[EXTERNAL   tten comments on the p oposed development of Post-2 26   olo ado R ve Ope at onal St ateg es

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Mon 7/4/2022 12:38 PM
To: CRB-Info, BOR <bor-sha-LCB-Info@usbr.gov>;Jerla, Carly <CJerla@usbr.gov>;PAO, BOR-sha-UCB <bor-sha-ucb-pao@usbr.gov>;Stemmer, Matthew J <MJStemmer@usbr.gov>

Dear All:
Subject: Written comments on the proposed development of Post-2026 Colorado River Operational Strategies

The solution for the Western USA water problems is revolutionary and also simple:

1. Import TRANSOCEANIC (transoceanic.us) long-distance water from Southern Mexico to Lower Colorado River Basin and share it among Mexico and the US neighboring states. (And also import additional long-distance water over the Pacific Ocean to SoCal and NW Mexico from Alaska, NW US, and Southwestern Mexico, so that the Colorado River water usage is decreased.) TRANSOCEANIC systems can import tens of millions of acre-feet of long-distance water per year at low cost and make a garden from the Western USA and NW Mexico.

2. Then reallocate more water to the Upper Colorado River Basin, increasing the Colorado Lakes levels and decreasing the flow to the lower basin.

3. BE HAPPY FOREVER (no more crying for water)!

I append two project proposals: one written for the Salton Sea (but applicable for the whole Colorado Basin) and another one for Marine Corps Camp Pendleton Base.

We are open for cooperation.
Please advise.

Concept (patented in the USA and Mexico): https://lnkd.in/gPDVCce

Projects: https://lnkd.in/ge6zJNJn

Sincerely,
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TRANSALTON PROJECT - TRANSOCEANIC PROPOSAL FOR MASSIVE FRESH WATER IMPORTS TO THE SALTON SEA AND THE LOWER COLORADO RIVER BASIN FROM SOUTH MEXICO RIVERS

Rev: NC

TRANSOCEANIC LLC USA
transoceanic.us

TRANSALTON PROJECT - A MASSIVE FRESH WATER IMPORTATION PROJECT FOR THE SALTON SEA IN CONJUNCTION WITH A LARGER TRANSOCEANIC LOWER COLORADO RIVER BASIN PROJECT

1. *Identification of Project Team*
   Members of the project team and their roles on the project should be identified.

   TRANSOCEANIC response: The project team for the TRANSALTON project will consist of the experts from TRANSOCEANIC LLC – USA and its associates, of the California State and federal agencies representatives who will be assigned to the project, as well as of the main water customer(s) who will participate in the project. Other team members can be included as required.

2. *Narrative description of project concept and how/when it will benefit the lake.*
   A brief description of the proposed project is required that includes a general discussion of the project concept, the business plan, and the implementation of the project. The project concept discussion should include a description of the project and how it will improve conditions at the lake. The business plan should include a discussion of the ownership of the proposed project and the plan for generating revenue from the project.

   TRANSOCEANIC response: The TRANSOCEANIC SALTON WATER IMPORTATION PROJECT (hereafter called **TRANSALTON** project) **is a FRESH WATER IMPORTATION PROJECT** that will be used mainly for agricultural irrigation and city water supply around the Salton Sea, while the irrigation and processed city drainage water will be collected and transferred to the Salton Sea for the control and stabilization of its level and playas with minimal increase of added salts.

   The TRANSALTON project is considered as part of a larger TRANSOCEANIC Lower Colorado River project intended to import a quantity of fresh water equivalent to about half of Colorado River flow (9 billion cubic meters - 7.3 million acre-feet, per year (AFY)) and to solve the water scarcity in the Western USA, the TRANSALTON project being allocated about 1/10 of this quantity, meaning 730 000 AFY.
   The fresh water is proposed to be imported from Southern Mexico's rivers on proprietary TRANSOCEANIC submersibles (see note 1) through the Gulf of California (see map on Annex 1). The designated fresh water source is the Balsas River in Southern Mexico, the water being loaded on the TRANSOCEANIC submersibles at an offshore station at Lázaro Cárdenas, Michoacán, Mexico. Other Mexican rivers can be considered, taking into account their water availability and quality. The fresh water will be delivered after being transported for 2100 kilometers (1300 miles) to an offshore station built into NW Mexico at the northern extremity of the Gulf of Mexico. The imported water will be shared with Mexico, and then will be delivered onshore to the USA's Lower Colorado Basin users.
   The required amount of water for stabilizing the Salton Sea level is expected to be 250 000 AFY per the measured evaporation of the Salton Lake between 2008 and 2018 and for

stabilization at -245ft level (see Note 2). This required water will come as used (agricultural and city) water returns after the use of the delivered 730 000 AFY of fresh water.
Because the required imported fresh water is about 10% of the deliveries of the proposed larger TRANSOCEANIC Lower Colorado River project, the estimated CAPEX portion for the TRANSALTON project is $869 million representing 10% of the estimated CAPEX of $8.687 billion for the larger TRANSOCEANIC Lower Colorado River project.
The beneficiaries of the project will be the California Governmental Agencies involved in the financing of the project, together with the participating federal agencies and with other partners of choice. Of course, the final sharing costs of the project and ownership will be established when all the beneficiaries of the larger Colorado River project will be established together with their participation.
The characteristics of fresh water deliveries are presented in Annex 2. It is expected that the delivered price of fresh water will be $186 per acre-ft ($0.15 per cubic meter). The imported water in its majority will be sold for irrigation or city utilities with the used water returns being received free of charge and transferred to the Salton Sea. It is expected that the TRANSALTON project will generate a certain net profit by the sale of water especially to Coachella Valley and other urban customers. However, the price of delivered water can be kept so low that it is also feasible to be sold for many agricultural uses.

As required, some TRANSALTON fresh water will be applied directly to the Salton Sea for improving the conditions of the playa and the lakeshore. It is proposed that some of the playas and parts of the Salton Sea be separated from the Salton Sea brine and filled with fresh water per the Perimeter Lake alternative by the Salton Sea Authority (see Note 2, Section 7), becoming a source of irrigation water and/or recreation lakes after applying the available imported water.

The TRANSALTON project is expected to need about 5 years for being implemented and its effects on the Salton Sea will start when the used imported water application happens.

Also, the TRANSALTON project does not require and we do not advise brine ejection from the Salton Sea into the Gulf of California, the brine ejection being unnecessary while water with low salinity is added as proposed by the TRANSALTON project. Presently the Salton Sea brine has about twice the ocean salinity and there are ecological concerns when ejecting concentrated brine in the ocean coastal areas, as the desalination plants do too.

A possible venue of the TRANSALTON project is to decouple it from the larger TRANSOCEANIC Lower Colorado River project, and eventually to include it in other specific TRANSOCEANIC fresh water delivery projects for southern California, Arizona, and NW Mexico; in this case, it is expected to have an increase of the CAPEX and unit price of delivered water.

During the implementation of the TRANSALTON/ larger TRANSOCEANIC Lower Colorado River project(s) their configuration will be optimized and it is expected to get better performance and cost than the present proposal.

3. *Planning and design process of project*
   Describe the planning process completed to date and detail how the planning process will be completed. The description should include the following:

   • Project Feasibility -- Documentation of the engineering feasibility of the project. Documentation should include at a minimum: system capacity; pumping requirements; channel and pipe size; water quality; other associated infrastructure such as desalinization, fish or trash screens, etc.; and expected energy use.

