FOR LESS …

- Recent cost and technological innovations in tunneling have unlocked an entirely new approach

- A direct and invisible tunnel from the pacific, **under** the mountains, to the Salton Sea, at ½ the distance of competing proposals, using gravity to move water.

- Adding pumping stations, and hydropower and tunnels for outflow conveyance, you could pump out the brine to circulate the sea, restore an ecological keystone, and unlock the region for development

SALTON SEA RESTORATION

- THE PACIFIC TO SALTON SEA **TUNNEL** ROUTE

A FIRST PRINCIPLES PHYSICS APPROACH

KEY DIFFERENTIATORS

- **An Aspirational Future**
  An ecosystem reborn, and a community rebuilt
- **And Achievable Path to Get There**
  Leveraging tunneling innovations for a ground-breaking, straightforward and affordable approach

*Population sources: https://www.wikipedia.org/

AN INTRODUCTION FOR THE UNINITIATED

1950s

Today

A DYING SEA

Once THE fishing and resort destination in the 1950s, Salton Sea has seen its water siphoned off to supply a growing population.

The salinity has risen to the point of fish die offs, and exposed shorelines have resulted in salt and chemical air pollution that now threaten LA, San Diego/Tijuana and Mexicali

California has now initiated requests for proposals to address this growing crisis

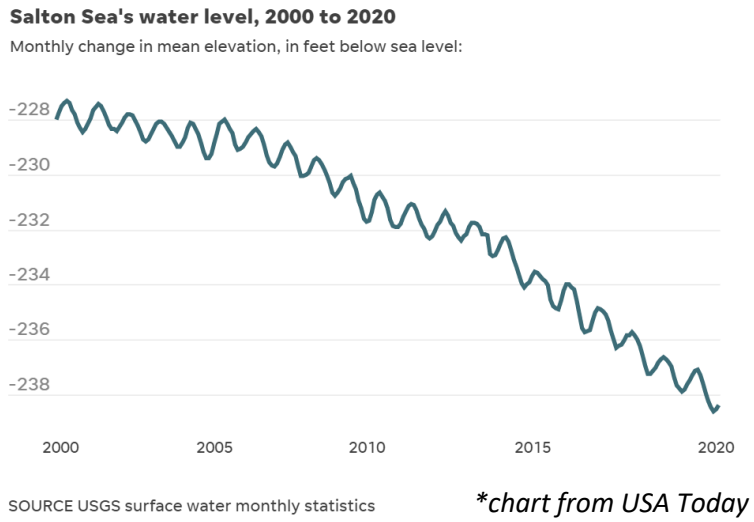
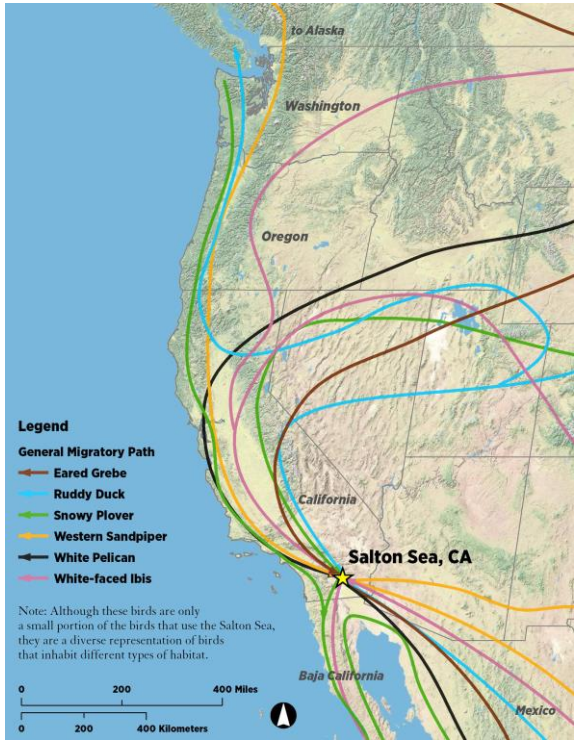


**chart from USA Today*

DECIMATING NATURE



Critical stopover on pacific flyway after LA marshes were built over. Now endangered.

FISH CAN NO LONGER SURVIVE

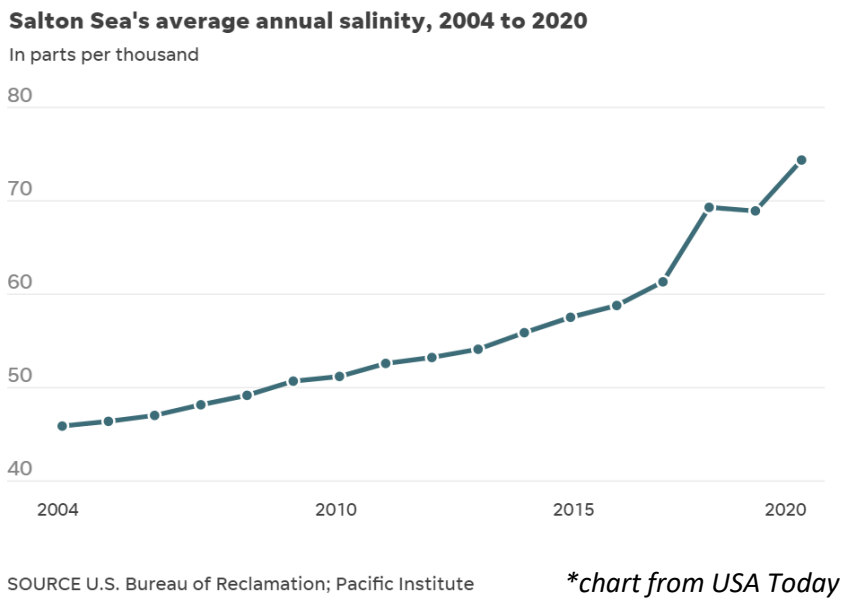


*chart from USA Today

DESTROYING A CRITICAL MIGRATORY BIRD HABITAT

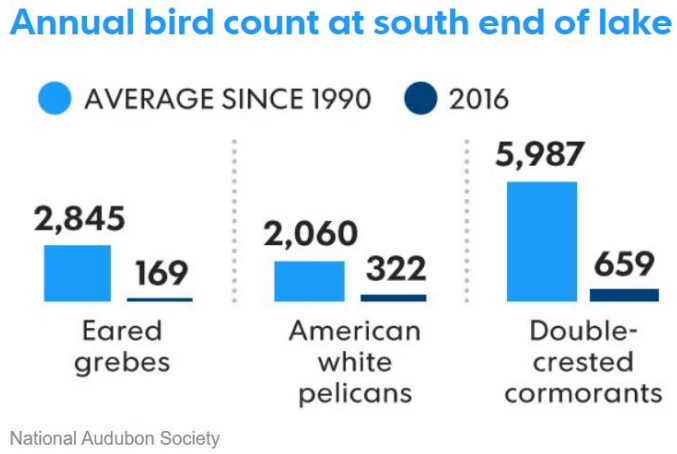
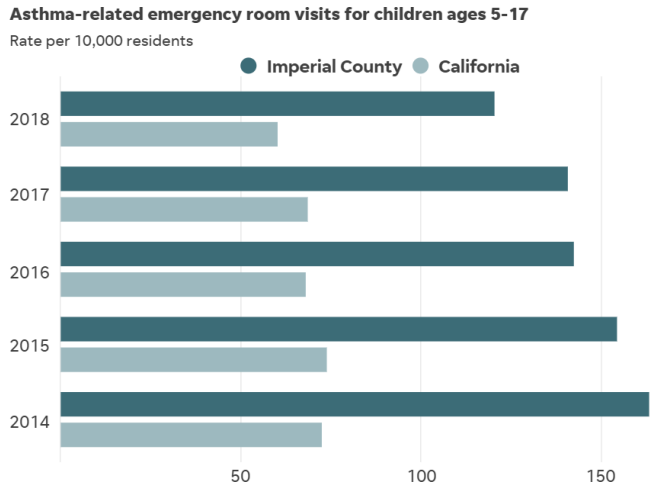


*chart from USA Today

HARMING KIDS & COMMUNITIES

The surrounding towns have the highest asthma rates in the nation

HEALTH



SOURCE Tracking California, Public Health Institute. Asthma Related Emergency Department & Hospitalization data. Accessed June 7, 2021 from www.trackingcalifornia.org/asthma/query

WEALTH

These issues have impacted a community without much of a voice, or resources to address them

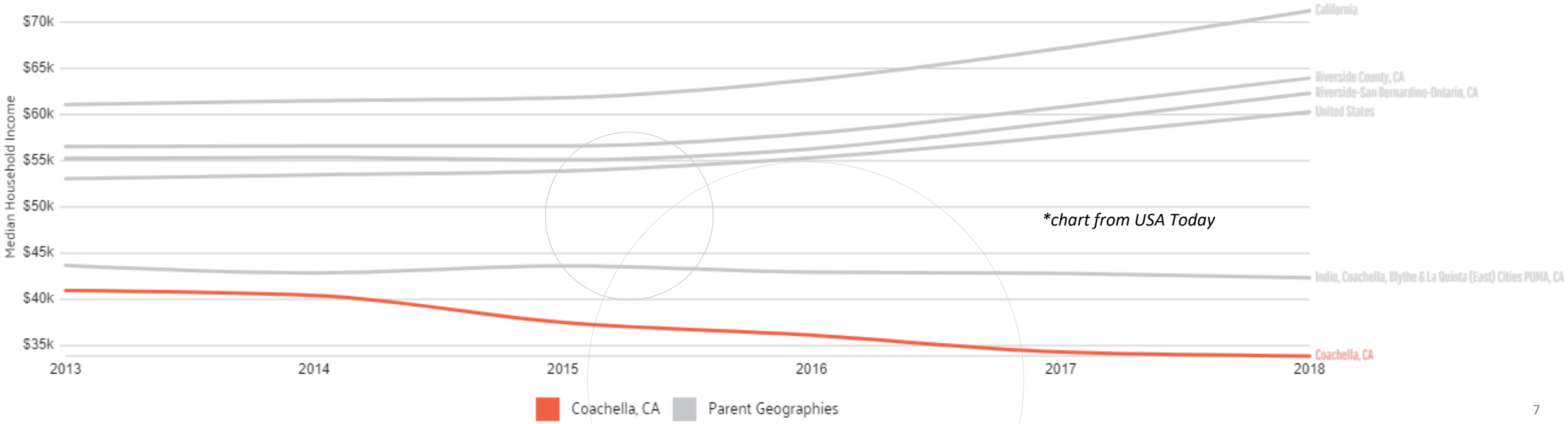
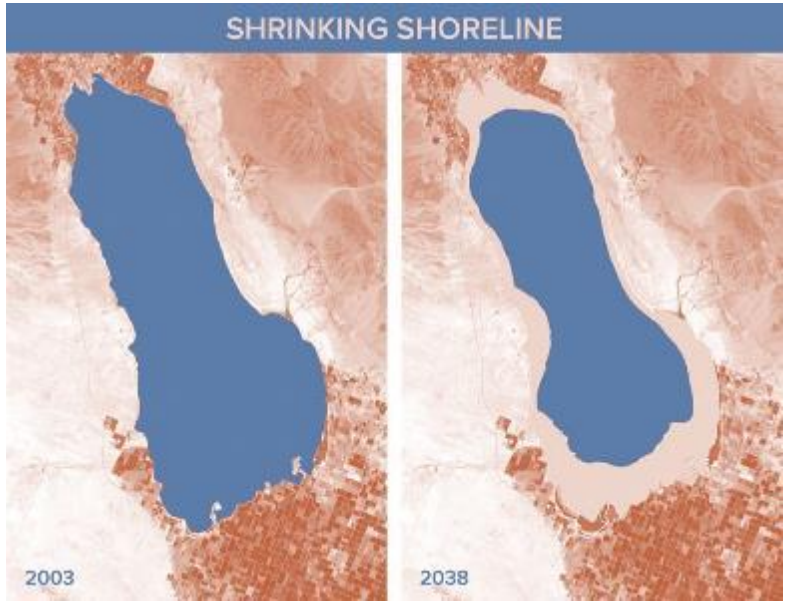


*chart from USA Today

THE POLITICAL LANDSCAPE

WE ALL HAVE A STAKE



A century of farm runoff, fertilizers and chemicals,

will affect not just the farming communities…

…but increasingly will impact populated, urban areas

with the financial means to solve the problem

Mountain ranges

Airborne playa

Los Angeles
population – 13.1m

Palm Springs

Airborne playa

Salton Sea

Urban Rural

Coachella Valley
Population – 0.35m

Airborne playa

San Diego
population – 3.4m

Mexicali
population – 1.1m

Tijuana
population – 2.1m

Pacific Ocean

Sea of Cortez

*Population sources: https://www.wikipedia.org/

CITIES

Worried the playa dust will exacerbate existing air quality issues, and in need of a relief valve for their population

ENVIRONMENTALISTS & WILDLIFE

A paradise lost, and birds with no home to go to after the LA marshes were paved over in the early 1900s

