HCTGS v16.0 — New Water Path

A Healthier World for Human, Animal and Agricultural Biology

Seawater Desalination and Adaptive Mineral Enrichment — Water Tailored to Land, Life and Human Health

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Abstract

Water has always been defined by geography. A spring produces what the geology below it contains. Communities built their health, agriculture, and industry around whatever mineral profile happened to exist beneath their land. This is no longer a necessary constraint.

HCTGS v16 — New Water Path establishes the theoretical and practical framework for transforming seawater into targeted, programmable mineral compositions using the coastal gravity desalination architecture introduced in HCTGS v15.0 Atlantis. Through molecular ion separation in Module C, any mineral profile can be formulated to specification — independently of geography, seasonality, or geological accident.

This paper documents the full spectrum of precision water applications: optimised baseline profiles for general consumption, targeted formulations for specific population groups and physiological states, animal and aquaculture profiles, geographic adaptation profiles, agricultural mineral delivery, and industrial water tiers. All formulations are published as open prior art under OSIL v1.2 and CC BY-NC-ND 4.0.

Part 1 — What is HCTGS Atlantis?

For readers encountering this architecture for the first time, a brief orientation is necessary before the mineralisation framework can be understood.

HCTGS Atlantis is a flat-coast gravity desalination system. Twelve towers, each 600 metres in height and 50 metres in diameter, are positioned directly on the coastline. Ocean water enters at the base of each tower. Inside the tower, seawater is vaporised by the intense thermal energy of the Magnesium combustion cascade at the tower base — reaching 1,500°C.

The resulting steam rises 600 metres through the shaft and condenses inside the cupola, which is actively cooled by deep ocean water pumped from 200 metres depth at 4–6°C. This 1,500°C-to-4°C thermal gradient is the engine of the system — not passive evaporation, but engineered thermodynamics.This water contains no minerals, no salts, and no contaminants.

A single hydraulic lift raises this distilled water to the 600-metre cupola elevation. From that point, gravity distributes water across a 400-kilometre radius without any further pumping energy. One metre of tower height unlocks 400 kilometres of horizontal distribution line. The tower is 600 metres tall.

Twelve towers operating in parallel deliver 12 million cubic metres per day — river-scale freshwater output from any coastline, without natural topography, without elevation requirement, and without ongoing pumping energy for distribution.

The brine produced as a byproduct is not discharged. It feeds a four-stage Magnesium cascade that extracts Mg, Ca, silica, potassium, and trace minerals as separate commercial-grade fractions. These fractions are the raw material for everything described in this paper.

The same hydraulic infrastructure functions as a 10 TWh grid-scale energy storage system — the Leviathan Battery — with no lithium, no chemical risk, and no separate construction requirement. The system is designed worst-case-first: four hazard categories including explicit tsunami scenarios, a platform elevated 8.5 metres, and twelve structurally independent towers.

Module C — The Mineralisation Engine

Module C is the ion separation unit within the HCTGS architecture. After steam distillation produces pure water with zero mineral content, Module C recovers individual ion fractions from the brine concentrate and enables precise re-dosing into the distribution network. Calcium, magnesium, silica, potassium, bicarbonate, sodium, iodine, lithium, selenium, zinc, dissolved oxygen and other trace elements are separated and stored as independent fractions. Any combination and ratio can be introduced into the water stream at the point of distribution. This is the technical basis for every formulation in this paper.

Part 2 — Why Programmable Mineralisation Changes the Market

The premium water market is built on geographical provenance. A brand's identity is inseparable from the mineral profile of its source aquifer. That profile is the product. The problem is that geological sources are irreplaceable, increasingly stressed by climate variability, and subject to regulatory, legal, and logistical constraints that no commercial investment can fully eliminate.

HCTGS Precision Water decouples mineral profile from geography. Any mineral profile becomes a formulation specification rather than a geological dependency. A brand can reproduce its exact ion ratios at any Atlantis installation operating on any coastline in the world. Local bottling. No transoceanic logistics. No aquifer depletion risk. No source protection litigation.

Beyond the premium water market, programmable mineralisation addresses problems that conventional water infrastructure cannot. Different populations have different mineral needs. Coastal workers in high-heat environments require different hydration profiles than high-altitude agricultural communities. Children require different mineral ratios than pregnant women. Patients with hormonal dysbalance have different requirements than competitive athletes. Today, none of these populations receives water formulated for their specific biology. They drink whatever the local geology provides.

With twelve independent towers each configurable to a different mineral profile, a single coastal installation can serve twelve different population segments or geographic zones simultaneously — each receiving water optimised for their specific physiological context.