   TRANSOCEANIC response: Annex 2 shows the engineering feasibility of the project. The main equipment of the TRANSALTON project consists of the submersible boats that transport the water for a distance of 2100 km (1305 miles) from the Balsas river to the northern part of the Gulf of Mexico. The submersible boats are manufactured of ballastable reinforced concrete hulls which enclose several very large collapsible bags for the transportation of fresh water. The proposed dimensions of the submersible boats are diameters of 120 meters (400 ft) and lengths of 840 meters (2750 ft), each being able to transport 9.5 cubic meters (2.5 billion gallons) of fresh water. The construction details of the hulls are presented in the same Appendix (1). The cost of one submersible boat is evaluated at $167 million. For the larger TRANSOCEANIC Lower Colorado River project it is necessary to build 50 submersible boats, with a 1/10 share assigned to the TRANSALTON project.
   However, the offshore loading and unloading stations are important items too, and each has costs similar to the cost of a submersible boat.
   The size of the main pipelines (in some areas replaced by opened canals) will be cost-optimized but is expected that the main offshore connecting pipelines to be about 20 ft in diameter. After landing, the water can be spread to the beneficiaries through new water systems connected to the legacy systems like the All America Canal. Some smaller installations, canals, and pipes will be provided for collecting the used water that will be transferred to the Salton Sea. All waterworks (beyond the main pipelines/canals and legacy facilities) are advised to be transferred to the local water customers.
   Also, a coefficient of 1.8 was considered for increasing the CAPEX calculation by 80% due to the novelty and specific configuration of the project(s).
   The energy use for over the ocean water transportation was presented together with other information in the attached spreadsheet of Annex 2 and it is equivalent to lifting the water to 176 meters (578 ft).
   Any other required pumping is considered as operational costs, which are to be defined accordingly. The amortization of the TRANSALTON project hardware (considered for 30 years) is substantially equal to the energy costs for transportation.
   The imported water quality is given by the water source river and it will be certified and afterward permanently monitored and tested for compliance. The water source contract(s) will require to keep the quality of the river water, thus improving the water quality of the whole river and ecosystem.

The estimated cost of water at the source ($0.07) is expected to be similar to its transportation costs.
There will be fish and trash screens at the loading of water, but these are minor subassemblies compared to the other systems required by the TRANSALTON project.
There is no desalination (and no desalination infrastructure) required; we let nature deliver fresh water from the source river(s).

• *Water Source Identification – Either provide documentation from the water rights holder that establish the willingness of the water rights holder to allow use of their water right or provide detailed description of process to establish those rights.*

TRANSOCEANIC response: For the TRANSALTON project, the only economical sources of fresh water are the South Mexican rivers located at acceptable transportation distance. We selected the Balsas river as the water source, having the required flow and being positioned away from the pollution sources. Closer sources are available but the water availability and quality should be evaluated.
Taking into account the quantity of water (7.3 million AFY) for delivery for the larger TRANSOCEANIC Lower Colorado River project and its transboundary nature, it is evident that the water access should be arranged at the intergovernmental/federal level with consultation and participation of the implied states (California, Arizona, Baja California, Sonora). Upper Colorado basin States (Nevada, Utah, Colorado, Wyoming) as well as New Mexico, should be invited to participate (also financially) if the future Colorado River water allocation will be positively affected by the larger Lower Colorado River project.

• *Land Use – provide project route alignment and status of land use permission for the conveyance route both in the United States and in Mexico.*

TRANSOCEANIC response: Like water rights, the land and sea use permission for the water loading and unloading should be established by agreement(s) at the federal and state level between the USA and Mexico. The land pipelines and canals are a federal issue (USA'S and Mexico's) as well as an issue at the affected state level for California, Arizona, Baja California, Sonora.
The offshore delivery terminal will be positioned in the Wagner Basin at depths required by the TRANSOCEANIC submersibles, and it will be connected to the shore by a pipeline landing close to San Felipe, Baja California, Mexico. This pipeline is dimensioned to serve the whole larger TRANSOCEANIC Lower Colorado River project.
It is necessary to build a similarly sized loading terminal(s) at the source river(s).
The land delivery pipelines/canals start at the offshore pipeline landing and are dimensioned for transporting almost all delivered water (less the one locally used) being positioned west from Highway 5 (Mexico), to Mexicali. After about 100 kilometers these large pipelines/canals transfer the water to multiple pipelines/canals and the All American Canal, and also to a dedicated branch going to the Salton Sea for direct water delivery.

Another possible routing is to land the offshore pipeline to Sonora state, crossing the Alto Golfo de California Biosphere Reserve on an efficient route and then going to the northeast of Highway 40 (Mexico) to Guadalupe Victoria, Mexico. After about 100 kilometers this large pipeline/canals transfer the water to multiple pipelines/canals, and also to a dedicated branch going to the Salton Sea for direct water delivery.
Other optimized routings can also be considered.
The access to Mexican coastal areas has to be approved by the Mexican federal and state authorities coordinated with the US government.

• *Environmental Impact – provide information on any anticipated environmental impacts from the project in both Mexico and the US and how those will be generally mitigated. This should include a discussion of any anticipated impacts to existing surface water use, groundwater basins, and wildlife resulting from the introduction of ocean water to existing, or new, river channels or canals. If the project is proposed within the Alto Golfo de California Biosphere Reserve, please identify any anticipated impacts to that area and expected mitigation measures.*

TRANSOCEANIC response: The TRANSALTON project transfers fresh water that is non-polluting. The footprint of the TRANSALTON project is kept minimal and consists mainly of underground fresh water pipelines, the only visible part being their markers. The ecosystem disturbance while positioning the pipelines should be minimal. The required canals will be built per regular procedures and are non-polluting too.
The TRANSOCEANIC submersible boats stay away from land and are low-speed boats having minimal impact on the environment. No ballast water is released due to the submersible proprietary construction and operation (see the TRANSOCEANIC patent of Note 1.)
The offshore and onshore pipelines routing will avoid the Biosphere Reserve of the Upper Gulf of California & Colorado River Delta as much as possible although the fresh water is non-polluting and would improve the neighboring environment in case of open canals; the onshore routing west from Highway 5 (Mexico) seems to be the one having no interference with the Biosphere Reserve.
It is important to take into account the seismicity on the project location and the mitigation of the possible seismic episodes.

• *Salton Sea Salinity – how does the project plan to deal with increased salinity at the Salton Sea from the imported ocean water? If the proposed project includes a desalinization system where will the resulting brine be deposited?*

TRANSOCEANIC response: The only used water for the TRANSALTON project is the imported long-distance fresh water; the resulting irrigation returns have slightly higher salinity, which is much lower than the salinity of seawater.
There is no imported ocean water/seawater required or proposed for the TRANSALTON project.

There is no desalination required or proposed for the TRANSALTON project.

• *Water Use – Describe the projected water balance including consumptive use, system loss, evaporation etc. and ability of the proposed project to operate successfully with decreased flows.*

TRANSOCEANIC response: We consider that beyond the present flows to the Salton Sea it is necessary to add 250 000 AFY per the measured evaporation of the lake between 2008 and 2018 and for stabilization at -245 ft level. This required water for the Salton Sea will come as water returns after use of the delivered 730 000 acre-ft of fresh water, the large difference covering the intended consumptive use and evaporation, while the system loss should be minimal.
The TRANSALTON project water deliveries will be adjusted accordingly for decreased flows from other sources by increasing the share of water from the larger TRANSOCEANIC Lower Colorado River project.

• *Cross Border Governmental Coordination and Permitting -- provide details of conducted or needed coordination and permitting from governmental agencies from both Mexico and the United States that deal specifically with cross border project development. Agencies include but are not limited to the International Boundary Water, Commission, Mexico federal agencies, tribal governments, and necessary United States agencies.*

TRANSOCEANIC response: The TRANSALTON project is complex and its complexity is increased when integrated into the larger TRANSOCEANIC Lower Colorado River project. The following aspects require the coordination and permitting from governmental federal and state agencies from both Mexico and the United States: (i) the water rights and export-import operations from Mexico, (ii) the harvesting and submersible boat loading of water, including the loading offshore station at the Southern Mexico location(s), (iii) the unloading of water at the offshore station in the Northern Gulf of California, (iiii) the land transfer of delivered water in NW Mexico/SW USA including the importation/border crossing.
After establishing the possible (and then the final) TRANSALTON project configuration(s) the appropriate agencies will be contacted and the needed final approvals will be obtained.