THE ONE THING EVERYONE AGREES ON…
THE SALTON SEA NEEDS SAVING

FARMING COMMUNITIES

Struggling with farmland quality loss, jobs and health degradation

WHAT DO YOU WANT FOR OUR FUTURE

YOUR CHOICES

AFFECT NOT ONLY THE SEA…

1 SUPPRESSION ONLY

Let it dry up.
Plow the dirt to minimize dust

2 MITIGATION ONLY

Import seawater.
Let the sea turn to salt

3 RESTORATION ONLY

Import seawater, export the brine.
Watch nature heal itself

MINE

EXTRACT

INVEST & DEVELOP

…BUT ALSO DETERMINE WHO INVESTS

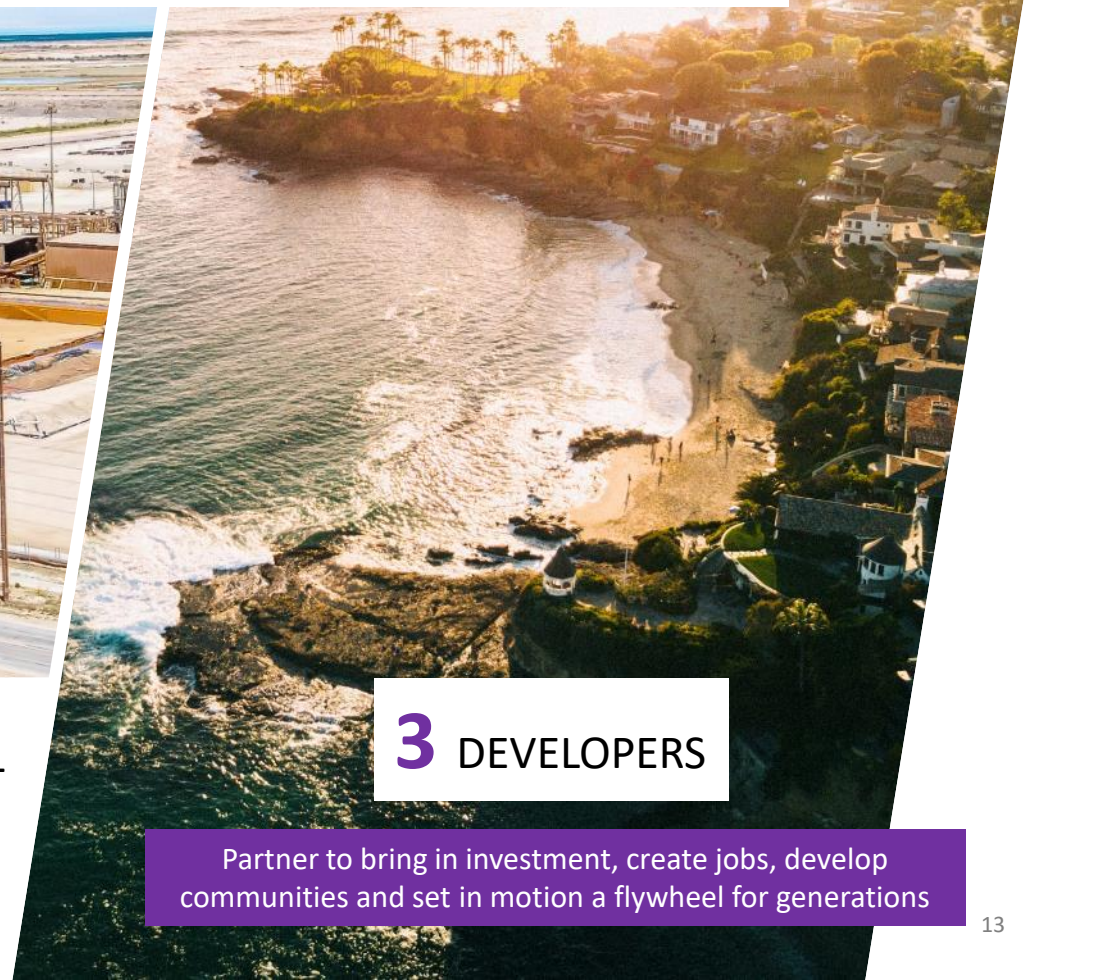
AND WHAT YOU ARE LEFT WITH WHEN THEY LEAVE

1 MINERS

Extractive industries, with poor job prospects, leaving wastelands behind when they leave

2 GEOTHERMAL & INDUSTRIAL

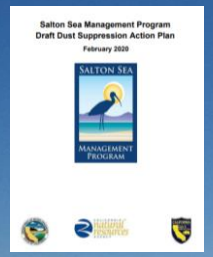
Develop geothermal energy & mineral resources, offering a living but no life



3 DEVELOPERS

Partner to bring in investment, create jobs, develop communities and set in motion a flywheel for generations

THE FUTURE WE DESERVE?

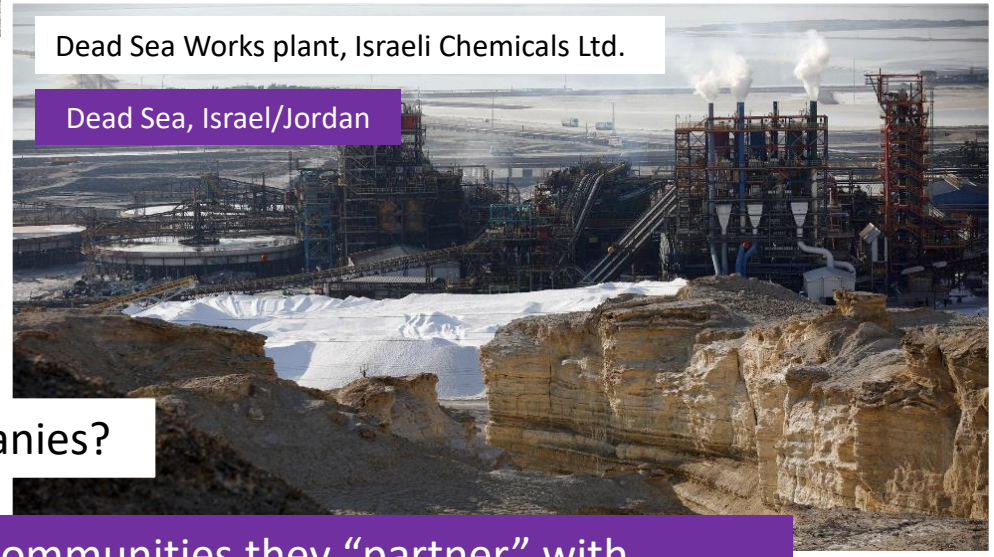


Do you just dig channels for dust "SUPPRESSION"…

…Essentially flipping the soil to break up the wind…

Dead Sea Works plant, Israeli Chemicals Ltd.

Dead Sea, Israel/Jordan



…and sell the Salton Sea off as a wasteland to mining & extraction companies?

Mining companies have a reputation for extracting, not investing in the communities they "partner" with

…or only import water for MITIGATION,
and watch as the salt accumulates indefinitely, killing the ecosystem?

THE FUTURE WE DESERVE?

The J.M. Leathers Geothermal Power Station

Do you leave real estate value and communities to decay – supported only by Geothermal plants?

THE FUTURE WE DESERVE

Or do you build a paradise and an inheritance for ourselves and our children…

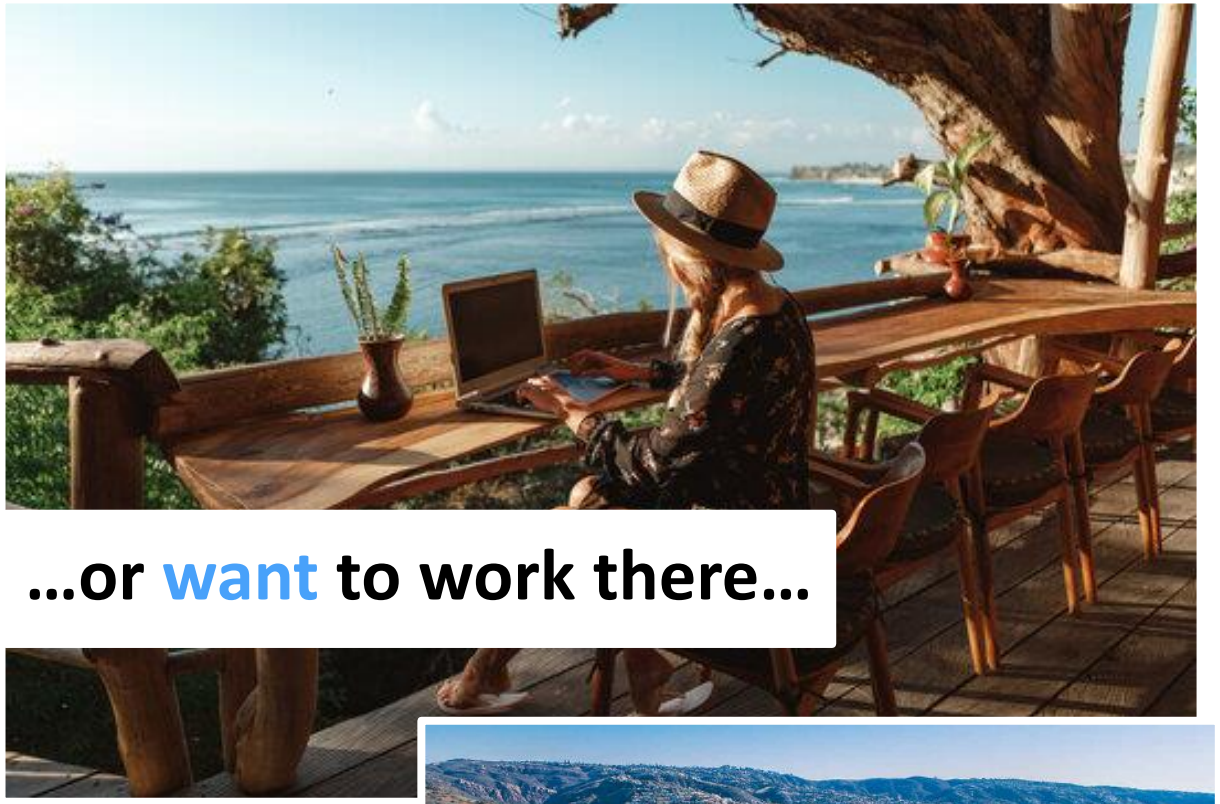
Imagine the Salton as a sea you would want to **LIVE** next to, rather than flee

At its peak, the Salton Sea was drawing more yearly visitors than Yosemite

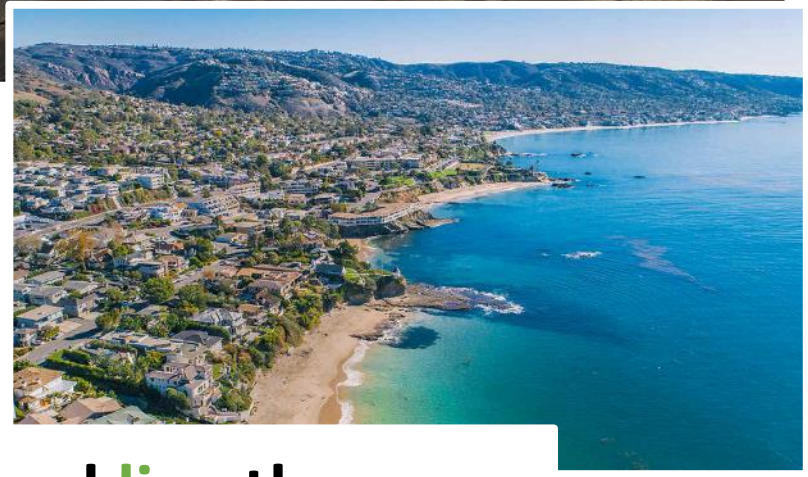
THE CHOICE IS YOURS

*existing Salton Sea geothermal power plant

Will our kids have to work there…



…or want to work there…



…and live there

THE FUTURE WE DESERVE

and our kids

1. SUPPRESSION

Turning over the dirt to minimize dust storms

2. MITIGATION

Import seawater to fill the Salton and permanently cover the playa

3. RESTORATION

Import fresh seawater AND pump out the brine,
to circulate the sea and bring life, investment, jobs and wildlife to these shores

BUT HOW CAN IT BE DONE?