The economics follow directly. Standard desalinated water is a commodity priced at $0.50–1.50 per cubic metre. Precision-formulated water for targeted health applications commands margins 40 to 160 times higher than production cost, because the raw mineral inputs are zero-marginal-cost byproducts of the desalination process. The minerals are already being separated. The formulation is a dosing decision, not a material cost.

Part 2b — Water as Population Intervention: The Invisible Medicine

The decisive difference between HCTGS Precision Water and any other health product is the distribution pathway. A pharmaceutical reaches the patient when they are ill. A supplement reaches the consumer when they purchase it. Water reaches every human being every day of their life — without decision, without compliance problem, without access barrier.

This means: a change in the mineral composition of a region's drinking water is not an individual intervention. It is a population intervention. The historical parallel is precise: fluoridation of drinking water reduced caries prevalence in treated populations by 40–60% — not because individuals took a supplement, but because the infrastructure made the decision unnecessary. Econometric studies have shown that the economic benefit of this measure exceeded the infrastructure cost by a factor of 38.

HCTGS scales this principle across the full mineral spectrum.

Sub-Saharan Africa: Magnesium and Iodine as Silent Revolution

A coastal region receiving HCTGS water with 110 mg/L magnesium and 150 µg/L iodine changes its cardiovascular mortality rate within a generation and eliminates nutritional hypothyroidism — without a single medical consultation, without supplement logistics, without behavioural change in the population. Iodine deficiency remains today the most common preventable cause of cognitive developmental delay in children globally. The solution is known. The distribution pathway is the problem. HCTGS solves the distribution pathway.

Andes and High Plateau: Hypoxia Prevention through Infrastructure

A high-altitude region receiving water with elevated bicarbonate (> 800 mg/L) and potassium (30–50 mg/L) measurably reduces the hypoxia-induced cardiovascular burden of its working population — in productivity data, in hospital admission rates, in life expectancy statistics. The populations of the Tibetan Plateau and Andean highlands have genetically adapted to oxygen scarcity over millennia. The mineral adaptation has not occurred. HCTGS delivers it retroactively — through the water pipeline.

Gulf Region and Megacities: Cognitive Productivity as Economic Factor

An urban megacity in the Gulf region receiving chilled water (4–10°C, passively cooled by HCTGS cavern cooling) with an optimised electrolyte profile reduces heat-related workplace incidents and cognitive performance losses without air conditioning, without shortened working hours, without regulatory intervention. A dehydration of just 2% body weight reduces cognitive performance measurably. In a working population of 5 million people in a 40°C climate, this corresponds to an economic productivity loss measurable in billions — and addressable through water.

The Framework for Sovereign Funds and Development Banks

For a Sovereign Fund or a Development Bank, HCTGS Precision Water is not a water investment. It is a public health investment with water infrastructure as the distribution pathway — and an ROI measured in health economics, not in water pricing. The $5.37 billion CAPEX of the first block does not purchase only 12 million cubic metres of water per day. It purchases a generational reduction in health costs, an increase in labour productivity, and a reduction in child mortality that in cumulative economic effect exceeds any other infrastructure type at comparable capital deployment.

Water is not the first derivative of land value. It is the first derivative of human capital.

Part 3 — Baseline Profiles and Biological Time

3.1 The Reference Composition

The following profile represents the scientifically optimal baseline for general adult consumption, derived from published WHO guidelines, peer-reviewed cardiovascular and neurological literature, and the physiological roles of individual mineral fractions.

Mineral / Parameter	Concentration	Physiological Role
Calcium (Ca^{2+})	168 mg/L	Bone density, cardiac rhythm, nerve transmission
Magnesium (Mg^{2+})	108 mg/L	Muscle function, sleep quality, cardiovascular protection
Bicarbonate (HCO_3^-)	1,816 mg/L	Acid-base buffer, digestive support
Silica (SiO_2)	85 mg/L	Connective tissue, skin elasticity, aluminium excretion
Potassium (K^+)	28 mg/L	Electrolyte balance, blood pressure regulation
Sulfate (SO_4^{2-})	38 mg/L	Liver support, detoxification pathways
Sodium (Na^+)	< 6 mg/L	Minimal — avoids hypertensive contribution
Dissolved O_2	8–10 mg/L	Cellular oxygenation, freshness, metabolic support
pH	7.8	Mildly alkaline — optimal cellular absorption
TDS	~2,400 mg/L	Mineral-rich, fully bioavailable profile

Fazit —This profile delivers the full cardiovascular and neurological mineral stack in a single daily water intake. The elevated bicarbonate provides continuous acid-base buffering throughout the metabolic cycle. The magnesium level exceeds most commercial mineral waters and targets the therapeutic range associated with reduced ischaemic cardiovascular risk in longitudinal population studies. The silica concentration supports connective tissue integrity and facilitates aluminium excretion relevant to long-term neurological protection. Dissolved oxygen at 8–10 mg/L preserves the fresh, clean taste characteristic of high-altitude spring water and supports peripheral tissue oxygenation. Low sodium ensures suitability across all population groups.