• *Project Development Schedule -- Schedule for project development from current stages through implementation.*

TRANSOCEANIC response: The TRANSALTON project part is expected to be developed in 5 years from the date of the project and financing approval if the project enters a sustained deployment; the larger TRANSOCEANIC Lower Colorado River project completion is expected to require 10-15 years from the date of the project and financing approval. The projects can be achieved in incremental phases with a gradual increase in the number of TRANSOCEANIC submersible boats.

The first phase of the project(s) will require a sustained engineering effort for the design of the TRANSOCEANIC hardware and the routing and complete configuration of the TRANSALTON project in conjunction with any other related water import project(s). During this phase, all the required aspects of the project(s) (economic, environmental, legal, international relations, etc.) will be solved too.

• Operation Schedule -- Provide an estimate of the length of time necessary for the proposed project to raise the water levels at the lake to recover potentially emissive playa.

TRANSOCEANIC response: It is expected that the first rise in water level will take place close to the completion of the TRANSALTON project in about five years from its financing approval. The rate of the raise can be adjusted by the ways (as used water or direct) that the water is transferred to the lake, but it also has an economic impact if the lake-received water does not exclusively consist of used water.
Also, the existence and configuration of the future perimeter lake(s) or agricultural land conversions will influence the speed of recovery of the selected potentially emissive playa(s).
The TRANSALTON project together with the larger TRANSOCEANIC Lower Colorado River project is a very strong instrument having the potential of raising the water level of the Salton Sea at any desired value, but the economic aspects (cost of water, and impact on its use) should also be taken into account.

4. *Cost projection*
• Provide a cost projection for the proposed project. The projection should be documented to the extent that the reviewers can review the cost projection process and determine the validity of the projections

TRANSOCEANIC response:
The TRANSALTON project uses the new TRANSOCEANIC technology of importing long-distance water and does not consist of the pipeline transportation of (salty) water contemplated in the RFI email; therefore the cost projections are presented in Annex 2, in a structure that is different from the Cost Template suggested with the specified RFI email.
The main assemblies of the TRANSALTON project are (i) the submersible boats and (ii) the terminal loading and unloading stations.
The main cost of the submersible boats is incurred for their ballastable hulls manufactured of reinforced concrete (@$55.4 million/each).
The propulsion is also important (@$9.7 million/boat) as well as the different items (@$27.7 million/boat) consisting in collapsible bags, Instrumentation and Command&Control (ICC), ballast control system(s), navigation and communication equipment, and all other required items.
Due to the novelty of the TRANSALTON/TRANSOCEANIC projects, a cost safety coefficient of 80% was added for the CAPEX, resulting in a total cost of $167 million for each submersible boat.

Each terminal station was considered to cost the same as one submersible boat. The loading station seems to be simpler than the unloading station where the required onshore work seems to be substantial. However, it is important to underline that these stations serve the whole larger TRANSOCEANIC Lower Colorado River project, the TRANSALTON project being just a share user.
The cost of the energy was also considered in the cost of delivered water, the cost of energy being similar to the TRANSOCEANIC hardware 30-year amortization. The propulsion and energy costs were considered for high-efficiency LNG diesel propulsion, but other propulsion modes (nuclear, hydrogen, ammonia) can be considered.

The CAPEX for the TRANSALTON project is $869 million, while the CAPEX for the larger TRANSOCEANIC Lower Colorado River project is $8.687 billion. The projected cost of water transportation for 1300 miles @$0.0738 per cubic meter (tonne) and the massive volume of water deliveries (9 billion cubic meters / 7.3 million acre-feet, per year (AFY)) is clear proof of the TRANSOCEANIC project importance and usefulness.

The considered commodity prices (for cement, rebar, LNG) were those of years 2012-2020 before the period of very volatile prices.
The spreadsheet with the cost computation can be obtained as an interactive file from dorian@transoceanic.us.
It is important to note that the present document is not an offer or a quotation; it is for information only.

5. *Plan for funding of proposed project*

• Describe how the planning, design and construction implementation of the project will be funded.

TRANSOCEANIC response: There are three funding sources for the TRANSALTON/ larger TRANSOCEANIC Lower Colorado River project:

1. The federal government through its agencies. An important funding source should be the federal infrastructure funds that at the date of this document are in the process of being approved.
2. California state funds should be an important part of the funding of the project. California and the federal fund should be the ones used for the initial planning and design for the project, this part of the project is estimated at 15% of the whole project(s) cost.
3. Third-party funds: Water Departments (San Diego, Metropolitan Water Department, Palm Springs, Indio), other states (Arizona, Nevada) and water departments and projects (Phoenix, Central Arizona Water Conservation District, Tucson) and other third parties interested in water.
4. It is also possible that some of the funding will be financed by banks and other credit institutions/instruments during the project's development.

The construction, funding, operation, and maintenance of the TRANSALTON/ larger TRANSOCEANIC Lower Colorado River project(s) should be centralized and consolidated under one entity dedicated to these projects, in a similar way to the construction and operation of Arizona's CAP.

Mexico might prefer to get water delivered in exchange for supplying the river water and the use of its sea and land for water conveyance. This fact might increase the required CAPEX but might slightly diminish the price of delivered water.

Let's be efficient! Do not forget that Arizona's CAP cost five times more US$ (in today's money), for five times less delivered water than the proposed larger TRANSOCEANIC Lower Colorado River project(s).

• *Identify the responsible parties for the operation and maintenance for the project and estimate annual cost.*

TRANSOCEANIC response: The construction, funding, operation, and maintenance of the TRANSALTON/ larger TRANSOCEANIC Lower Colorado River project(s) should be centralized and consolidated under one entity dedicated to these projects, in a similar way to the construction and operation of Arizona's CAP.
The price of water we computed already includes for the TRANSALTON project a "Cost of Operation+Maintenance /Repair +Replacement, and profit and other costs" of 25% ($13.3 million/year) added to the net cost of water transportation. Also, a water mark-up of 10% ($6.3 million /year) was added to cover the Operation+Maintenance costs of the TRANSALTON project with priority.
No pre-established profit was added to the water import operation considering it a federal/state program; however, no loss is expected to be encountered and substantially all investment should be recuperated.
The values above are increased tenfold as appropriate for the larger TRANSOCEANIC Lower Colorado River project.

NOTES

Note 1. The TRANSOCEANIC concept is described on the websites:
https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2021101684&tab=PCTBIBLIO and https://transoceanic.us/

{Note 2. Salton Sea Hydrological Modeling and Results
https://www.iid.com/home/showdocument?id=17299#:~:text=The%20open%20water%20surface%20evaporation,System%20%5BCIMIS%5D%202012).