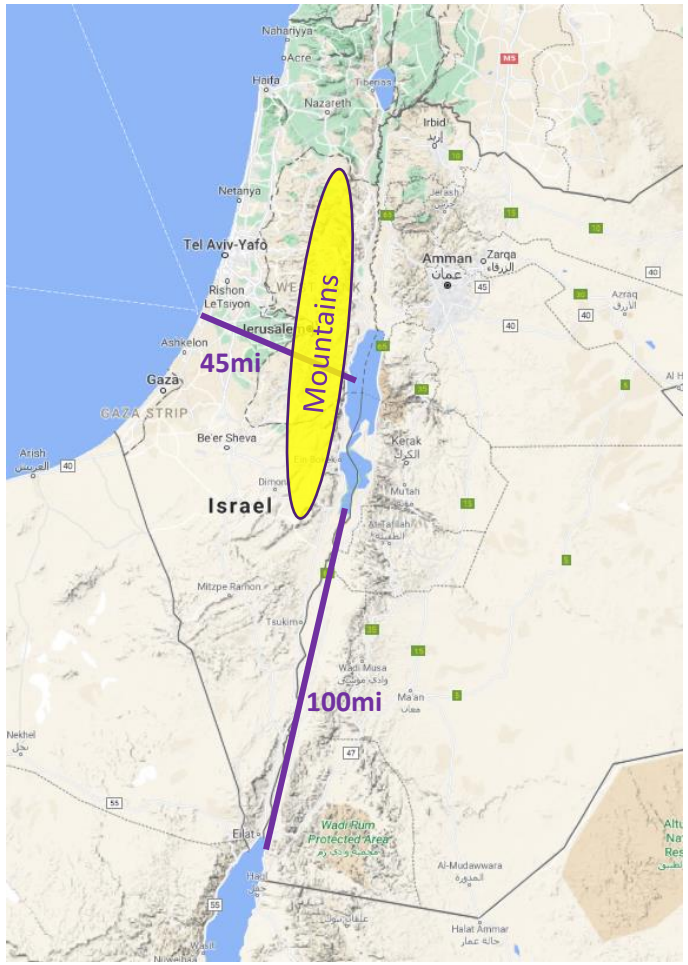
THE INTUITIVE OVERLAND APPROACH WAS TRIED ONCE BEFORE AND FAILED

COULD WE SHOW THEM HOW ITS DONE?

The Dead Sea, Israel/Jordan

$11B PROJECT CANCELLED – “RED TO DEAD SEA”

They had two options



Without cheap tunnels, they took the longer, “easier” route over land

Est. Project Cost = $11B

But failed anyways…

THE TIMES OF ISRAEL

After years of delays, Jordan said to nix Red Sea-Dead Sea canal with Israel, PA

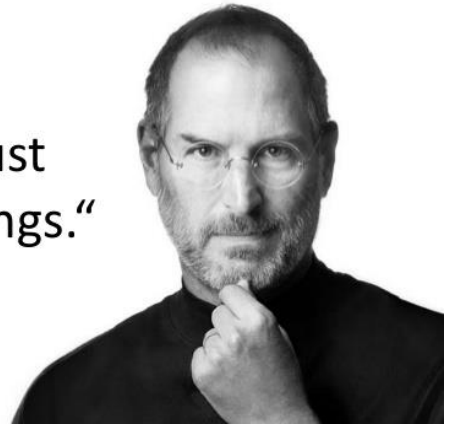
Report says kingdom will pull the plug on pipeline and instead focus on internal desalination project

17 June 2021, 3:18 pm

Dry earth in time of drought, north of Israel's Dead Sea.(ABIR SULTAN/Flash90)

Jordan has decided to cancel a highly touted joint project with Israel and the Palestinian Authority for a canal linking the Red Sea and the Dead Sea, after years of the plan stagnating, the Kan public broadcaster reported Thursday.

"Creativity is just connecting things."
- *Steve Jobs*



INNOVATION IN RESTORATION

THE FRESH APPROACH TO HOW

Gravity Fed Tunnel Pipeline

+

Hydropowered Sea Circulation

THE KEY BREAKTHROUGH

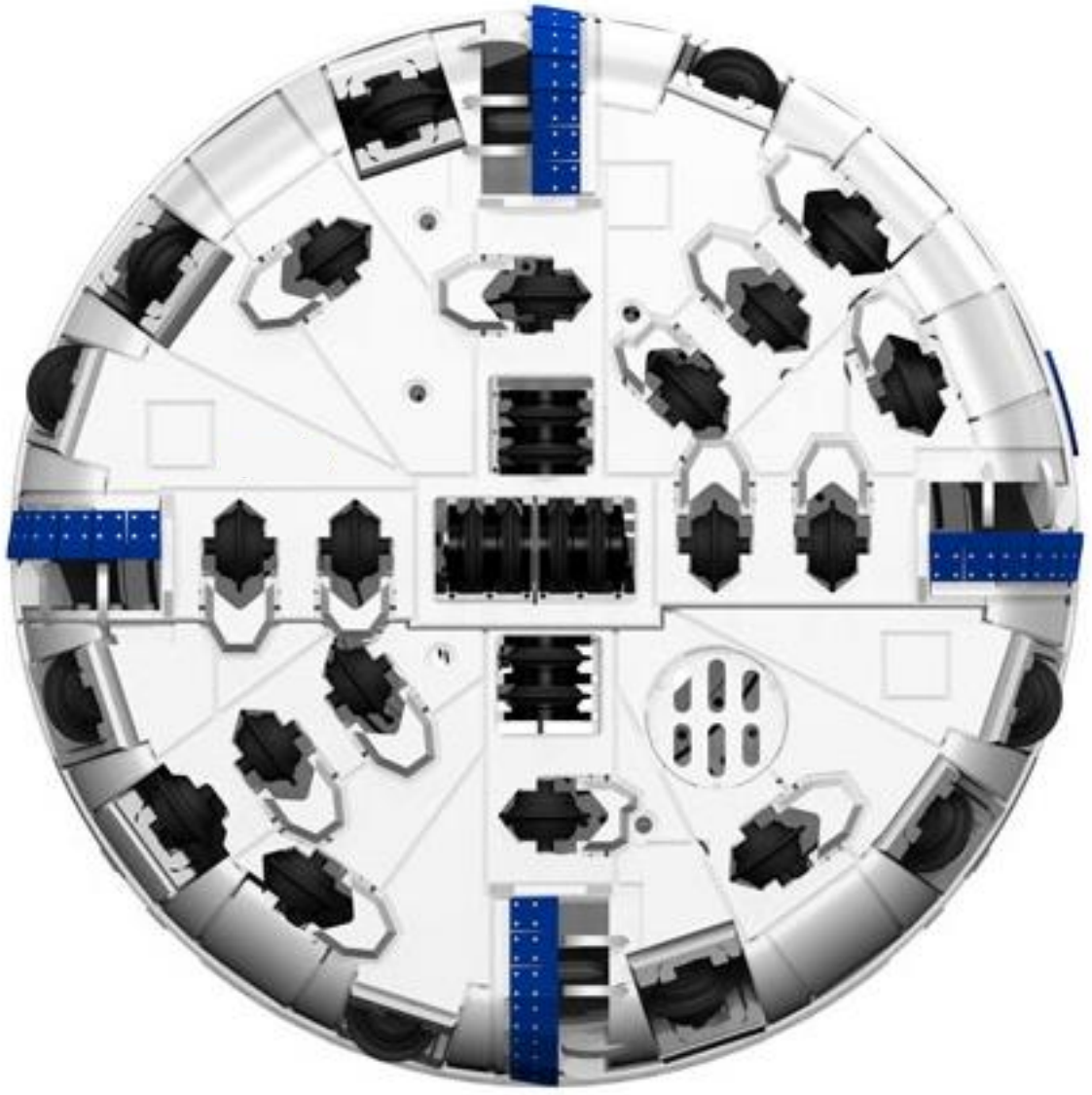
LOW COST TUNNELS

WHY TUNNELS?

COST & TECHNOLOGY INNOVATION

This project is only now feasible, thanks to the recent innovative cost and technological breakthroughs

Tunneling Cost Before	$100M - 1B / mile
Cost Now	As low as $5M/ mile



THE UNLOCKED SOLUTION

A FULL RESTORATION

The direct, shorter route afforded by tunnels massively reduces head loss…

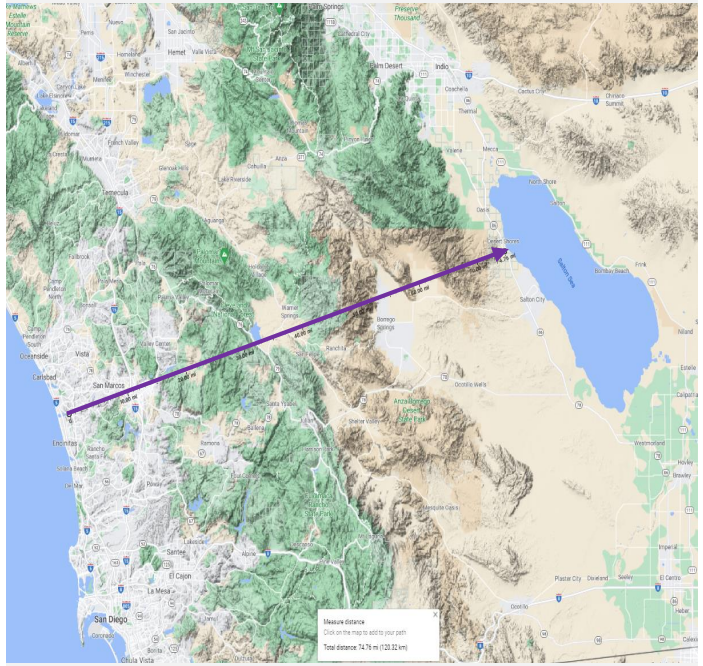
enabling not only a cost effective **refill**,
but **brine removal** as well

THE 3 STEP PLAN TO DO IT…

A THREE PHASE APPROACH

PHASE 1

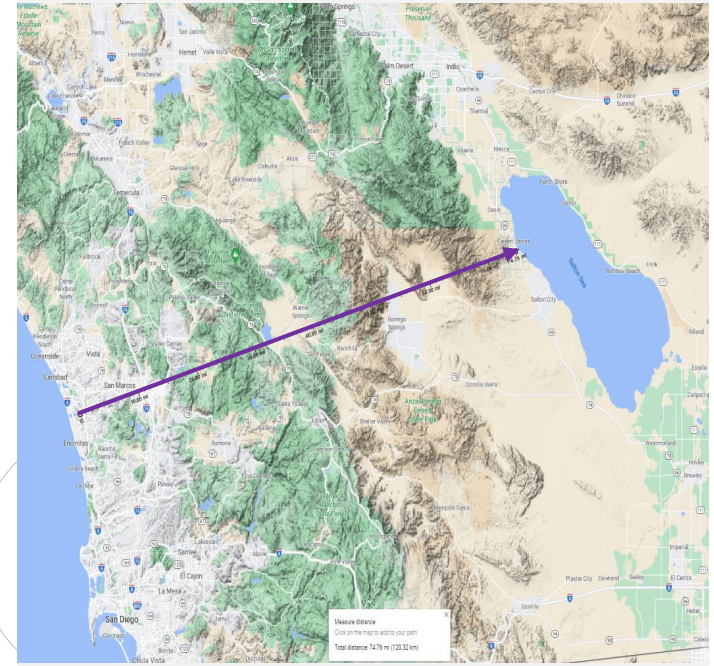
PROOF OF CONCEPT



A single poof of concept tunnel pipeline to the Salton to de-risk and offset evaporation

PHASE 2

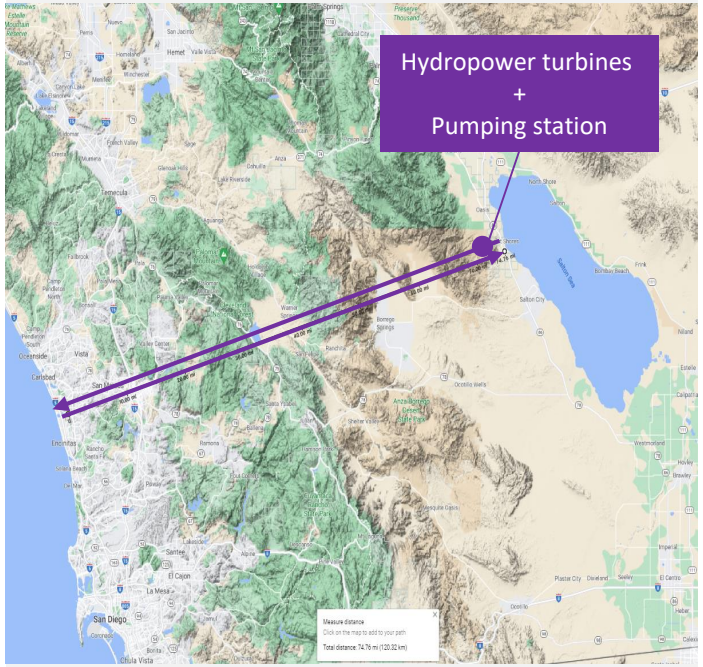
MITIGATE



More pipeline capacity from the Pacific to the Salton Sea to refill the dying sea

PHASE 3

REHABILITATE



Pump out the brine from Salton Sea to Pacific to return to ocean water salinity levels