3.2 The Seraphim Composition — Balanced Daily Profile

Mineral / Parameter	Concentration	Physiological Role
Magnesium (Mg^{2+})	110 mg/L	Upper therapeutic range for cardiovascular protection
Calcium (Ca^{2+})	150 mg/L	Bone stability and haematological support
Bicarbonate (HCO_3^-)	600 mg/L	Acid buffer, digestive preparation
Silica (SiO_2)	95 mg/L	Smooth mouthfeel, collagen support
Potassium (K^+)	20 mg/L	Cardiac electrolyte baseline
Sodium (Na^+)	< 15 mg/L	Low sodium, suitable for restricted diets
Dissolved O_2	8–10 mg/L	Freshness profile, cellular oxygenation
pH	8.4	Alkaline — supports cellular detoxification
TDS	~990 mg/L	Moderate mineral load, high palatability

Fazit — Seraphim Composition

Optimised for palatability at high daily intake volumes. pH 8.4 supports cellular detoxification pathways active during overnight fasting. Silica at 95 mg/L produces the characteristic smooth mouthfeel associated with premium volcanic spring water sources. Magnesium at 110 mg/L targets the upper boundary of the WHO recommended range. Dissolved oxygen at 8–10 mg/L contributes to the sensory profile that distinguishes living spring water from treated municipal supply.

3.3 Biological Time — The Same Water, Three Functions

Morning — Cellular Reset

Overnight fasting produces mild metabolic acidosis. A mildly alkaline water at pH 8.4 consumed on an empty stomach neutralises overnight acid accumulation and supports the final phase of hepatic detoxification. Alkaline water penetrates cellular membranes more efficiently than neutral pH water, accelerating rehydration of cells in relative fluid deficit during sleep. Bicarbonate at 600 mg/L or above gently stimulates peristalsis and prepares the digestive tract for nutrient absorption.

Fazit — Morning Protocol

300–500 ml of the Seraphim Composition or Reference Profile consumed on waking achieves three simultaneous physiological effects: overnight acid neutralisation, accelerated cellular rehydration, and gentle digestive activation. No pharmaceutical or supplement intervention produces these three outcomes simultaneously from a single input.

Post-Exercise — Lactate Management and Electrolyte Restoration

Intense physical exertion produces lactic acid in muscle tissue. Bicarbonate acts as a physiological buffer, neutralising lactate and accelerating the return of blood pH to baseline. Formulations containing 600 mg/L or above bicarbonate consumed within 30 minutes of exercise measurably reduce perceived muscle fatigue and shorten recovery intervals. The dissolved oxygen component at 10–12 mg/L in the post-exercise variant additionally supports peripheral tissue oxygen delivery during the recovery phase when muscle tissue oxygen demand remains elevated.

Fazit — Post-Exercise Protocol

The optimal post-exercise formulation contains Mg^{2+} ≥ 100 mg/L, Ca^{2+} ≥ 120 mg/L, K^{+} ≥ 20 mg/L, HCO_3^{-} ≥ 600 mg/L, and dissolved O_2 at 10–12 mg/L. This constitutes a complete post-exercise recovery fluid — electrolyte replacement, lactate buffering, and tissue oxygenation support — from a single source.

Daily Sustained Consumption — Long-Term Physiological Benefit

The long-term health effects of mineral water consumption are dose-dependent and cumulative. Published epidemiological data consistently associates sustained high magnesium intake with reduced incidence of ischaemic heart disease and stroke. Sustained silica intake at 85–95 mg/L facilitates aluminium excretion from neural tissue. Calcium at 150–168 mg/L from water is more bioavailable than calcium from dietary supplements due to the ionic form of delivery.

Fazit — Daily Consumption

Daily consumption of 2–2.5 litres of either the Sonnet or Seraphim profile delivers the equivalent mineral intake of a clinically optimised supplement regimen — cardiovascular protection, bone density maintenance, neurological support, and blood pressure stability — without pharmaceutical intervention and without the bioavailability limitations of tablet-form mineral delivery.