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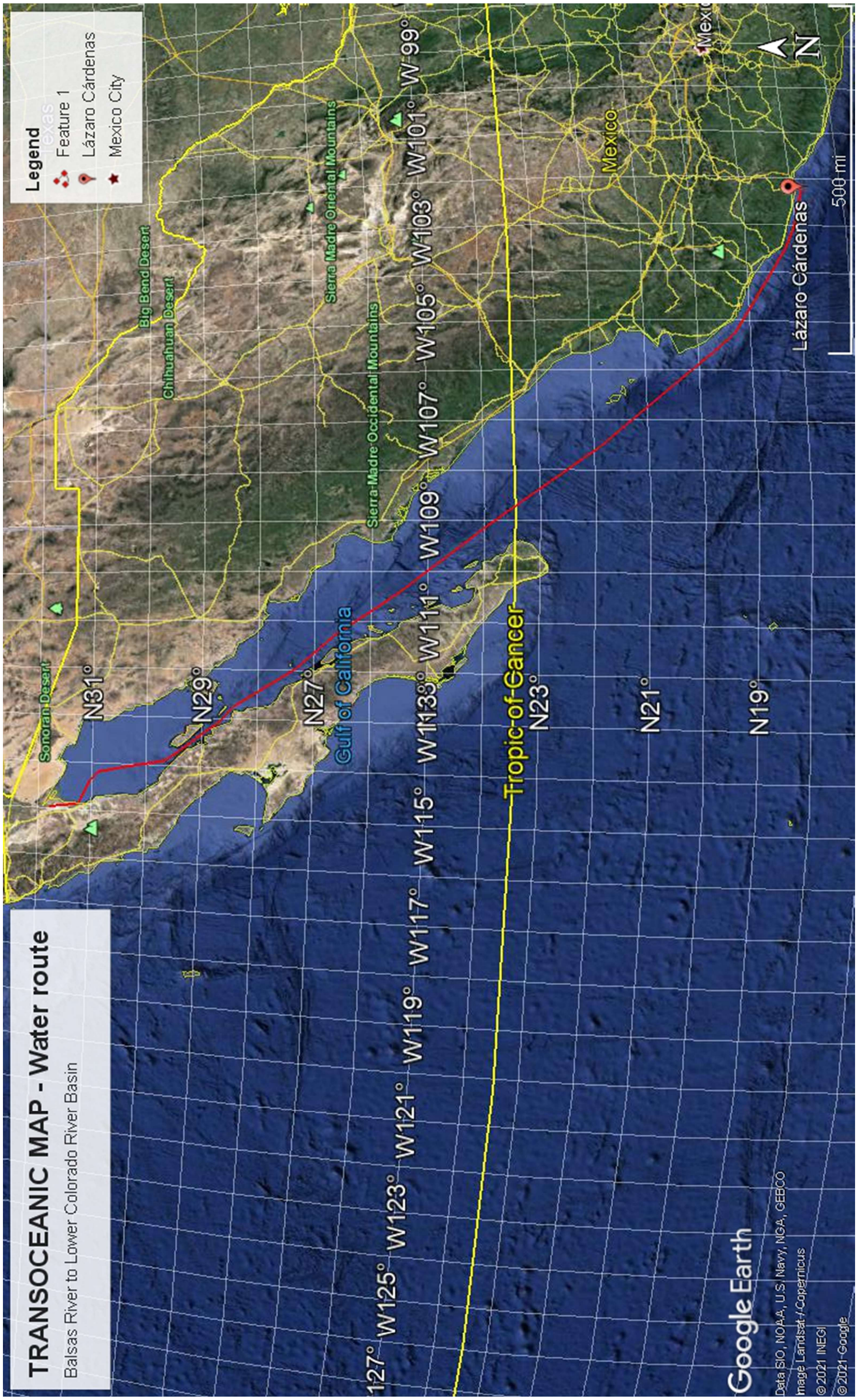
Annex 1

Map of marine water transportation for the TRANSALTON / TRANSOCEANIC Lower Colorado River Basin projects



TRANSOCEANIC MAP - Water route
Balsas River to Lower Colorado River Basin
Legend
Feature 1
Lázaro Cárdenas
Mexico City
Texas
Sonoran Desert
Big Bend Desert
Chihuahuan Desert
Sierra Madre Oriental Mountains
Sierra Madre Occidental Mountains
Gulf of California
Mexico
Tropic of Cancer
Lázaro Cárdenas
N31°
N29°
N27°
N23°
N21°
N19°
W99°
W101°
W103°
W105°
W107°
W109°
W111°
W113°
W115°
W117°
W119°
W121°
W123°
W125°
127°
500 mi
N
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
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Annex 2

Characteristics of the TRANSALTON / TRANSOCEANIC Lower Colorado River Basin Projects

PROJECT TRANSALTON - TRANSOCEANIC (transoceanic.us)
(Interactive file - inputs in green cells)

Supply station	**Balsas River, Mexico**	**Balsas River, Mexico**
Delivery station	**Lower Colorado River**	**Salton Sea Project**
Distance, one way, km	**2100**	

CONSTANTS AND TRANSFORMATIONS	
cubic meters for one acre ft	1233.48
meters for one ft	0.3048
Sea water density is (kg/cubic meter)	1028
Pi value	3.14159
Kilometers in one mile	1.60934

SUBMERSIBLE TRANSPORTER	GEOMETRY
Radius, meters	60
Radius, ft	197
L/(2R) RATIO	7
Equivalent submersible length, m	840
Submersible Section, square meters	11310
Submersible surface (cylinder, considered closed by hemispheres)	361911
volume (cylindrical length), cubic meters	9,500,168
volume, acre-ft	7701.92

BALLASTING	
Relative density of concrete	2.4
ballasting required (on cylindrical part), kg/square meters	840
thickness of concrete wall, m	0.612
Volume of concrete required, cubic meters	221578
Volume of concrete required, cubic yards	289813
Weight of concrete structure, metric tonnes	531788
Chamber thickness, meters	0.84
Total hull thickeness, meters	1.45

STRESSES

Max tangent force, Newton/linear meter		1,483,272
Max tangent force, metric tonne force/linear meter		151.200

HYDRODYNAMICS

cx (drag coefficient)		0.08
speed v, m/s		2.9
speed km/h		10.44
Drag force, Newton		3,911,120
Drag force, metric tonne force		398.69
Power required for cruising (w)		11,342,247
Power for cruising, Mw		11.342

POWER AND ENGINE

Hydrodynamic efficiency		0.7
Required Engine power, Mw		16.203
Engine reserve, %		20%
Total Engine Installed Power		19.444

FIXED COSTS

SUBMERSIBLE COST

Unit Concrete price, $/cubic meter		70.00
Unit cost of armature, $/cubic meter		60.00
Unit cost of work, $/cubic meter		120.00
Total unit price of concrete, $/cubic meter		250.00
Cost of concrete for submersible, $	$	55,394,567

PROPULSOR COSTS

Cost of propulsion $/Mw		500,000
Total cost of propulsion	$	9,721,926

INSTRUMENTATION, COMMAND AND CONTROL (ICC) +OTHER ITEMS

Cost of ICC, BAGS OTHER STRUCTURES (AT 50% OF CONCRETE COST)	$	27,697,283
Complexity Factor		1.80
Total cost of one submersible	**$**	**167,064,797**

VARIABLE COSTS (FUEL)

FUEL COST PER HOUR		
Fuel Consumption, kg/kWh		0.165
Fuel cost (LNG), $/kg		0.2207
Cost of fuel per hour (at required power) $/hour		590

TRIP COMPUTATION

Supply station	**Balsas River, Mexico**	
Delivery station	**Lower Colorado River**	
Distance, one way, km		**2100**
Distance, one way, miles		1305
Stationing, days at each station		1.25
Cruise time, round trip, hours		402.30
Cruise time, round trip, days		16.76
Total travel time, hours		462
Total travel time, days		19.26
Fuel cost per trip (stationary at half consumption per hour), $	$	255,077
Submersible life (years)		30
Amortization of submersible (30 year life) $/hour		661.14
Cost of submersible per trip	$	305,644
Net cost per trip (submersible+fuel)	$	560,721
Net transport cost $/acre-ft		72.80
Cost of O+M/R+R, profit and other costs (% of net cost)		25%
Brut cost per trip, $		700901
Brut transport cost $/acre-ft		**91.00**
Brut transport cost $/cu meter		**0.0738**