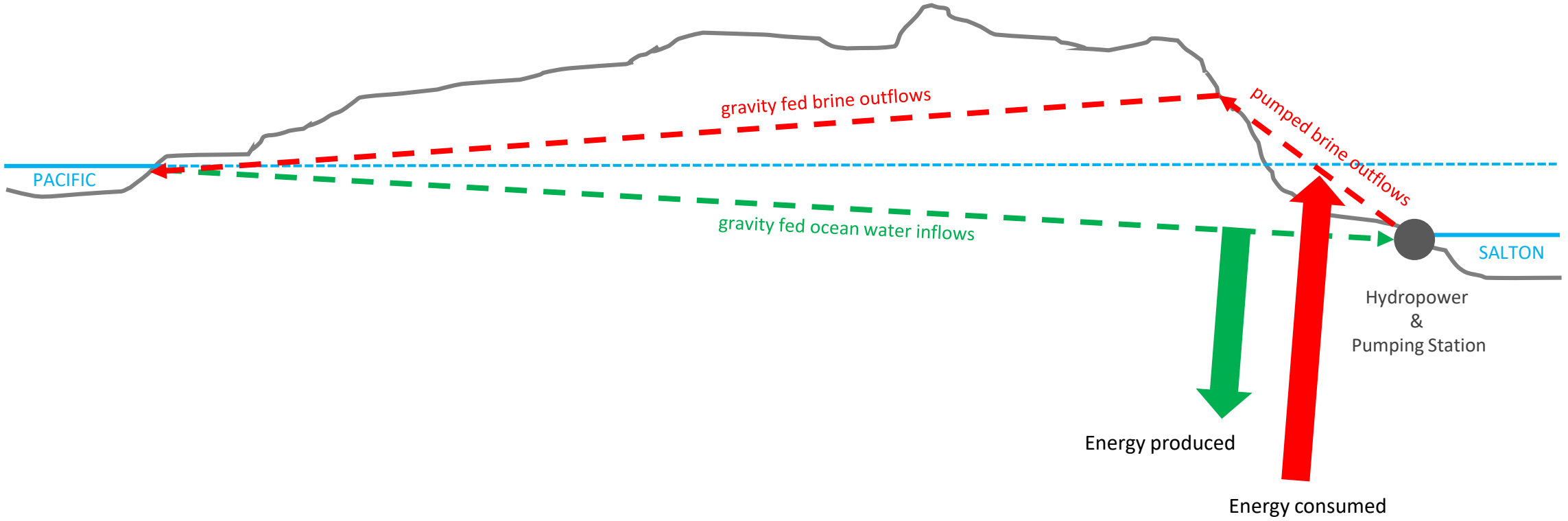
	CHALLENGES	HOW WE SOLVE IT
• FUNDING	Funding exists, but nowhere near enough. How do you drive enthusiasm for a dead sea no one will visit or live by.	• Restoring the sea opens it up to tourism, development & investment. • An aspirational vision drives excitement, support and funding
• POLITICAL	Complex treaties with Mexico. Little to be gained, much financially to lose, and timelines longer than a politicians career.	• We align the interests of cities, environmentalists, farmers and those that represent them. • No treaties needed, and a relief valve for crowded cities • Something to be gained by everyone
• TECHNICAL	Multiple solutions, multiple components, and experts who haven't solved it yet	• The simplest configuration necessary • Involve ambitious companies for an ambitious task • Off-the-shelf technologies
• ECONOMICS	Long routes, expensive approaches, and how do you pay to remove brine?	• Gravity fed collapses costs. • Short route back minimizes head loss, making pumping cheap • Restoration of the sea to unlock development $$
• ENVIRONMENTAL	A dead sea, no fish, no birds, no people	• Refill the sea, reduce salinity – and nature heals itself • Low energy solution for lowest environmental impact • Tunnels under for minimal disruption of land and life

BENEFITS OF TUNNELS

	TUNNEL	OVERLAND
PERMITTING & LAND RIGHTS	• No national borders crossed • No need for land purchases, or rights of way • Only 15 miles out of 75 miles of total tunnel length is under/near private property	• Issues with US – Mexico water treaties • Above ground aqueducts require the acquisition and purchase of significant property rights • Complex permitting
PREDICTABILITY	• Not impacted by weather • No above ground impact, reduced schedule risk from NIMBYism • Terrain agnostic technology allowing for direct route • Low cost of operation due to gravity fed system • Turnkey solutions with The Boring Company	• Unpredictable political environment with US – Mexico water treaties • Schedule risk due to adverse weather & desert climate impact on worker productivity • Long term cost unpredictability due to necessary pumping infrastructure & cost • Multiple partners & contractors
PUBLIC OPPOSITION	• Hard to hate an invisible, inaudible dig site underground	• No town is going to like a gigantic trench being dug outside their homes, schools and through their farms
SPEED	• Months	• Years
EARTHQUAKES	• Low risk, but vulnerable to lateral movements of land	• Low risk, but vulnerable to lateral movements of land
EVAPORATION	• None due to isolation underground	• Slight to moderate depending on length of the route and variables such as weather and whether the canal is enclosed as a pipe or open

TECHNICAL DETAILS, ASSUMPTIONS & CALCULATIONS

Full system data model available in accompanying Excel



SALTON SEA MODEL ASSUMPTIONS

	m3/yr	m3/s	acre-feet/yr	cf/yr	cf/s	gal/s
Evaporation	1,603,524,000	50.8	1,300,000	56,627,870,000	1,796	13,288
Watershed Freshwater Inflows	902,907,360	28.6	732,000	31,885,902,546	1,011	7,482
Net Water Loss	700,616,640	22.2	568,000	24,741,967,454	785	5,806

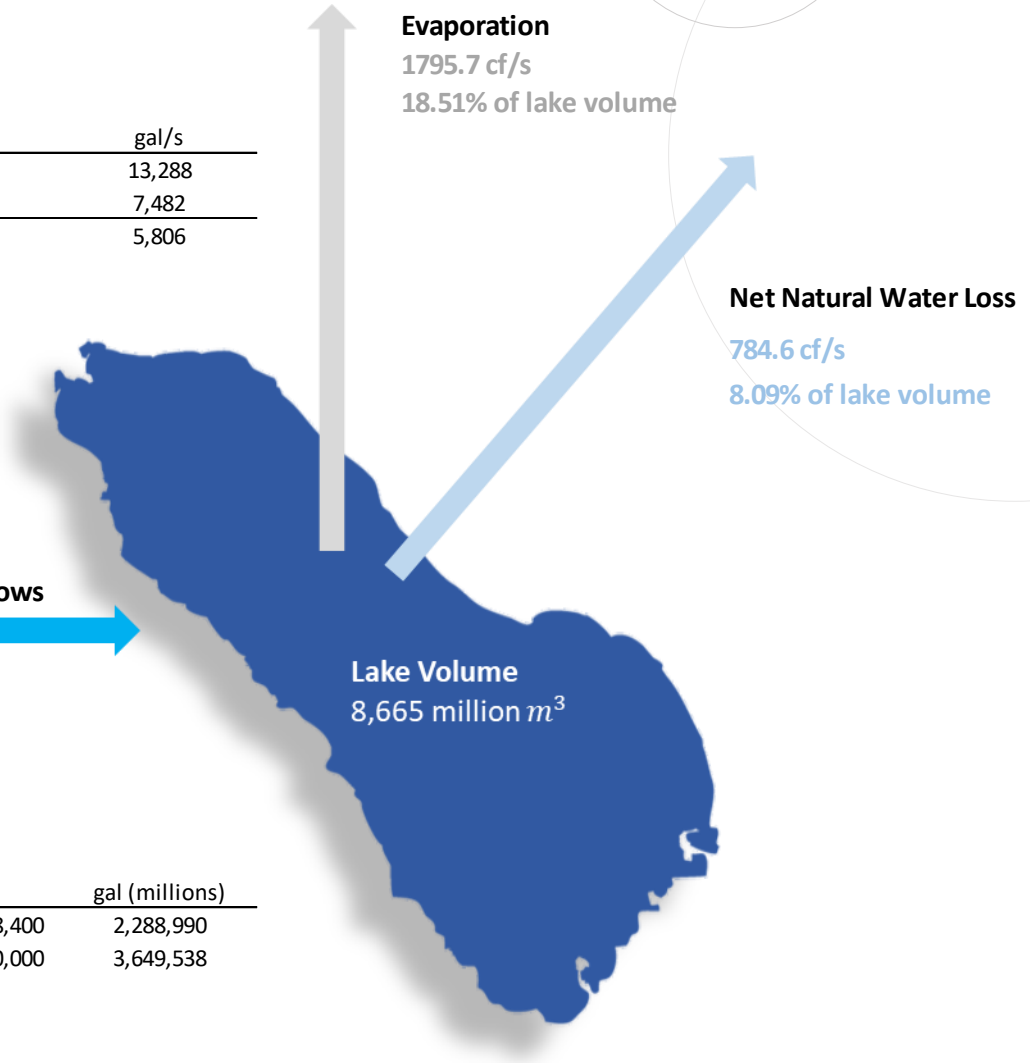
	km2	m2	mi2	ft2
Sea Surface Area (Current)	888	888,366,570	343	9,562,291,200
Sea Surface Area (Filled)	906	906,496,500	350	9,757,440,000

	%	g/L
Sea Starting Salinity	7.5%	75.0
Watershed Freshwater Salinity	0.4%	3.7
Ocean saltwater	3.5%	35.0

	kg/m3
Specific Gravity of Ocean saltwater	1,035.0
Specific Gravity of Salton (current) saltwater	1,075.0

	m	ft
Sea Avg Depth (Current)	10	32
Target Avg Depth (Full)	15	50
Sea height below sea level	70	230

	km3	m3	liters (millions)	acre-feet	ft3	gal (millions)
Sea Volume (Current)	9	8,664,772,177	8,664,772	7,024,652	305,993,318,400	2,288,990
Sea Volume (Filled)	14	13,815,006,660	13,815,007	11,200,019	487,872,000,000	3,649,538



PHASE 1

PROOF OF CONCEPT

1. Salt water intake north of San Diego
2. A single 75 mile gravity fed seawater tunnel & pipeline to Salton Sea
3. Tunnel outlet at Salton Sea ~60 meters below sea level

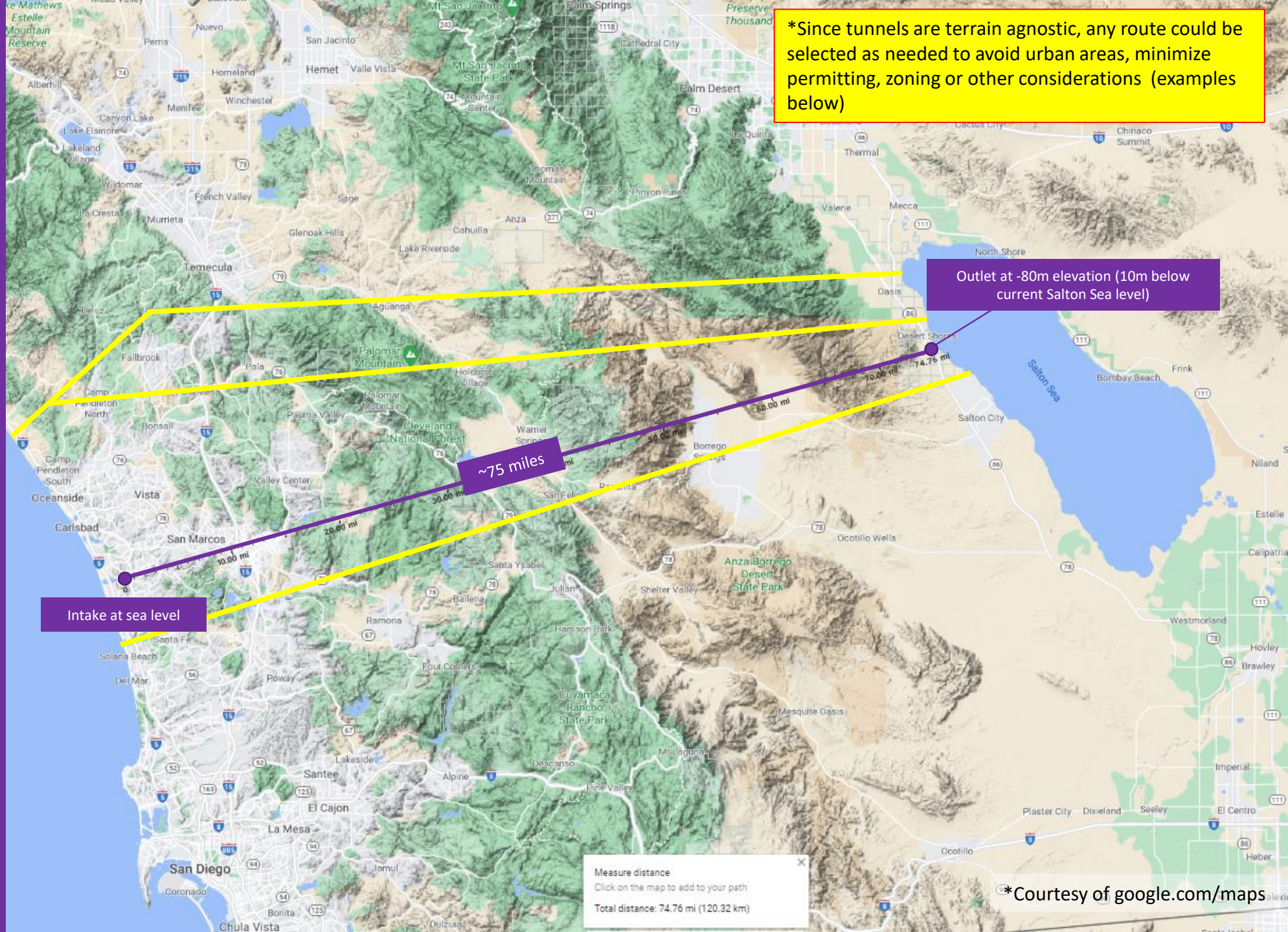
COST

Fixed costs = $750M

Operating costs = NEGLIGIBLE

TIME

100 weeks



PHASE 2

SALTON FILL UP

1. Salt water intake north of San Diego
2. A second 75 mile gravity fed seawater tunnel & pipeline to Salton Sea
3. Tunnel outlet at Salton Sea ~60 meters below sea level