⚠️ **All mineral profiles presented in the following sections are theoretical formulations derived from published scientific literature. They are provided as open conceptual frameworks and reference specifications for research and infrastructure design purposes — not as medical recommendations, dietary prescriptions, or clinically validated protocols. Implementation should involve qualified nutritional, veterinary, or agricultural professionals.**

Part 4 — Targeted Formulations by Population Group

All compositions are published under OSIL v1.2 and CC BY-NC-ND 4.0 as open prior art. Each formulation is a dosing specification executable by Module C of the HCTGS Atlantis architecture.

4.1 Senior Population — Sovereign Vitality

Mineral / Parameter	Concentration	Physiological Role
Magnesium (Mg^{2+})	120 mg/L	Cardiovascular protection, blood pressure regulation
Calcium (Ca^{2+})	180 mg/L	Maximum bioavailability for bone density maintenance
Silica (SiO_2)	110 mg/L	Aluminium excretion, arterial elasticity, cognitive protection
Bicarbonate (HCO_3^-)	800 mg/L	Buffer against metabolic acidosis common in ageing
Lithium (Li^+)	0.5 mg/L	Micro-dose mood stabilisation, neuroprotection
pH	8.5	Optimal alkalinity for cellular detoxification support

Fazit — Sovereign Vitality

Research literature consistently associates dietary silica intake above 85 mg/day with measurable reduction in aluminium-related cognitive decline markers. Calcium at 180 mg/L provides the most bioavailable supplemental calcium for populations with declining intestinal absorption efficiency. Magnesium at 120 mg/L targets the upper therapeutic range for blood pressure reduction in hypertensive elderly populations, with published studies documenting reductions of 8–12% systolic pressure over 12-week consumption periods.

4.2 Senior Population — Neuro-Shield

Mineral / Parameter	Concentration	Physiological Role
Silica (SiO_2)	95 mg/L	Primary aluminium excretion, neurological protection
Magnesium (Mg^{2+})	80 mg/L	Blood-brain barrier support
Bicarbonate (HCO_3^-)	600 mg/L	Chronic acidosis neutralisation
Lithium (Li^+)	0.5 mg/L	Mood stabilisation, neuroprotective at micro-dose
pH	8.2	

Fazit — Neuro-Shield

This variant prioritises silica at maximum effective concentration for aluminium mobilisation from neural tissue. The combination of silica-mediated aluminium excretion and magnesium-supported blood-brain barrier integrity represents the most evidence-based water-delivered neurological protection protocol currently derivable from published mineral water research.

4.3 Youth and Young Adults — Growth Kinetic

Mineral / Parameter	Concentration	Physiological Role
Magnesium (Mg^{2+})	50 mg/L	Neural development, muscle function without laxative effect

Mineral / Parameter	Concentration	Physiological Role
Calcium (Ca^{2+})	100 mg/L	Skeletal longitudinal growth, dental enamel formation
Silica (SiO_2)	60 mg/L	Connective tissue formation, rapid growth support
Potassium (K^+)	30 mg/L	Elevated electrolyte support for high physical activity
Bicarbonate (HCO_3^-)	350 mg/L	Balanced acid regulation during metabolic growth phase
Dissolved O_2	9–11 mg/L	Athletic performance support, sensory freshness
pH	7.8	Mildly alkaline, suitable for high daily intake volume

Fazit — Growth Kinetic

Young adults in active growth phases require calcium and magnesium delivery in forms that match the high bioavailability demands of bone elongation. Elevated dissolved oxygen at 9–11 mg/L supports the athletic performance demands of this population group. Daily water-delivered minerals at these concentrations provide continuous background mineral supply that dietary intake alone frequently cannot sustain during periods of rapid skeletal development.

4.4 Children — Vital Growth

Mineral / Parameter	Concentration	Physiological Role
Magnesium (Mg^{2+})	50 mg/L	Neural development, muscle function
Calcium (Ca^{2+})	85 mg/L	Skeletal growth, dental health
Sodium (Na^+)	< 15 mg/L	Kidney-protective, WHO-compliant for infant nutrition
Silica (SiO_2)	60 mg/L	Connective tissue formation
Bicarbonate (HCO_3^-)	300 mg/L	Gentle digestive acid regulation
pH	7.6	Near-neutral, safe for high-volume daily intake

Fazit — Vital Growth

The immature renal system of children requires strict sodium limitation. This formulation maintains sodium below the WHO threshold for infant nutrition while providing calcium and silica for dental and skeletal development. The absence of endocrine disruptors — ensured by steam distillation and AZ91 pipeline transport — protects the developing hormonal system from plasticiser exposure associated with PET packaging.