TRANSPORTATION SYSTEM CONFIGURATION AND COST		**Lower Colorado River**		**Salton Sea Project**
Transported water, million cubic meter / year		**9,000**		**900.00**
Transported water, acre-ft per year		**7,296,429.61**		**729,643**
Transporter capability per boat, trips/year		18.949		
Transporter capability per boat, mil cubic m/year		180.02		
Transporter capability per boat, acre-ft/year		145,942		
Required number of transporters		**50**		**5**
Cost of transporters (boats)	**$**	**8,353,239,833**	**$**	**835,323,983**

Cost of two teminal stations (each equal to one submersible transporter cost)	$	**334,129,593**	$	**33,412,959**
Total cost of transportation system	$	**8,687,369,426**	$	**868,736,943**

PARAMETERS

Transportation pressure drop equivalent, meters		176		
Transportation pressure drop equivalent, ft		578		
Water flow at stations for continuous filling/emptying, cubic m/sec		285.39		
Transportation system capability (acre-ft/yr)		7,297,103		
Cost of O+M/R+R, profit and other costs, $	$	132,799,986	$	13,279,999
Unit cost of water at purchase ($/cubic meter)		0.07		
Total cost of water, $/year		630,000,000.00	$	63,000,000
Markup (water)		10%		
Water sale maerup, $/year (includes G&A)		63,000,000.00	$	6,300,000
Total delivered price of water, $/year		**1,356,999,930**	$	**135,699,993**
Unit price of water, delivered, $ / cubic meter		**0.1508**		
Unit price of water, delivered, $ / acre-ft		**185.98**		
For information only: Present Value Investment per Present Value Yield - 5-year construction period, 30-year project life, real discount rate of 2.5%, no salvage value, ($/acre-ft)		**63.99**		
Investment cost per yearly yield $/(acre-ft/year)		1191		

MCB CamPen -TRANSOCEANIC Project

ANSWER TO THE RFI FOR ENERGY AND WATER DEVELOPMENT OPPORTUNITY AT MARINE CORPS BASE CAMP PENDLETON

Rev: 1

TRANSOCEANIC LLC – USA
transoceanic.us

ANSWER TO THE RFI FOR ENERGY AND WATER DEVELOPMENT OPPORTUNITY AT

MARINE CORPS BASE CAMP PENDLETON

By TRANSOCEANC LLC – USA

1. Respondent Information

a. Name and brief description of company

TRANSOCEANIC LLC is a USA company registered in Wyoming, USA, that deals exclusively with the dissemination and implementation of the intellectual property pertaining to the TRANSOCEANIC massive fresh water transportation systems presented on the patent:

https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2021101684&_cid=P20-KQZEKZ-53399-1

TRANSOCEANIC LLC is 100% owned by Silviu Dorian Chelaru, a US citizen.

Contact details are: Silviu Dorian Chelaru, Owner/CEO, TRANSOCEANIC LLC – USA, https://transoceanic.us/ ; email: dorian@transoceanic.us ; phone: +1 213 340 4320

b. Capability and relevant experience

TRANSOCEANIC LLC is the applicant of the TRANSOCEANIC patent and presents a long-distance massive water transportation system proposition that can fully cover the water requirement for Southern California (especially for Los Angeles and San Diego areas) ensuring a low-cost water transfer with onshore transfer to and through MARINE CORPS BASE CAMP PENDLETON which has a strategic position for the water market in its extended area. Silviu Doran Chelaru is the inventor of the TRANSOCEANIC patent and has 45 years of experience in engineering.

c. Financial capacity to finance, develop, construct, own, operate and maintain the developed asset(s)

TRANSOCEANIC LLC will look to cooperation and sub-contracting with third parties to develop, construct, operate, and maintain the TRANSOCEANIC water transportation systems as well as to acquire, transport, supply, and sell the water to the final customers.

The proposed TRANSOCEANIC system has a value of US$2 billion and would supply water for industry, agriculture, and millions of people. The size and complexity of the project require a large group of cooperating entities to implement the proposed TRANSOCEANIC project, as will be defined at the RFP stage.

2. Proposed Project Details

a. Provide a descriptive summary of the nature and scope of a proposed project including the purpose, justification and qualifying criteria, design features, capacity and estimated total capital cost

The parameters of the proposed MARINE CORPS BASE CAMP PENDLETON – TRANSOCEANIC project (MCB CamPen -TRANSOCEANIC project) are shown in Appendix A.

The MARINE MCB-TRANSOCEANIC is designed to deliver large quantities of imported fresh water (2,5 billion tonnes – 2 million acre-ft - per year) to Southern California, after harvesting the water from the US (Columbia River and/or other sources) or South Mexico rivers, transferring it by TRANSOCEANIC submarines, and landing the water through at least one offshore pipeline connected through MCB Cam-Pen Base to the legacy or new (municipal) water networks, thus solving forever the water scarcity in the zone.

The quality of the delivered water should be conforming to the consumer requirements same and its cost should be lower than the cost of other prospective sources.

For the designed quantity of water to be delivered (2.5 billion tonnes per year, or 2 million acre-ft per year) MCB-TRANSOCEANIC project estimates a transportation cost of $100/AF ($0.08/per tonne) with a capital cost of $1.94 billion and a total delivered water value exceeding $200 million per year.

MCB CamPena and DON will be compensated as negotiated for the facilities used by the project and for the performed project work. In-kind compensation (free of charge water or agreed others) can also be considered for the DON/DOD installation in the project area.

b. Technology Description

i. Power and water systems components (or technology to be employed) as they relate to the project and its commercial feasibility

The MCB-TRANSOCEANIC proposed system consists of loading stations and transport submarines that are not located on the MCB Cam-Pen and a fixed offshore delivery station with a pipeline that is proposed to come on land onto the MCB Cam-Pen Del Mar Harbor .83 acre lot, where a pumping and processing station will be built (other MCB Cam-Pen locations for the pumping and processing station can be considered together with the base). The received water will be delivered through a dedicated underground pipeline which will be partially built on MCB Cam-Pen and that will be connected to the (municipal) water network(s) for the municipal customers and other diverse use.

ii. Technical pre-feasibility work completed to date (if any) and any analysis of alternatives

The MCB CamPen -TRANSOCEANIC project shown in Appendix A is just one of the project alternatives and proves the feasibility of the project. Other alternatives were analyzed for water deliveries from Alaska (Sitka Borough) or Southern Mexico (the Balsas River). Also, other TRANSOCEANIC projects for other locations are presented on the website https://transoceanic.us/#projects .

iii. If applicable, discuss why any technology to be used on the project is not now in general use and how the applicant intends to employ such technology. Compatibility of the intended technology with the current technology on the installation shall be discussed.

The TRANSOCEANIC submarines used in the MCB CamPen -TRANSOCEANIC project are the main part of the project and belong to a new disruptive technology designed to deliver 10 times more fresh water than the regular desalination plants at 10 times lower unit cost. The concept of rigid container marine transportation of fresh water has been studied and analyzed for almost 30 years, but the PCT patent (described above) for this concept has less than a year from its publication of May 2021.

Although large submarines are not usually hosted at MCB Cam-Pen, the DON is the best specialist in submarines and can help in the engineering and the deployment of the MCB CamPen -TRANSOCEANIC project, being also compensated for this effort.

Pipelines, connections, and pumps are regular technology, although their positioning and size can be demanding.

iv. Confirm that any technology or vendors to be used would meet national security requirements if submitted for review per Attachment 3

The MCB CamPen -TRANSOCEANIC project is a purely commercial project with no military or dual applications and meets the national security requirements as shown in Attachment 3 of the RFI.