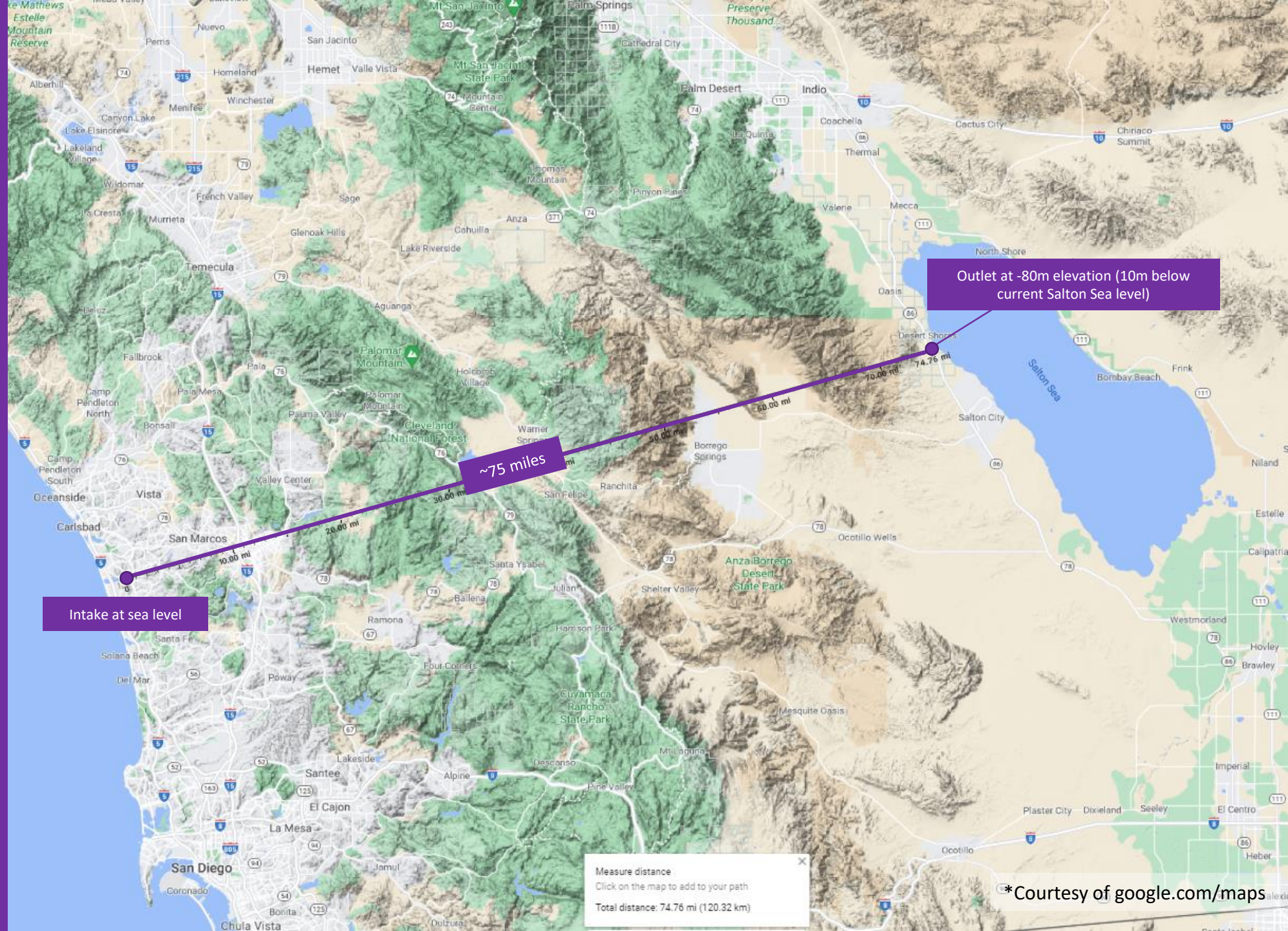
COST

Fixed costs = $750M

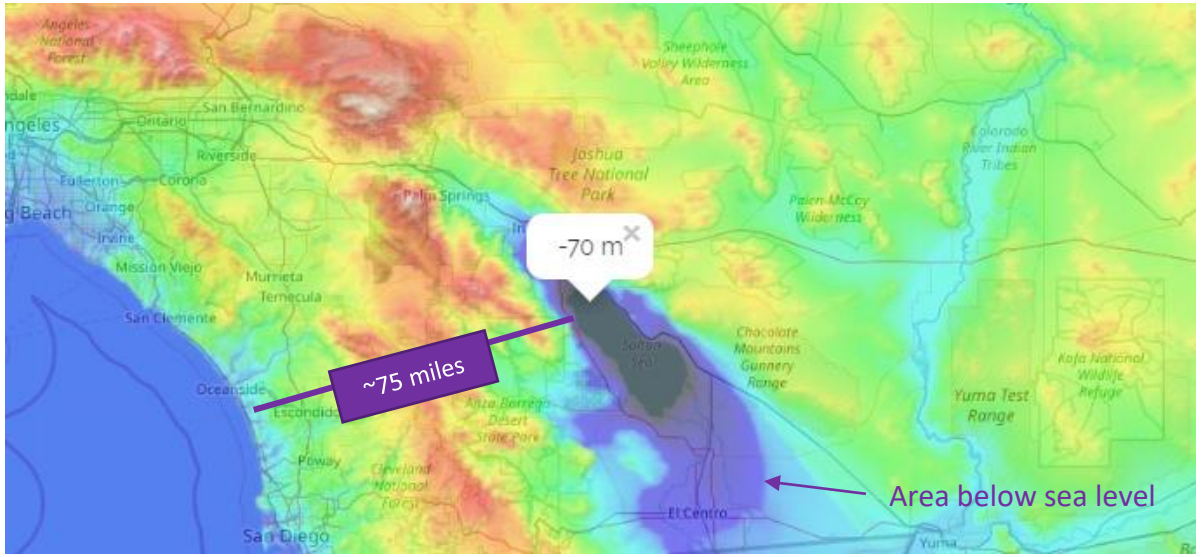
Operating INCOME = $0.6M/yr

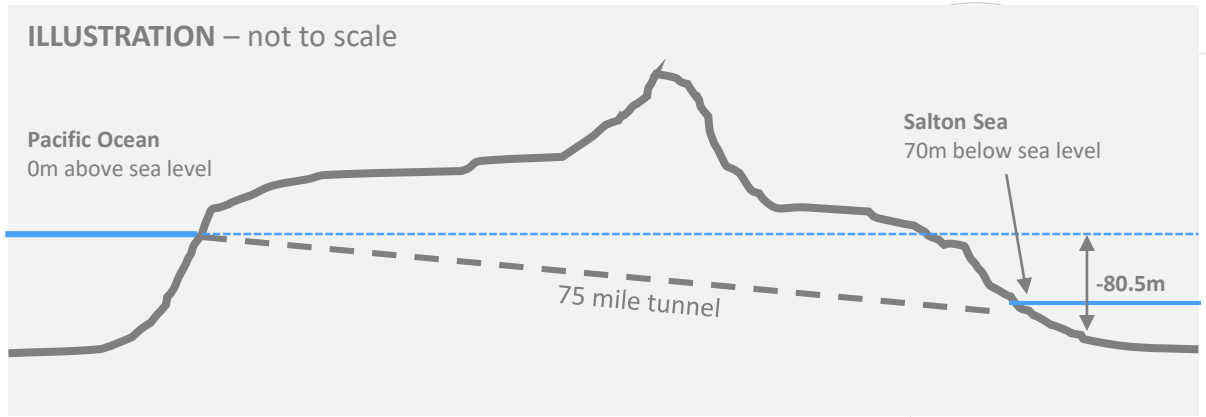
TIME

90 weeks



THROUGHPUT PER TUNNEL





Hazen-Williams Equation

$v = k * C * R^{0.63} * S^{0.54}$

	m	ft
Conversion Factor (k)	0.849	1.318
Material	Concrete	
Roughness Coefficient (C)	120	
Hydraulic Radius (R)	1	3
Pipe Length	120,701	396,000
Drop	70	230
Slope (S)	0.000580	

	m/s	ft/s
Flow Velocity (v)	1.721	5.648

	m3/s	ft3/s
Flow Discharge	18	639

TUNNELS

Net Natural Water Loss (per year)

785 f^3/s

Throughput per 12ft Diameter Pipe

639 f^3/s

Pipeline Tunnels Needed

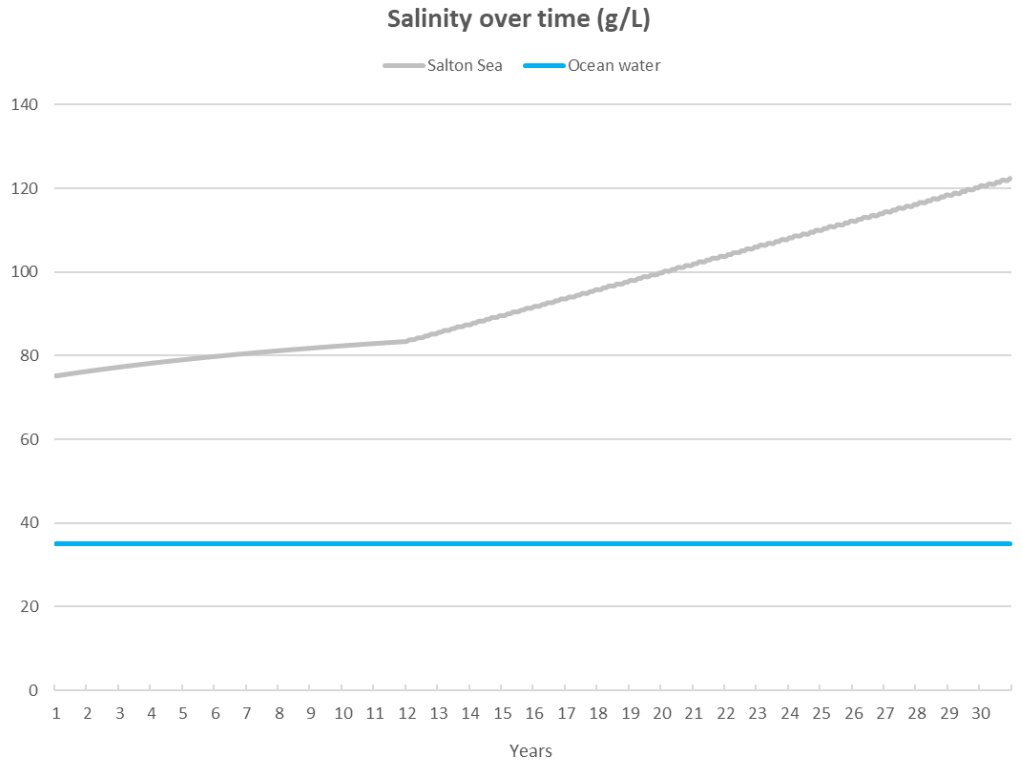
2

Total Capacity

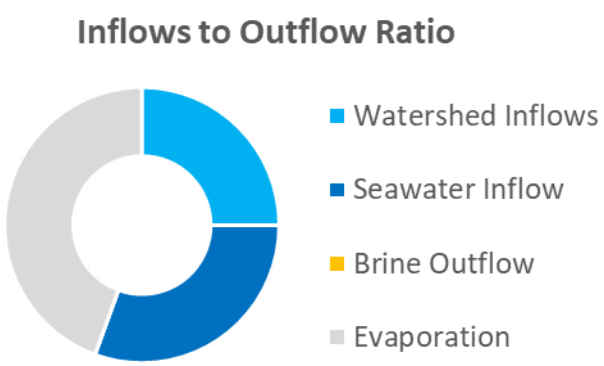
1278 f^3/s

Total Tunneling Cost

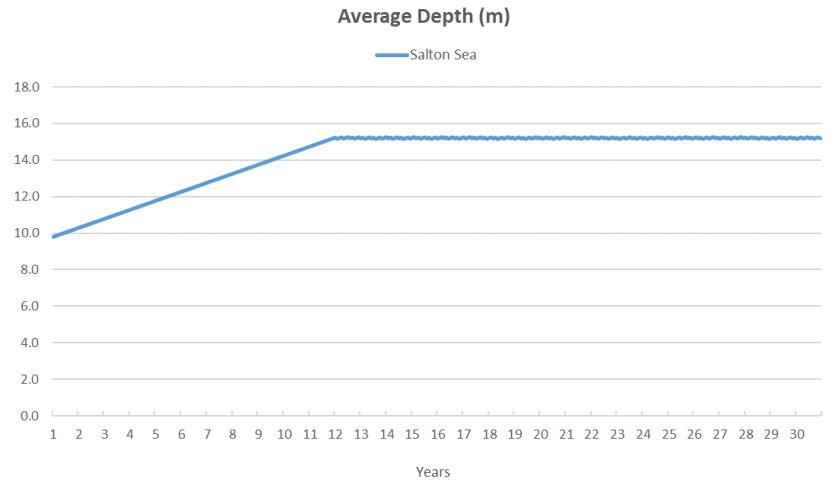
$1,200M



Assuming that we target to refill the sea by 5m (15ft) – and hold it there



*surplus until steady state when flow is reduced to maintain equilibrium



PHASE 3

EXTACTING THE BRINE

1. Salt water intake at Salton Sea
2. Pumping station to return water to sea level for brine removal
3. Tunnel outlet at Pacific Ocean