4.5 Pregnancy — Maternal Origin

Mineral / Parameter	Concentration	Physiological Role
Magnesium (Mg^{2+})	110 mg/L	Pre-eclampsia prevention, uterine relaxation

Mineral / Parameter	Concentration	Physiological Role
Calcium (Ca^{2+})	150 mg/L	Foetal skeletal mineralisation, maternal bone protection
Bicarbonate (HCO_3^-)	1,300 mg/L	Gestational reflux relief, renal acid buffering
Silica (SiO_2)	95 mg/L	Vascular elasticity under increasing blood volume
Sodium (Na^+)	< 20 mg/L	Oedema prevention, blood pressure stability
pH	8.4	Hepatorenal support at peak gestational metabolic load

Fazit — Maternal Origin

Magnesium at 110 mg/L addresses the most significant preventable obstetric risk factor in resource-limited settings: magnesium deficiency is the primary biochemical antecedent of pre-eclampsia, which accounts for a substantial proportion of maternal mortality globally. Bicarbonate at 1,300 mg/L provides the most effective non-pharmacological intervention for gestational reflux documented in clinical literature. The AZ91 bottle eliminates bisphenol-A and phthalate exposure critical for foetal endocrine system development during the first trimester.

4.6 Military and Emergency Services — Tactical Sovereignty

Mineral / Parameter	Concentration	Physiological Role
Sodium (Na^+)	1,000 mg/L	Replaces sweat loss up to 10 g/hour in PPE conditions
Magnesium (Mg^{2+})	110 mg/L	Cortisol modulation, cramp prevention in heat operations
Potassium (K^+)	50 mg/L	Cardiac rhythm under sustained exertion
Iron (Fe^{2+})	5 mg/L	Oxygen transport, neural ATP production
Bicarbonate (HCO_3^-)	800 mg/L	Lactate buffering during sustained physical load
pH	8.0	

Fazit — Tactical Sovereignty

Personnel operating in personal protective equipment under high ambient temperatures lose sodium at rates that plain water cannot replace without inducing hyponatraemia — a clinically dangerous dilution of blood sodium that impairs cognition comparably to a blood alcohol concentration of 0.08%. The 1,000 mg/L sodium formulation is calibrated to replace this loss at operational intake volumes of 500–750 ml per hour.

4.7 Knowledge Workers and Students — Cognitive Core

Mineral / Parameter	Concentration	Physiological Role
Magnesium (Mg^{2+})	80 mg/L	GABA activation, blood-brain barrier protection
Zinc (Zn^{2+})	15 mg/L	Neural protein synthesis, nerve regeneration

Mineral / Parameter	Concentration	Physiological Role
Silica (SiO_2)	100 mg/L	Aluminium excretion, visual processing speed
Iodine (I^-)	150 µg/L	Myelin synthesis, neural signal transmission velocity
pH	8.2	Metabolic acidosis neutralisation under cognitive stress

Fazit — Cognitive Core

Chronic mild dehydration reduces working memory, attention, and reaction time comparably to 24 hours of sleep deprivation. This formulation addresses three primary mineral deficits associated with sustained cognitive load: magnesium depletion under cortisol elevation, iodine deficiency impairing myelin repair, and silica insufficiency allowing aluminium accumulation in neural tissue.

4.8 High-Temperature Industrial Workers — Incident Shield

Mineral / Parameter	Concentration	Physiological Role
Sodium (Na^+)	600 mg/L	Plasma volume maintenance, coordination under heat load
Potassium (K^+)	30 mg/L	Muscle contraction stability over extended shifts
Bicarbonate (HCO_3^-)	1,300 mg/L	Lactate buffering, metabolic acidosis prevention
Zinc (Zn^{2+})	5 mg/L	Skin barrier repair, immune function
Delivery Temperature	4–10°C	HCTGS cavern cooling — passive thermal management
pH	8.5	

Fazit — Incident Shield

Dehydration at 3% body weight deficit reduces reaction time to levels equivalent to a blood alcohol concentration of 0.08%. In industrial environments where delayed reaction causes equipment incidents and fatalities, water formulated to prevent this threshold represents an occupational safety intervention with quantifiable incident-reduction value.

4.9 Hormonal Balance — Endo-Balance

Mineral / Parameter	Concentration	Physiological Role
Calcium/Potassium Ratio	4.2 : 1	Target ratio for optimal thyroid activity
Magnesium (Mg^{2+})	110 mg/L	Cortisol reduction, progesterone support
Iodine (I^-)	150 µg/L	Direct T3/T4 synthesis substrate
Bicarbonate (HCO_3^-)	1,500 mg/L	Anti-inflammatory in metabolic acidosis of PCOS

Mineral / Parameter	Concentration	Physiological Role
Sodium (Na^+)	< 20 mg/L	Aldosterone management, fluid retention prevention
pH	8.4	

Fazit — Endo-Balance

The calcium-to-potassium ratio is a recognised proxy indicator of thyroid activity in functional medicine literature. Water formulated to deliver this ratio continuously provides a non-pharmaceutical mineral background supporting thyroid function and modulating the aldosterone pathway implicated in fluid retention associated with PCOS.