As shown above at “1. Respondent Information”, TRANSOCEANIC LLC is a US entity and its owner is a US citizen. The USA has all the competencies to achieve the whole MCB CamPen -TRANSOCEANIC project with national personnel and entities and the water supplies can be restricted if required to US sources. Also, the TRANSOCEANIC submarines will stay a few miles ashore (never on MCB CamPen), due to their large draft, and are expected to be unmanned installations.

c. Market Environment

i. Current and upcoming market opportunities in detail to include specific demand for proposed assets (RFPs, existing contracts, etc.)

There are growing requirements and repeated deficits for fresh water in Southern California and especially in the already interconnected Los Angeles & San Diego areas. Some present deliveries of desalinated water in the area are done now at over $1.3 per tonne ($1500 per acre-ft). The population in the area is expected to slowly increase and the water deliveries to be more scarce. There are also possibilities to export water to NW Mexico (Tijuana area).

ii. Market absorption rates and competing projects

Although there is a clear need for new water in SW California and the market absorption would be immediate, there are no valuable projects to bring new water to the area, except by desalination, which is expensive, energy-intensive, and polluting. Some project evaluations of smaller refurbished/new desalination plants have been started in Southern California, but they meet resistance due to their costs, pollution, and other innate disadvantages.

iii. Market headroom for new projects

The MCB CamPen -TRANSOCEANIC project has a large headroom due to the much lower costs compared to any other technology to create new water for the area. The project delivers new water in larger quantities and at a smaller cost than desalination, water reuse, pipeline/canal remote water imports, atmospheric water generation, or any other technology.

iv. Range of expected product values (e.g., energy, capacity, ancillary services, water volume, etc.) and market pricing references.

The water transportation cost of the MCB CamPen -TRANSOCEANIC project is expected to be $0.08/tonne for the variant presented in Appendix A with the Columbia River as the source. To this cost, an equivalent value for at-the source cost and allowed profit will be added. It is expected that the total delivery price to be double the transportation cost, meaning $0.16/tonne ($200/acre-ft).

The expected price for the delivered water will be a negotiated price with the local water authorities, that have a regulated position on the market. After all payments for the construction, operation, and maintenance of the MCB CamPen -TRANSOCEANIC project, a small profit is expected to result. The profit obtained will also be influenced by governmental financing and the water price is expected to be regulated and lower than the free market one.

It is possible that for some large customers, the MCB CamPen -TRANSOCEANIC project to become just a transporter of water contracted by the buyers and/or sellers of water.

v. Potential economic benefits from the project that Western, regional entities, governmental agencies, or the project applicant may realize if the project achieves commercial operation

The potential economic benefits of the MCB CamPen -TRANSOCEANIC project for the region of SW California are huge. Southern California has a chronic imbalance resulting from the lack of available water in an environment with (i) a very large and educated population that has a high potential and living standard, and that needs a lot of facilities, including water, and (ii) with excellent weather and soil that allow the development of agriculture which also needs large quantities of water. Thus, any new low-price water will be welcome and highly useful for Southern California, and will also decrease the expensive water transfers from other basins like the Colorado River or Northern/Central California which also need more water.

d. Financing

i. Proposed approach and timeline for obtaining financing.

The main financing for the MCB-TRANSOCEANIC project is expected to be governmental. The financing will be coordinated with the timeline of the project and defined after the approval of its final configuration. The project can be implemented in phases so that it starts delivering water before its completion.

ii. Sources of funds to support the development plan

The governmental financing would consist of federal infrastructure funds and the State of California Funds. Some private funds would be accessed in the preparation of the project at the RFP stage and for the development phase of the project. PPP agreements – with at least partial private funding - might be possible but difficult to execute mainly due to the size and complexity of the MCB CamPen -TRANSOCEANIC project.

iii. Anticipated/ indicative financial model for development that the developer and stakeholders can use to track development milestones and costs to determine project impacts on risks, returns and the rate for the offtake revenue.

It is difficult to make a financial model for the development of the MCB CamPen -TRANSOCEANIC project at the stage of RFI. Any figures at this stage might be guesstimates that can change during the RFP and subsequent developments.

Of the expected investment of $1.94 billion, it is expected that 15-20% would be spent for studies and engineering permits and approvals, 30%-40% for production facilities and personnel preparation, and 40% - 55% would cover the materials/subassemblies, manufacturing, and quality control. The expected investment was estimated using a coefficient of correction (of 1.4) that has been introduced to cover some of the unknown variables of the MCB CamPen -TRANSOCEANIC project. During the project development, there will be milestones that will allow decisions on the modifications and continuation of the project. The project will generate a first article that will start delivering transported water before the project completion, and that will also allow for modification and continuation decisions on the project as required.

iv. Tax treatment of development on Federal property, and any benefits to be highlighted

Tax treatment is mainly a function of the future owner of the MCB CamPen -TRANSOCEANIC project and will be established at the RFP stage. If desired, DON with its high expertise in submarines, can be the owner of the project (without investing its own money) and have a specific tax treatment.

v. Parallel grants, incentives, other financial instruments (State and Federal, etc.) and their application to capital investment costs, operations & maintenance, etc.

As previously stated the MCB CamPen -TRANSOCEANIC project is intended to be financed mainly from State of California and Federal (infrastructure) funds. There will also be some financing from local districts (like Metropolitan Water District of Southern California, San Diego County Water Authority, or similar) and other interested third parties. Other specific instruments will be used during the later phases of project development, like future sales of water rights to neighboring territories when it is evident that the imported water will be available.

Bank loans and capital funds are also considered, as well as any other funds that are welcome.

vi. Estimated total cost and an estimated breakdown by cost category (resources and deliverables) for Project Development

The details of the MCB CamPen -TRANSOCEANIC project are presented in Appendix A. The investment is estimated at $1.94 billion. The majority of investment is allocated to the build of the 12 pcs transport submarines @ $138 million each. The loading and unloading terminals are also considered @ $138 each. A complexity factor of 1.4 was used for computing the capital costs and adjusting for any unknown expenditures.

The corrected net roundtrip cost as the sum of the cost of fuel for LNG diesel propulsion plus the TRANSOCEANIC submarine amortization and loading/unloading stations amortization for the trip period was considered.

A total cost of water transportation of $0.08/tonne ($100/AF) resulted after Operation/Maintenance and Repair/Replacement (O/M and R/R cost at 25% of the net transportation cost) were considered.

vii. Indicate whether any financiers to be used would meet national security requirements if submitted for review per Attachment 3

All financiers would meet the national security requirements of Attachment 3 of the RFI. Integral US financing is expected.

e. Site Considerations

i. Known constraints or concerns that will affect the opportunities at MCB CamPen. Suggest mitigations if available.

The proposed MCB CamPen -TRANSOCEANIC project will have minimal constraints affecting the MCB CamPen. The constructions required by the project include submerged/underground pipelines and a low-rise water pumping/processing building on Del Mar Harbor .83 acre lot which, being on the perimeter of the base, can have traffic and access separated from MCB CamPen. The pipeline(s) location will be chosen so that any inconvenience to the MCB CamPen will be minimized. There is no pollution generated by the operation of the MCB CamPen -TRANSOCEANIC project which will work with enclosed water and electrical energy. The personnel and material circulation required by the project on MCB CamPen is minimal. The construction phase will be performed with approved personnel with limited access to the area of project implementation. The submarines and offshore pipelines will be built remotely.

ii. Applicability of CEQA and California Coastal Commission regulations to the proposed project

The project will comply with the CEQA and California Coastal Commission regulations. There is no pollution or discharges from the project and the required approvals will be obtained for the final configuration of the project. The TRANSOCEANIC submarines are built to generate no discharge ballast water, and no discharge of any kind is expected. n case of accidents the only discharge is expected to be fresh water.

iii. Detailed listing and status of agreements, licenses, permits and approvals essential to the development of both business and technical project aspects (e.g., interconnection requests/ studies, NEPA, Lands and Right of Way, Commercial Off-take Agreements/ Letter of Intent, Authority Having Jurisdiction permits/ inspections)

The TRANSOCEANIC patent is already approved at the PCT phase and the US national phase is in process, TRANSOCEANIC LLC – USA being the applicant.