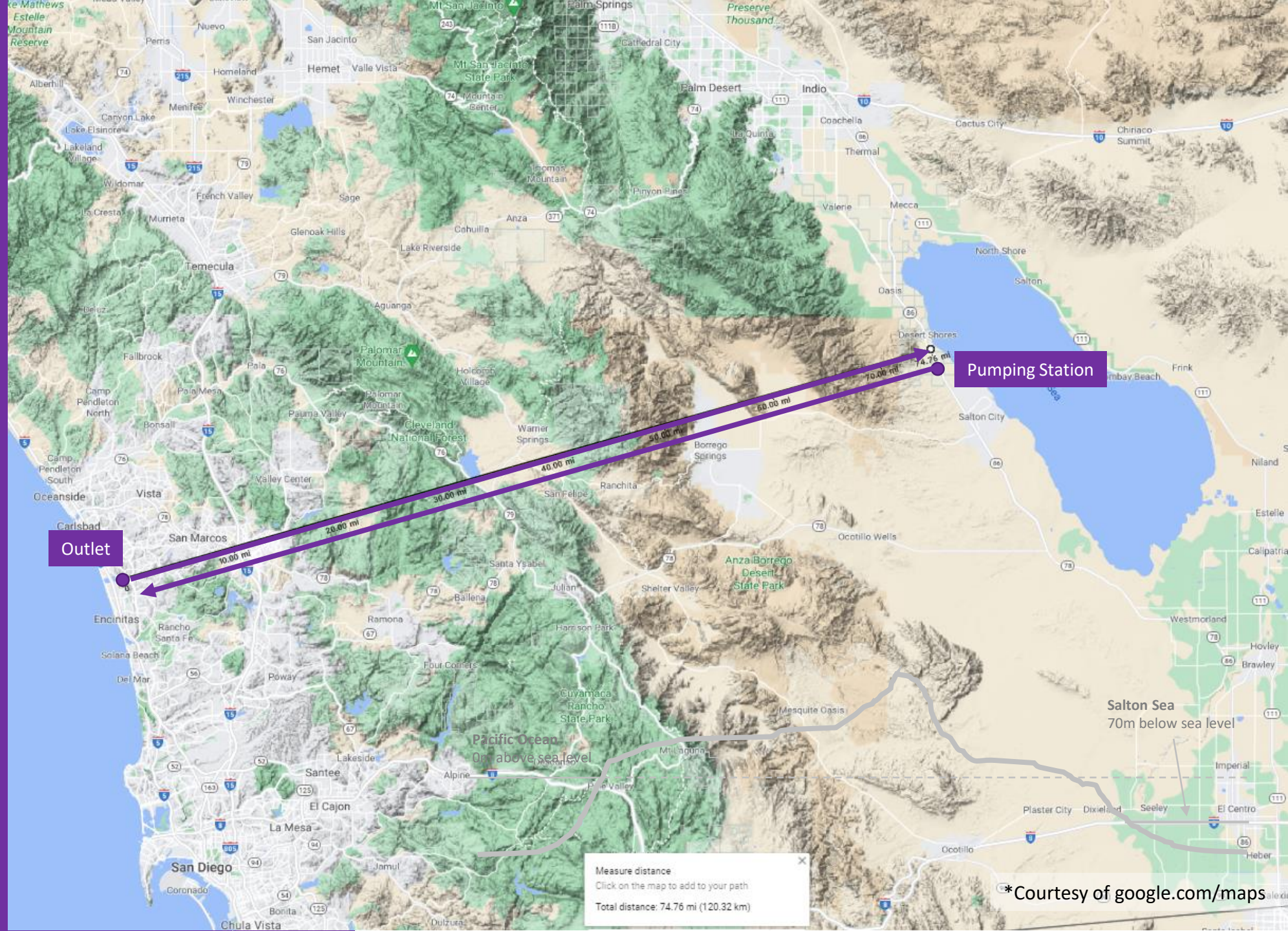
COST

Fixed costs = $ 3,300M

Operating Costs = $ 15M/yr

TIME

200 weeks



*Courtesy of google.com/maps

CHEAPER THAN DESALINATING THE SALTON

The majority of solutions submitted to the state did not solve for salt/brine removal, and when they did, due to the long route and massive pumping capacity, did so at substantial op ex costs.

Leveraging existing tunnels to **PUMP OUT** the salty sea, and create circulation with the ocean would be far simpler option than expensively desalinating water only to dump it into the Salton Sea. It would stabilize salinity levels at that of sea water.

A pumped hydro battery could be inserted to create new utility and a revenue source for this return journey – which would anyways require energy to pump the Salton Sea brine to a higher elevation to reach the Pacific.

Even pumping in fresh waster – if not removed, salt inevitably accumulates to toxic levels

VS

Salt is simply pumped out and away, and replenished with Pacific Ocean water

TUNNELS

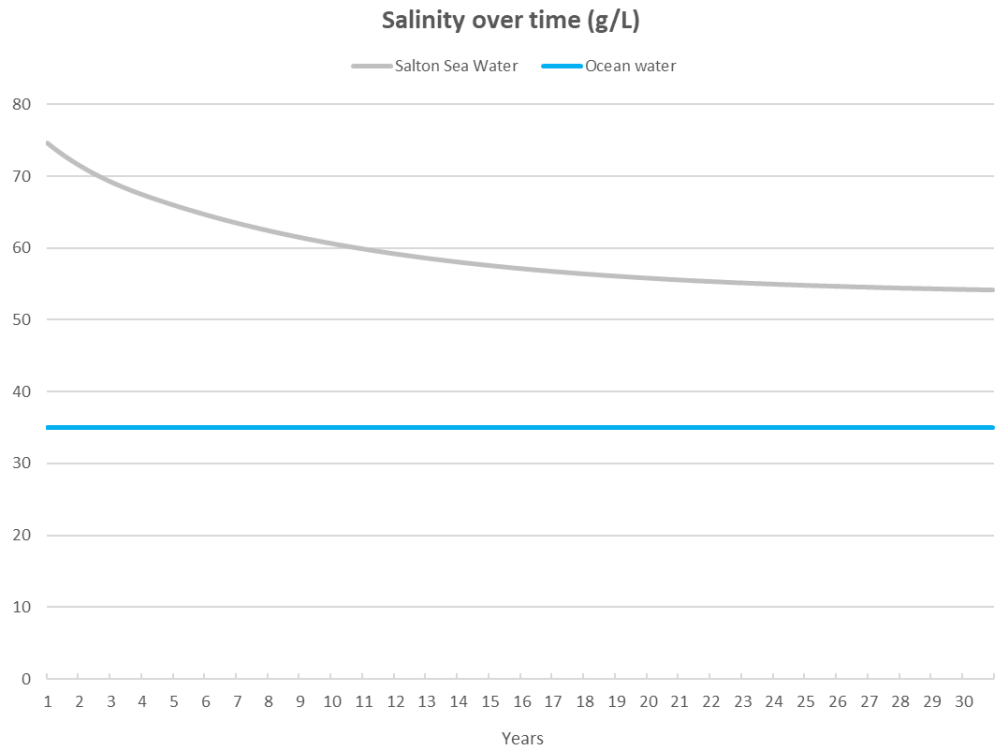
Net Natural Water Loss (per year)
785 f^3/s

Throughput per 12ft Diameter Pipe
639 f^3/s

Pipeline Tunnels Needed
4 total inbound
3 total outbound

Total Capacity
2,468 f^3/s inbound
1,851 f^3/s outbound

Total Tunneling Cost
$1,200M Phase 1
$3,200M Phase 2

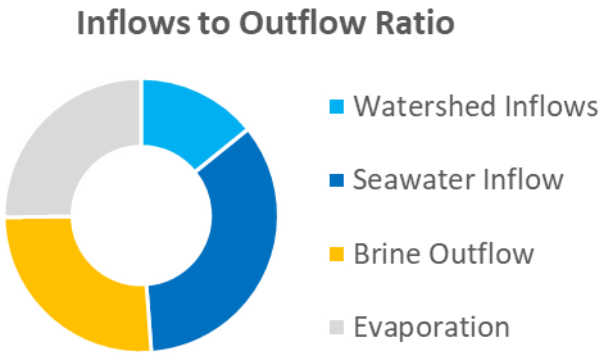


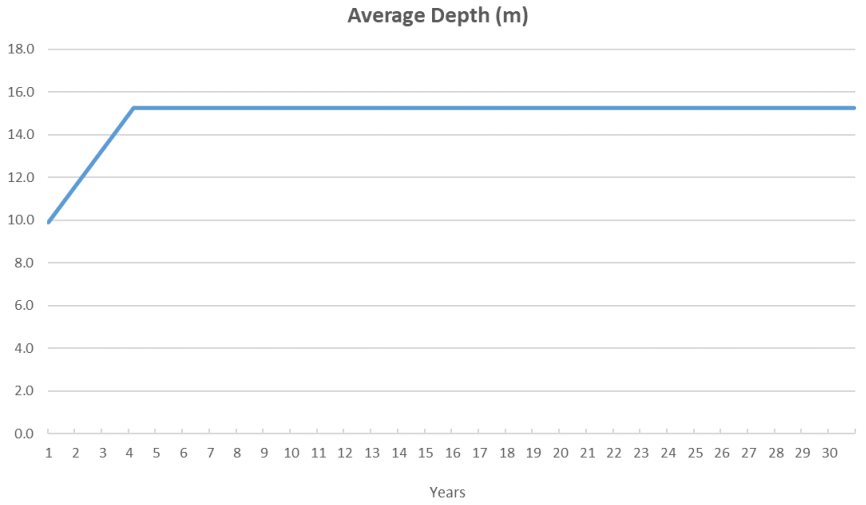
To bring down salinity further, add more pipeline capacity through
(a) more tunnels,
(b) larger diameter tunnels, or
(c) smoother tunnels

Assuming that we target to refill the sea by 5m (15ft) – and hold it there

36%
% of **Current** Lake Volume Cycled / yr

22%
% of **Filled** Lake Volume Cycled / yr





Hydropower systems and Pumping technologies

are things California has plenty of know-how in

HYDRO ENERGY

$U = m * g * h$

Water Head to sea level

70m (230ft)

Turbine Energy Efficiency

90%

Flow Capacity

69.9m^3/s (2,468 f^3/s)

Generation Capacity

69.9m^3/s * 1035kg/m^3 * 9.81m/s^2 * 70m * 90% turbine efficiency * 29% remaining head

= 13.0 MW

Energy Production

13.0MW * 24h/day * 365 days/yr

= 114,263 MWh/yr

Average Wholesale Electricity Price

$20/MWh

Energy Production

$2,285,266/yr

PUMPING ENERGY

$U = m * g * h$

Water Head to sea level

70m (230ft)

Max Water Head for gravity conveyance to Ocean

140m (460ft)

Pump Energy Efficiency

95%

Flow Capacity

52.4m^3/s (1851 f^3/s)