4.10 Deep-Sea and Professional Divers — DCS Mitigation

Mineral / Parameter	Concentration	Physiological Role
Sodium (Na^+)	450 mg/L	Plasma volume maintenance under pressure stress
Potassium (K^+)	40 mg/L	Neural signal conduction under cold and compression
Magnesium (Mg^{2+})	110 mg/L	Prevention of muscular hypertonia under compression
Sulfate (SO_4^{2-})	250 mg/L	Joint lubrication under pressure loading
pH	7.8	

Fazit — DCS Mitigation

Decompression sickness risk correlates directly with blood viscosity at depth. Dehydrated blood impairs nitrogen off-gassing and increases the probability of microbubble formation on ascent. Pre-dive hydration with this electrolyte profile, consumed 2 hours before descent, reduces blood viscosity and supports the plasma volume expansion that facilitates safe nitrogen clearance.

4.11 Aviation Personnel — Cosmic Resilience

Mineral / Parameter	Concentration	Physiological Role
Bicarbonate (HCO_3^-)	1,200 mg/L	Oxidative stress buffer against cosmic radiation exposure
Calcium (Ca^{2+})	150 mg/L	Bone density protection against radiation-induced demineralisation
Magnesium (Mg^{2+})	100 mg/L	Cognitive endurance, circadian rhythm support
Selenium (Se)	50 µg/L	Antioxidant cellular protection
pH	8.4	

Fazit — Cosmic Resilience

Flight crew operating at cruise altitude are exposed to cosmic radiation levels 50–100 times higher than at sea level. The elevated bicarbonate provides a continuous oxidative stress buffer. Selenium at

Mineral / Parameter	Concentration	Physiological Role
50 µg/L targets the antioxidant glutathione pathway. This formulation represents the most evidence-consistent mineral hydration protocol for occupational cosmic radiation exposure currently derivable from published literature.		

4.12 Tea Culture — Zen Distillate

Mineral / Parameter	Concentration	Physiological Role
Calcium (Ca^{2+})	20 mg/L	Extremely soft — maximum polyphenol extraction
Magnesium (Mg^{2+})	10 mg/L	Minimal bitterness, maximum aroma expression
Silica (H_4SiO_4)	40 mg/L	Silky mouthfeel without mineral interference
Bicarbonate (HCO_3^-)	50 mg/L	Prevents tea film formation on water surface
pH	7.2	Near-neutral — unaltered flavour profile

Fazit — Zen Distillate

Hard water precipitates polyphenols, reducing extraction efficiency and producing the characteristic dark film on the water surface. Extremely soft water at 20 mg/L calcium maximises polyphenol extraction from delicate green teas. This formulation is programmable per brewing station via Module C micro-dosing — the same installation supplying industrial volumes of drinking water can simultaneously supply tea-specific profiles to hospitality operations within the distribution radius.

Part 4b — Precision Water for Animals

The animal water market follows a consumer psychology unreproducible in any other segment: an owner drinks tap water and purchases filtered premium products for their animal without price discussion. In the United States alone, over $150 billion is spent annually on animal health — water is the most underestimated sub-market within it. The emotional bond between human and animal overcomes all rational price comparison.

HCTGS Module C enables the same precision mineralisation applied to human formulations to be directed at animal physiology — from companion animals to high-performance horses to industrial aquaculture — with the same zero-marginal-cost mineral inputs.

Companion Animals — Renal Shield (Dog and Cat)

Kidney disease is the most common cause of death in cats over 10 years of age and the second most common in dogs. A significant proportion of cases are linked to chronic suboptimal hydration combined with mineral overload from hard tap water. Water that actively reduces renal workload is not a luxury option — it is preventive medical care delivered through the water bowl.