<u>TRANSOCEANIC LLC intends to negotiate and sell a non-exclusive license for the TRANSOCEANIC patent specific to the MCB TRANSOCEANIC project for any alternative entity that will be approved to achieve the project, or for any other configuration.</u>

There is no other agreement, licenses, permits, and approvals obtained at this phase of the MCB CamPen - TRANSOCEANIC project; they will be obtained at/after the RFP processing and establishing the project configuration.

iv. Development timeframe that would maximize the land opportunity. Discuss the factors that are used to determine that timeframe, and if applicable, note the drivers for an expedited time frame (e.g., tax incentives, zoning variances, etc.)

The development timeframe is given by the complex process of planning and implementing the MCB CamPen - TRANSOCEANIC project. It is expected that expedited approvals and good project management would expedite the implementation of the project. The assets of the MCB CamPan will be used when the unloading TRANSOCEANIC water station is built. Engineering and preliminary approvals are required. It is expected that the land opportunity will be maximized by the massive import of water to the SW California area.

v. Summary of project milestones on the critical path that will determine the earliest completion time of the project

The project milestones on the critical path are (i) the studies and engineering and critical approvals and permits, (ii) the submarine manufacturing facilities preparation, (iii) the manufacturing of the first article submarine and its certification and manufacturing of the loading and unloading stations, (iv) finalizing the manufacturing of all the TRANSOCEANIC submarines of the project. Other activities will be performed in parallel but they are not on the critical path, as the contracting of water and getting some of the permits and approvals for the MCB CamPen - TRANSOCEANIC project. Detailed project milestones and critical path reports will be presented with the response to the future RFP.

vi. Lifetime of the development and expected performance trends across the project lifetime.

The development of the MCB CamPen -TRANSOCEANIC project is expected to achieve the first article and the loading/unloading stations in five years from the date of contracting and to be finalized in 10 years. The delivered quantities of water will increase proportionally with the increase in the number of TRANSOCEANIC submarines. The life of the project is expected to be a minimum of 25 years and it is expected that the submarine structure and pipelines to have an extended use by refurbishment. The end-of-life/disposal procedures will be non-polluting and can increase the marine habitat as shown on the TRANSOCEANIC patent; the majority of the materials on the TRANSOCEANIC submarines and pipelines are reusable.

vii. Operations and Maintenance (O&M) Plan essential to provide planning, execution and implementation activities that impart consistency across and within Federal and utility jurisdictions

Operation/maintenance and repair/replacement were considered at 25% of the net costs of water transportation as shown in Appendix A. These activities will be coordinated with the Federal and utility jurisdictions so that there are minimal disturbances upon the project implementation sites, deliveries, customers, and interfaces.

viii. If applicable, provide examples of real-world projects/case studies that demonstrate proposed development concepts will be viable.

Some other proposed projects are shown on the website https://transoceanic.us/#projects ; they show the low cost of water transportation compared with other means of obtaining water for arid areas.

f. Lease Payment and In-Kind Consideration

i. The size and capacity of the development that maximize both the potential value of the land interest and the In-Kind benefits to MCB CamPen

The total investment for the MCB CamPen -TRANSOCEANIC project is $1.94 billion of which the unloading station at MCB CamPen is allocated $138 million. Part of the value of land usage is covered by this investment amount. The leasing or any other operational costs will be paid from the O&M and Repaid and Replacement (R&R) costs which are expected to be $41 million/year.

ii. Describe any innovative and/or new conceptual ideas and technologies for use in IKC in lieu of lease payments

Instead of lease payments, the project can agree to transfer MCB CamPen a part of the profits resulting from the project's sale of water.

Also, TRANSOCEANIC LLC can transfer specific intellectual property rights to DON and invite it in partnerships for other TRANSOCEANIC projects, taking into account the extensive submarine capabilities that the DON has.

iii. Discuss any potential for revenue sharing, and any legal elements to be considered

There are many possibilities of revenue sharing for MCB CamPen including (i) participation in profit sharing, (ii) DON being invited in partnerships for other TRANSOCEANIC developments,

iv. If applicable, discuss the IKC project development timeline along with any external factors influencing the project's success

The In-Kind Compensation can be started immediately for partnership with DON and transfer of specific intellectual property rights. Many external factors are influencing the project success, like (i) defining the engineering and specific offer we can make for the project, (iii) contracts for the source of water and sales, (ii) financing, (iiii) approvals; (v) implementation and deployment to the planned scale; (vi) long term, continuous operation of this very large system. All these factors will be thoroughly analyzed and evaluated at the RFP time.

v. Outline other risks and opportunities, including impacts to the MCB CamPen mission, and any other information helpful to the DON to formulate a strategy for the land opportunity

The basic MCB CamPen mission is not affected. The impact of the TRANSOCEANIC project on the base is very low and the project operation is insulated from the base.

The MCB CamPen -TRANSOCEANIC project offers MCB CamPen and DON extensive capabilities to develop TRANSOCEANIC systems in the USA and the world, helping the USA develop a commercial water diplomacy arm.

vi. Discuss the benefits of the proposed asset for the installation

With minimal interference, the MCB CamPen can get the desired revenue and become a model of low-cost innovative water resources for Southern California and for many other new TRANSOCEANIC projects in other markets.

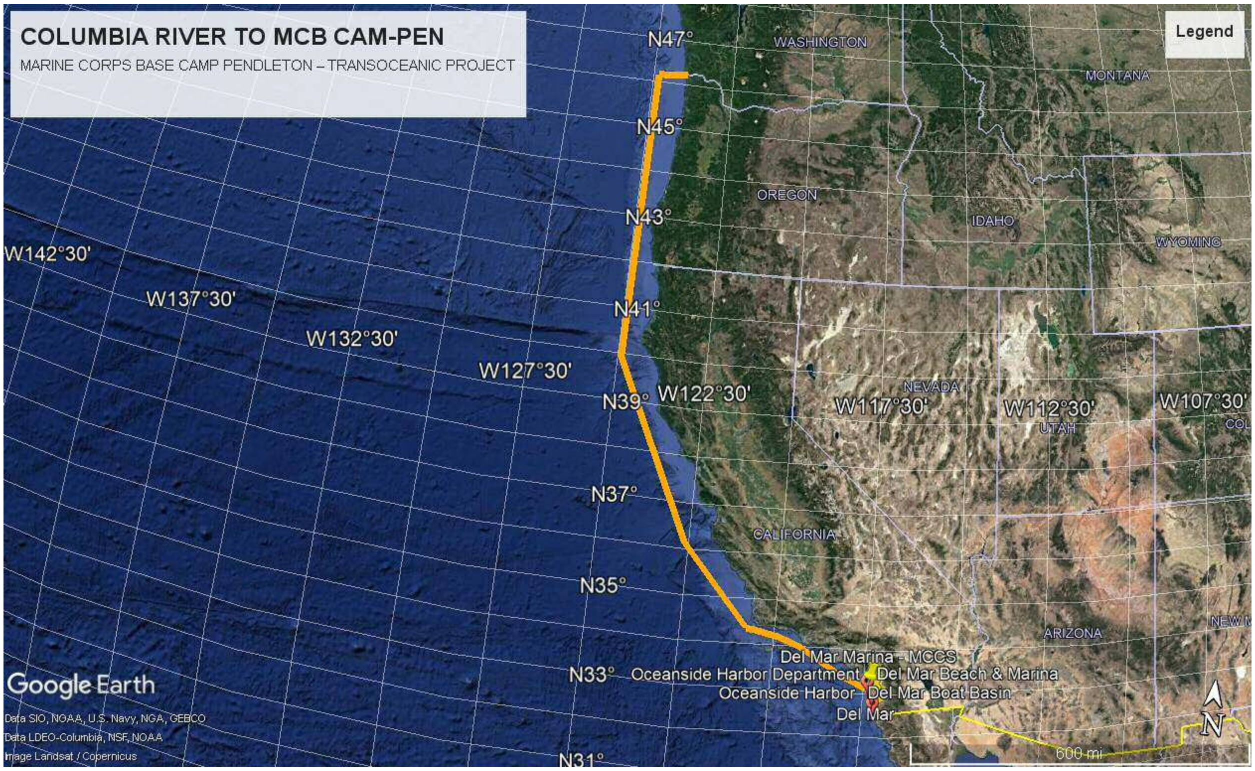
1. **Would the proposed development be integrated with existing installation infrastructure? If so, how?**

The MCB CamPen -TRANSOCEANIC project can use some of the existing infrastructures like electrical networks, roads, and public data networks.
There is a strong synergy between the TRANSOCEANIC disruptive technology of massive water transportation and the DON expertise in submarines and complex system integration.