Pumping Capacity

74.1 MW

Energy Use

648,851 MWh/yr

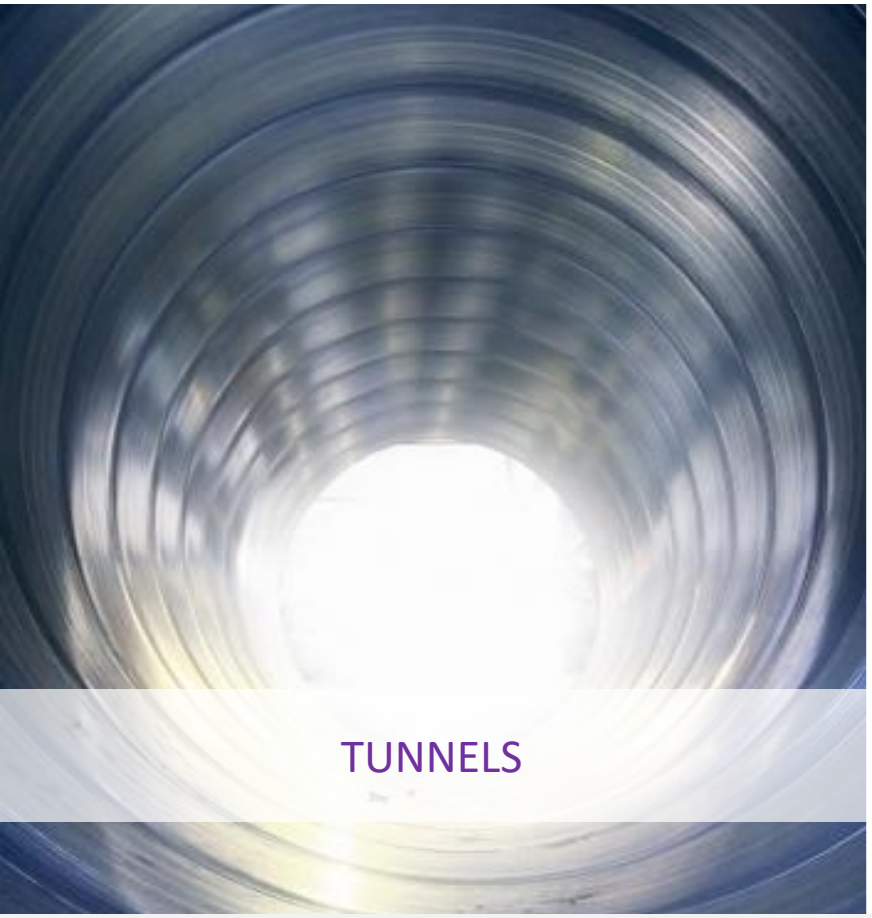
Average Electricity Cost

$20/MWh

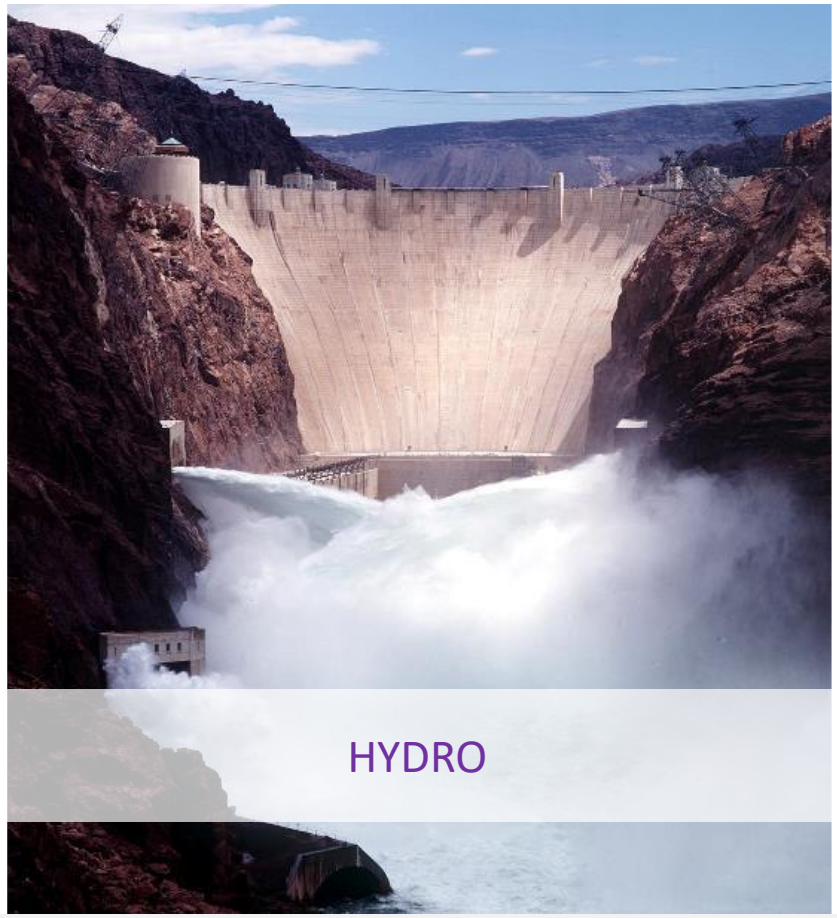
Energy Cost

$12,977,017/yr

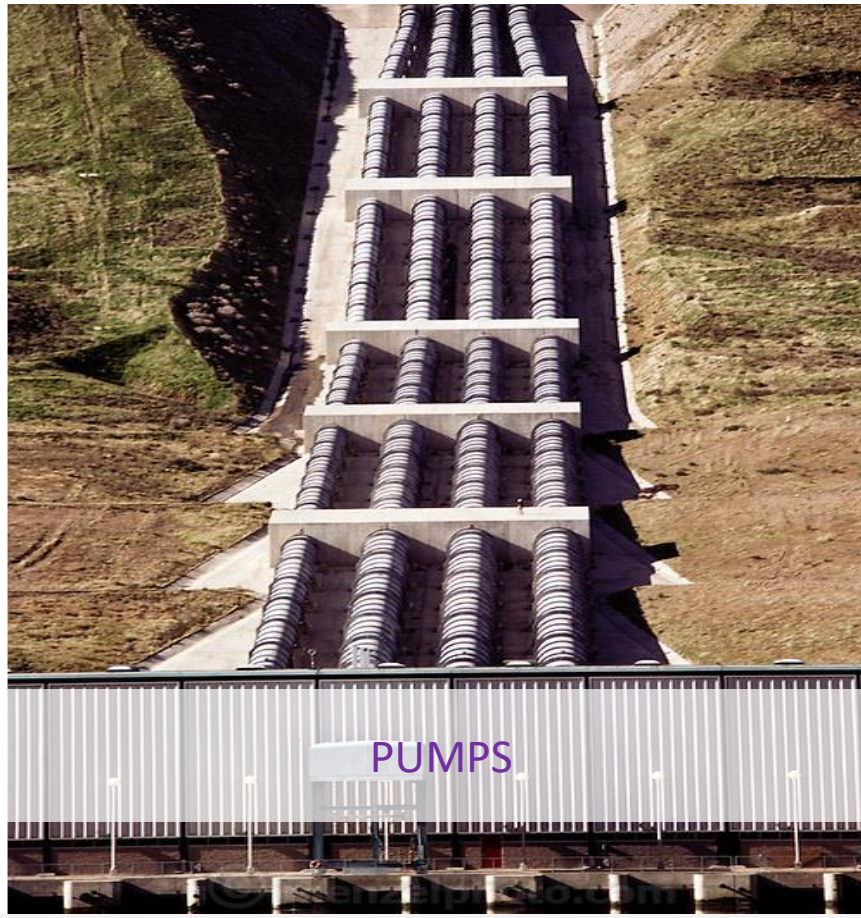
THE PRICE OF THE FUTURE



TUNNELS



HYDRO



PUMPS

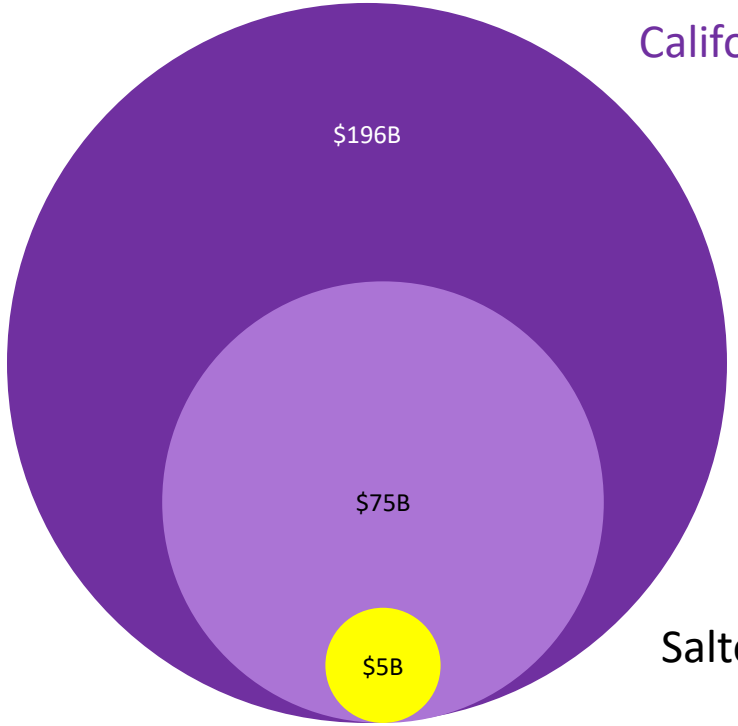
TO BUILD ~ $5 Billion

TO RUN ~ 15 Million/yr

*Actual quote to state may vary depending on contingency costs, financing costs, and other assumptions required in CA State RFI submission format

PERSPECTIVE ON THE PRICE

This will be an expensive and difficult undertaking.
What is worth doing, and at what price?



California State 2021 Budget

California 2021 COVID Revenue surplus

Salton Sea Project Core Cost

WHO DO YOU PICK?

What do we value?

What are we willing to risk to achieve it?

LEGACY APPROACHES

CORE VALUES

- Longevity matters
- Size matters
- Resumes matter

VS

The focus is on **OUR** past

The focus in on **YOUR** future

CORE VALUES

- Vision & Insight matter
- Speed matters
- Results matter

INNOVATIVE APPROACHES

THE IDEA TEAM

Guy Nadler

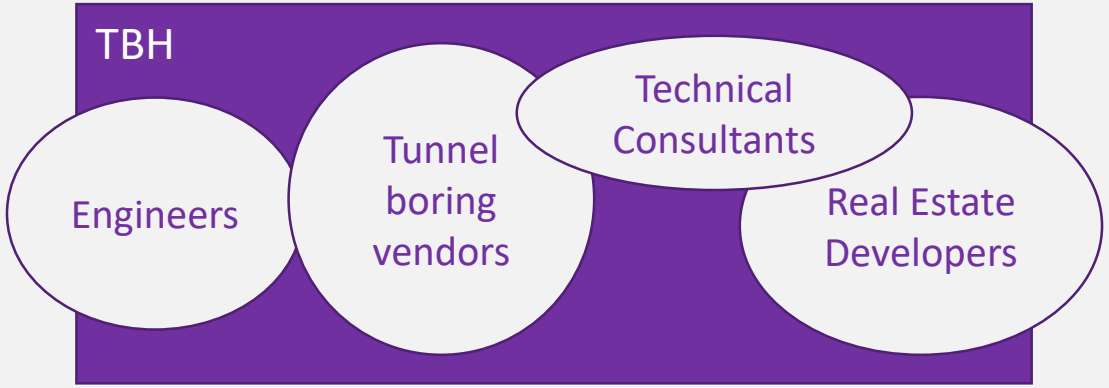
Design, Marketing, Management

Semiconductors, Israeli Air Force
- **MIT**, Boston MA – MBA
- **Technion**, Israel – B.S Physics

Jason McBride

Operations, Design

Semiconductors, Delivery Startups
- **Georgia Tech,** Atlanta GA – B.S. Industrial & Systems Engineering