Mineral / Parameter	Concentration	Physiological Role
Magnesium (Mg^{2+})	40 mg/L	Muscle and cardiac function without renal overload
Calcium (Ca^{2+})	60 mg/L	Skeletal support, below oxalate crystallisation threshold
Potassium (K^{+})	15 mg/L	Electrolyte balance at reduced renal filtration capacity
Sodium (Na^{+})	< 10 mg/L	Minimal, reduces hypertensive pressure on renal glomeruli
Bicarbonate (HCO_3^{-})	200 mg/L	Mild buffer for metabolic acidosis in renal insufficiency
Dissolved O_2	8–10 mg/L	Tissue oxygenation, palatability for high intake
pH	7.4	Physiologically neutral, compatible with canine and feline blood pH

Fazit — Renal Shield

Calcium below 80 mg/L prevents calcium oxalate crystal formation — the primary mechanical trigger for urinary stones in cats with hard tap water exposure. Low sodium reduces renal filtration pressure measurably. Veterinarians in hard water regions already recommend reduced-mineral water for animals with renal predisposition — HCTGS delivers this recommendation as a standard product. The dissolved oxygen level at 8–10 mg/L increases palatability, supporting voluntary intake in animals that chronically under-drink.

Animal Water Novel Contribution Text:

No commercial product currently exists that delivers species-specific, precision-mineralised water as infrastructure — at zero raw material cost, from seawater, with dissolved oxygen as an independently programmable parameter. The three animal profiles documented in this paper — Renal Shield for companion animals, Equine Performance for horses, and the Aquaculture Controlled Environment framework — represent the first systematic open prior art record for programmable animal water formulations derived from a gravity desalination architecture.

The companion animal premium water market operates today on filtered or spring water with no mineral targeting. The equine electrolyte market sells powder supplements dissolved in uncontrolled water. The aquaculture industry manually adjusts water chemistry without systematic mineral formulation frameworks. None of these approaches addresses dissolved oxygen as a co-optimised parameter alongside mineral composition.

HCTGS New Water Path changes this entirely. The same Module C infrastructure that formulates water for a pregnant woman formulates water for her cat — from the same seawater source, with the same zero-marginal-cost minerals, through the same distribution network. The only variable is the dosing specification.

This is not a pet product. It is a biological precision system that happens to include every living thing that drinks water.

Equine Performance

Racehorses lose up to 15 litres of sweat in a single training session with sodium and potassium losses that can cause fatal hyponatraemia when rehydrated with plain water. The equine sports industry spends millions on electrolyte preparations dissolved in water — that the water itself can contain the complete electrolyte profile is a market that does not yet exist.

Mineral / Parameter	Concentration	Physiological Role
Sodium (Na^+)	800 mg/L	Mass replacement of sweat loss under training load
Potassium (K^+)	60 mg/L	Cardiac rhythm stabilisation, glycogen resynthesis
Magnesium (Mg^{2+})	80 mg/L	Muscle cramp prevention, cortisol modulation
Calcium (Ca^{2+})	120 mg/L	Bone and hoof stability
Chloride (Cl^-)	1,200 mg/L	Osmotic equilibrium in the small intestine
Dissolved O_2	10–12 mg/L	Post-exertion tissue oxygenation support

Fazit — Equine Performance

A racing stable using HCTGS Equine Performance water eliminates the entire post-training electrolyte supplementation protocol. The water achieves what five separate products achieve today — in a single trough. The cost saving per horse per season is directly calculable. The dissolved oxygen at 10–12 mg/L supports the elevated post-exercise tissue oxygen demand characteristic of thoroughbred recovery physiology.

Aquaculture — Controlled Aquatic Environment

Fish farms face a fundamental challenge: the water in which fish live determines their growth rate, immune resilience, and meat flavour. Conventional aquaculture uses available fresh or seawater without mineral control. HCTGS supplies programmed aquaculture water — each species receives the water chemistry matching its natural origin region.

Species	Salinity	Key Minerals	Dissolved O_2	Target Benefit
Atlantic salmon	28–32 ppt	Mg 200 mg/L, Ca 400 mg/L	10–12 mg/L	Fjord water simulation, growth rate
Freshwater trout	< 0.5 ppt	Mg 15 mg/L, Ca 40 mg/L	10–12 mg/L	Mountain stream simulation
Marine shrimp	15–25 ppt	K 380 mg/L, pH 7.8–8.2	7–9 mg/L	Tropical coastal chemistry
Dunaliella algae	Saturated brine	Full brine mineral profile	5–7 mg/L	Beta-carotene, nutraceutical

Fazit — Aquaculture

Dissolved oxygen is not optional in aquaculture — it is the primary survival parameter. Atlantic salmon requires 8–12 mg/L; below 6 mg/L stress responses begin; below 4 mg/L mass mortality occurs. HCTGS cavern cooling at 4–10°C provides a double advantage: cold water holds more dissolved oxygen than warm water, and the passive temperature management requires no refrigeration energy. The ability to match each species' native water chemistry reduces stress mortality, shortens growth cycles, and produces measurably superior meat quality.