2. **Provide market analysis study that will evaluate the impact of the development**

The water in the area of the project implementation (California) tends to become a commodity. The quotations are available on:
https://www.nasdaq.com/solutions/nasdaq-veles-water-index and
https://www.nasdaq.com/market-activity/index/nqh2o
the present value being about $700/acre-ft.
It is important to discuss the specific TRANSOCEANIC project(s) with the appropriate water districts in the region (like MWDSC and SDCWA) when answering the future RFP.
Coordination with other TRANSOCEANIC water projects in the SW USA and NW Mexico is advisable.

APPENDIX A
MCB CamPen -TRANSOCEANIC Project
Routing, Design, Performance, and Financial Details



Summary Data:

Water Source: Columbia River, USA
Destination: MCB CamPen, California, USA
Distance from Source to Destination: 1830 km (1137 miles)
Submarine Dimensions: Length 840 meters (2756 ft), Diameter 120 meters (394 ft)
Submarine Volume: 9 500 000 m^3 (7700 AF)
Number of Submarines for MCB CamPen -TRANSOCEANIC Project: 12
Cruise speed: 3.4 m/s (6.61 knots)
Installed Power: 31 MW
Water Transported: 2 500 000 000 m^3/year (2 027 000 AF/year)
Water Transportation Cost (@25 year submarine life): $0.0817/ m^3 ($101/AF)
Cost of MCB CamPen -TRANSOCEANIC project: $1.94 billion

Note 1 : For Rev 1 - Correction of Installed Power was done from 31 GW to 31 MW

MARINE CORPS BASE CAMP PENDLETON – TRANSOCEANIC PROJECT
(Interactive file - inputs in green cells)

Supply station	**Columbia River**
Delivery station	**MCB CamPen, CA**
Distance, one way, km	**1830**

CONSTANTS AND TRANSFORMATIONS	
acre ft in cubic meters	1233.48
ft in meters	0.3048
Sea water density (kg/cubic meter)	1028
Pi value	3.14159
mile is -- km	1.60934

SUBMERSIBLE TRANSPORTER GEOMETRY	
Radius, meters	60
Radius, ft	197
L/(2R) RATIO	7
Equivalent submersible length, m	840
Submersible Section, square meters	11310
Submersible surface (cylinder, considered closed by hemispheres)	361911
volume (cylindrical length), cubic meters	9,500,168
volume, acre-ft	7701.92

BALLASTING	
Relative density of concrete	2.4
ballasting required (on cylindrical part), kg/square meters	840
thickness of concrete wall, m	0.612
Volume of concrete required, cubic meters	221578
Volume of concrete required, cubic yards	289813
Weight of concrete structure, metric tonnes	531788
Chamber thickness, meters	0.84
Total hull thickeness, meters	1.45

STRESSES	
Max tangent force, Newton/linear meter	1,483,272
meter	151.200

HYDRODYNAMICS	
cx (drag coefficient)	0.08
speed v, m/s	3.4
speed km/h	12.24
Drag force, Newton	5,376,046
Drag force, metric tonne force	548.02
Power required for cruising (w)	18,278,555
Power for cruising, Mw	18.279

POWER AND ENGINE	
Hydrodynamic efficiency	0.7
Required Engine power, Mw	26.112
Engine reserve, %	20%
Total Engine Installed Power, Mw	31.335

FIXED COSTS

SUBMERSIBLE COSTS		
Unit Concrete price, $/cubic meter		70.00
Unit cost of armature, $/cubic meter		60.00
Unit cost of work, $/cubic meter		120.00
Total unit price of concrete, $/cubic meter		250.00
Cost of concrete for submersible, $	$	55,394,567
PROPULSOR COSTS		
Cost of propulsion $/Mw		500,000
Total cost of propulsion	$	15,667,333
INSTRUMENTATION, COMMAND AND CONTROL (ICC)+OTHER ITEMS		
Cost of ICC, BAGS, OTHER STRUCTURES (AT 50% OF CONCRETE COST)	$	27,697,283
Complexity Factor		1.4
Total cost of one submersible	**$**	**138,262,856**

VARIABLE COSTS (FUEL)

FUEL COST PER HOUR	
Fuel Consumption, kg/kWh	0.165
Fuel cost (LNG), $/kg	0.2207
Cost of fuel per hour (at required power) $/hour	951

TRIP COMPUTATION

Supply station		**Columbia River**
Delivery station		**MCB CamPen, CA**
Distance, one way, km		**1830**
Distance, one way, miles		1137
Stationing, days at each station		2
Cruise time, round trip, hours		299.02
Cruise time, round trip, days		12.46
Total travel time, hours		395
Total travel time, days		16.46
Fuel cost per trip (stationary at half consumption per hour), $	$	329,977
Submersible life (years)		25
Amortization of submersible (25 year life) $/hour		736.56
Cost of submersible per trip	$	290,956
Net cost per trip (submersible+fuel)	$	620,933
Cost of O+M/R+R, profit and other costs (% of net cost)		25%
Brut cost per trip, $	$	776,166
Brut transport cost $/acre-ft		**100.78**
Brut transport cost $/cu meter		**0.0817**

TRANSPORTATION SYSTEM CONFIGURATION AND COST		**PARAMETERS**	
Transported water, million cubic meter / year	2,500	Investment cost per yearly yield ($/(acre-ft/yea	955
Transported water, acre-ft per year	**2,026,786**	Transportation pressure drop equivalent, mete	211
Transporter capability per boat, trips/year	22.176	Transportation pressure drop equivalent, ft	693
Transporter capability per boat, mil cubic m/year	210.68		
Transporter capability per boat, acre-ft/year	170,799	Water flow at stations for continuous filling/emptying, cubic m/sec	79.27
Required number of submersible boats	**12**	Transportation system capability (acre-ft/yr)	2,049,585
Cost of transporters (boats)	**$ 1,659,154,271**		
		Cost of O+M/R+R, profit and other costs, $/yea	40,850,134
Cost of two teminal stations (each equal to one submersible transporter cost)	**$ 276,525,712**	Unit cost of water at source ($/cubic meter)	0
Total cost of transportation system	**$ 1,935,679,983**	Total cost of water, $/year	-
		Markup (water)	0%
		Water sale profit, $/year (includes G&A)	-
		Total delivered price of water, $/year	**204,250,669.65**
		Unit price of water, delivered, $ / cubic meter	**0.0817**
		Unit price of water, delivered, $ / acre-ft	**100.78**
		Present Value Investment per Present Value Yield - 5-year construction period, 25-year project life, real discount rate of 2.43%, no salvage value, ($/acre-ft)	**57.88**
		($/cubic meter)	**0.047**