THE INNOVATION APPROACH

1. PEOPLE BEFORE THE PROBLEM

Who we help is key to how we help

2. PROBLEM BEFORE THE SOLUTION

We care that we solve it, more than how we solve it

3. VISION BEFORE EXECUTION

Executing well to a bad plan, is worse than not starting at all

4. SOLUTION BEFORE THE TEAM

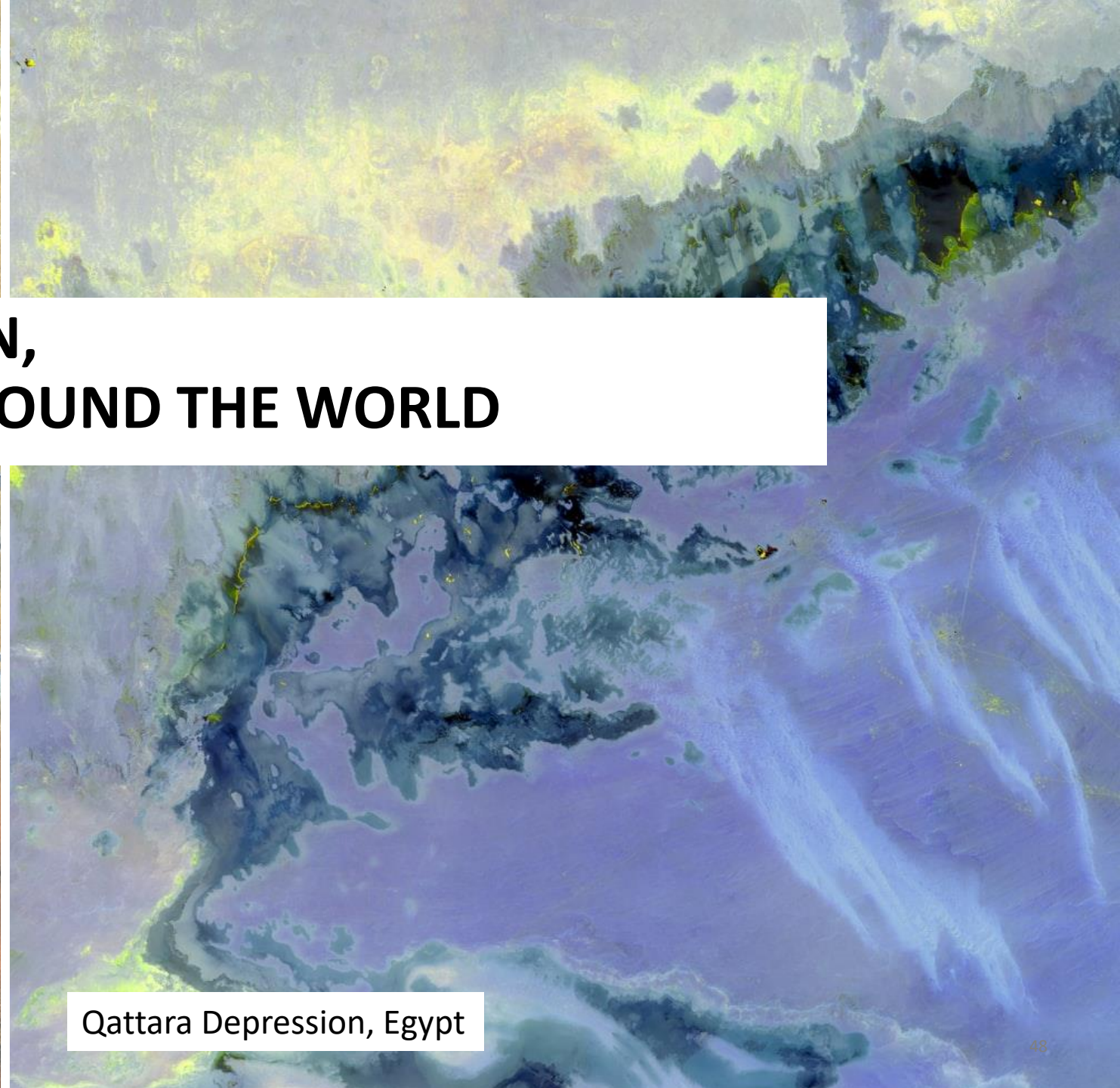
We build the team to solve the problem, not fit the solution to the team

SUCCEED & PAVE THE WAY FOR OTHERS

Save the Salton and inspire the world

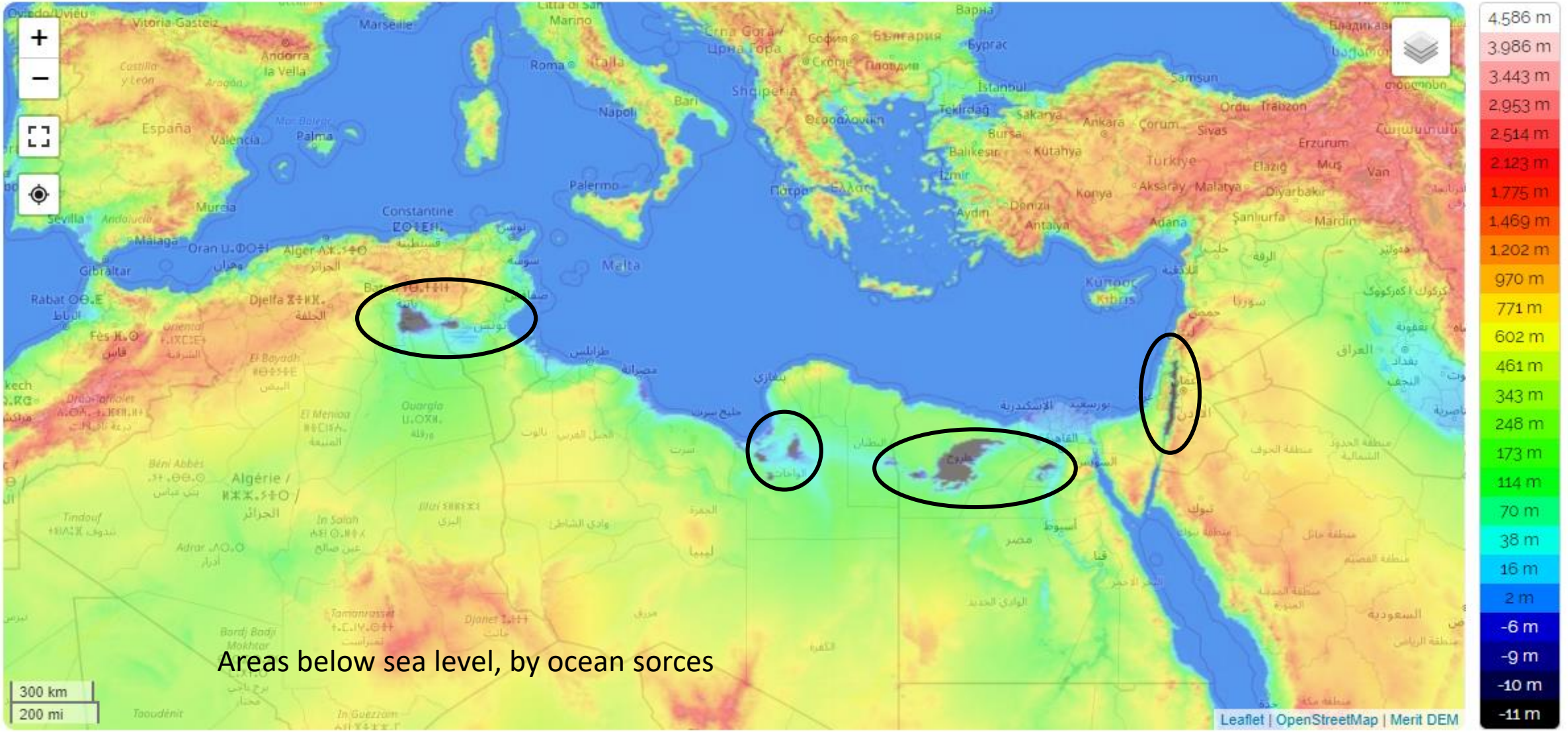
SAVE NOT ONLY THE SALTON,
BUT THE DRIED UP SEAS AROUND THE WORLD

Lake Eyre, Australia



Qattara Depression, Egypt

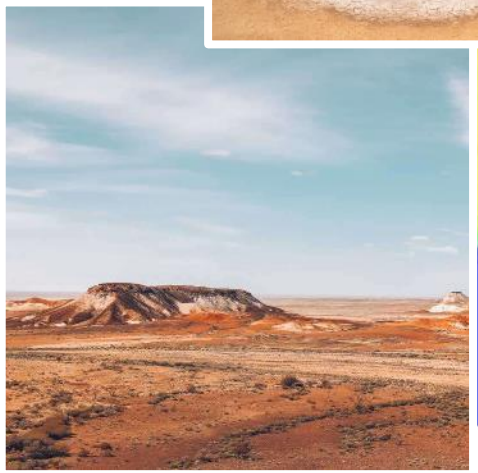
SIMILARLY SITUATED CHALLENGES IN NEED OF INNOVATION



Areas below sea level, by ocean sorces

Source: https://en-gb.topographic-map.com/

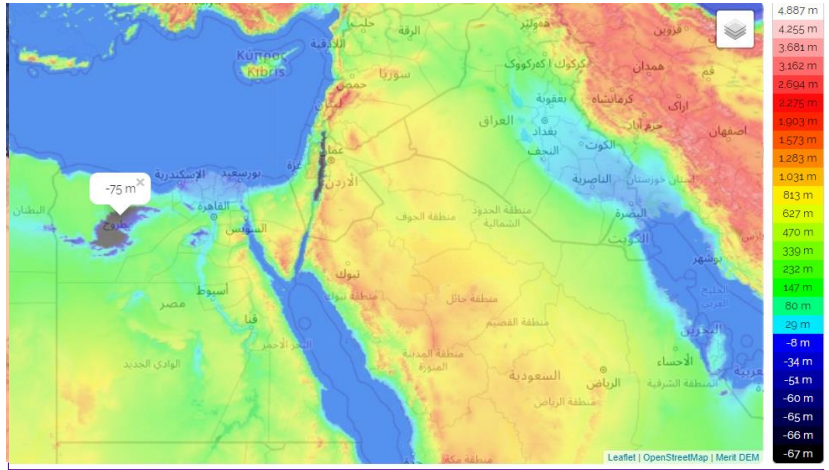
…ONE OF WHICH IS CONTINENTAL IN SCALE



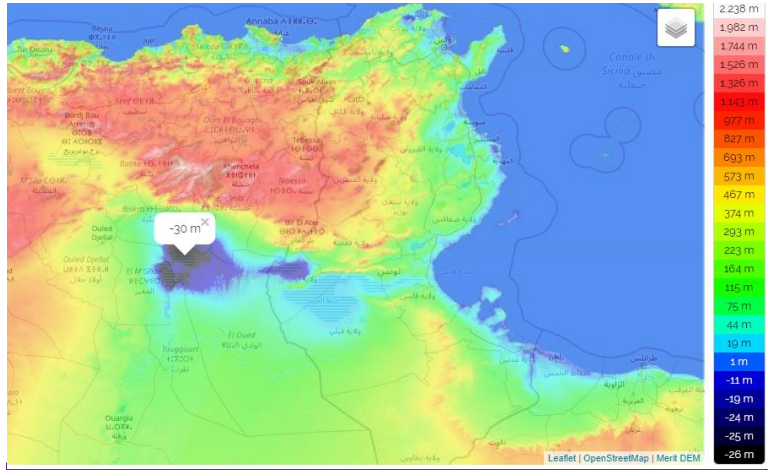
Imagine a water source driving an ecological dynamo, deep in the dry interior

Source: https://en-gb.topographic-map.com/

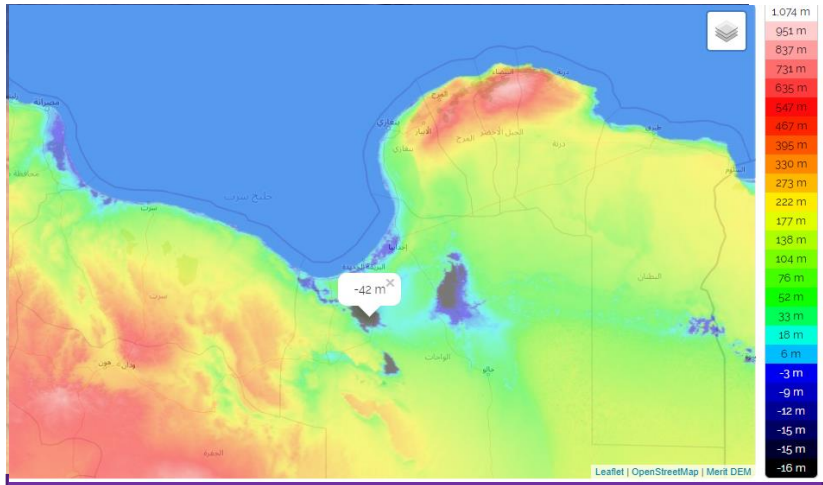
WORLDWIDE LOCATIONS FOR LESS THAN $2B TO CHANGE



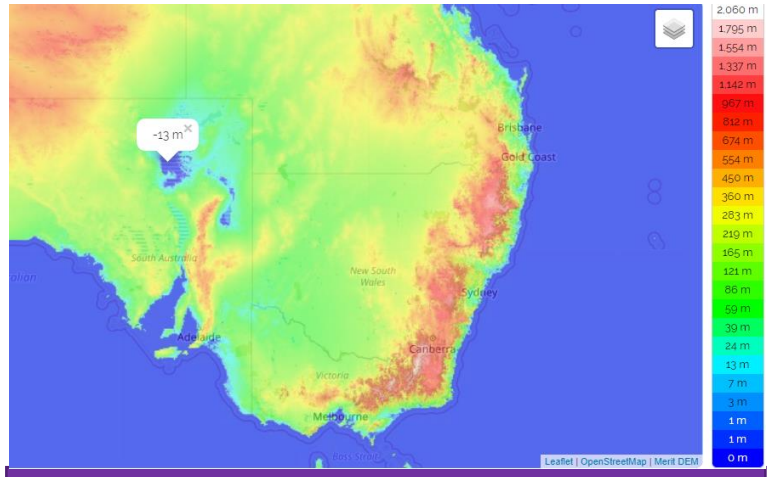
EGYPT (~45mi)



ALGERIA & TUNISIA (~112mi)



LIBYA (~7mi & ~21mi)



AUSTRALIA (~215mi)

Should this approach prove successful, significant geo-engineering opportunities exist in deserts worldwide.

Egypt & Algeria offer depressions of considerable magnitude near population centers where the benefits would be most acute.

Australia offers an opportunity to introduce a body of water in the arid desert interior.
At 60mi X 130mi the evaporative effects would be transformational on the regional climate

Source: https://en-gb.topographic-map.com/

CONTACT INFO

www.engineeringtoeden.com

Restoring two dead and dying seas

Salton Sea, CA, USA

Dead Sea, Israel/Jordan

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