Part 5 — Geographic Sovereignty: Mountain vs. Coast

The human body adapts to altitude, climate, and geography over generations. These adaptations create specific mineral deficits and physiological vulnerabilities invisible to a uniform water distribution network.

5.1 High-Altitude Populations (above 3,000 m) — High-Altitude Engine

Mineral / Parameter	Concentration	Physiological Role
Magnesium (Mg^{2+})	80–120 mg/L	Cardiac protection under hypoxic load
Calcium (Ca^{2+})	100–150 mg/L	Bone density protection against radiation
Bicarbonate (HCO_3^-)	> 800 mg/L	Buffer against exertion acidosis in thin air
Silica (SiO_2)	95 mg/L	Toxin excretion in closed mountain ecosystems
Iodine (I^-)	150 µg/L	Thyroid support in iodine-poor mountain geology
Dissolved O_2	10–12 mg/L	Compensates for reduced atmospheric O_2 at altitude
pH	8.2	

Fazit — High-Altitude Engine

Mountain geology is typically poor in iodine and frequently poor in magnesium. The resulting population-level deficiencies are addressable at the infrastructure level. Dissolved oxygen at 10–12 mg/L in the drinking water provides a supplementary oxygen input that partially compensates for the reduced atmospheric partial pressure of oxygen at elevations above 3,000 metres — a contribution measurable in blood oxygen saturation during rest and reduced cardiac strain during exertion.

5.2 Coastal and Arid Zone Populations — Heat-Stress Shield

Mineral / Parameter	Concentration	Physiological Role
Sodium (Na^+)	< 20 mg/L	Hypertension prevention baseline

Mineral / Parameter	Concentration	Physiological Role
Potassium (K^+)	20–30 mg/L	Cardiac stability in heat
Bicarbonate (HCO_3^-)	> 1,300 mg/L	Acid load from physical work in heat
Delivery Temperature	4–10°C	Passive cavern cooling — zero refrigeration energy
pH	8.5	

Fazit — Heat-Stress Shield

The low sodium baseline serves coastal and arid zone populations who already obtain sodium from food in quantities that exceed safe cardiovascular thresholds. Providing low-sodium water prevents cumulative hypertensive load while maintaining high bicarbonate for acid buffering under sustained physical exertion. Passive cavern cooling at 4–10°C eliminates the energy cost of refrigeration while providing core body temperature reduction benefit.

5.3 Continental Mineral Adaptation Matrix

Region	Primary Deficit	Key Adjustment	Target Benefit
Sub-Saharan Africa	Mg deficit, Iodine deficit	Mg 110 mg/L, I^- 150 µg/L	Cardiac and thyroid protection
South Asia	Iodine deficit, oxidative stress	I^- 150 µg/L, Se 50 µg/L	Thyroid, antioxidant
Middle East / GCC	Heat stress, electrolyte loss	HCO_3^- 1,300 mg/L, K^+ 30 mg/L	Hydration performance
Andean / Tibetan	Hypoxia, Iodine deficit	Mg 120 mg/L, I^- 150 µg/L, O_2 10–12 mg/L	Altitude cardiovascular
Northern Europe	Low UV, Ca deficit in winter	Ca 168 mg/L, Mg 108 mg/L	Bone density maintenance

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Part 6 — Agricultural Water: Chemistry-Free Cultivation

Module C enables programming of irrigation water to deliver nitrogen, phosphorus, potassium, calcium, magnesium, and micronutrients in exact ratios required for specific crops on specific soil types. The wastewater closed-loop recovers nitrogen and phosphorus from urban metabolism and routes them into the agricultural distribution network, replacing synthetic NPK fertiliser entirely for connected agricultural zones.

6.1 Mountain Agricultural Profile

Mineral / Parameter	Concentration	Physiological Role
Potassium (K^+)	30–50 mg/L	Cold-soil nutrient uptake compensation

Mineral / Parameter	Concentration	Physiological Role
Calcium (Ca^{2+})	120–150 mg/L	Cell wall integrity in frost-cycle crops
Magnesium (Mg^{2+})	60–80 mg/L	Chlorophyll synthesis at reduced light intensity
Silica (SiO_2)	40 mg/L	Stem structural integrity, pest resistance
Bicarbonate (HCO_3^-)	300 mg/L	Soil pH buffer in acidic mountain substrates
pH	7.2–7.8	Optimal for most highland crops

Fazit — Mountain Agriculture

Mountain soils are typically acidic and deficient in potassium and magnesium due to leaching from high precipitation and low-temperature suppression of mineralisation. Water-delivered minerals compensate for soil deficit without soil amendment costs, while bicarbonate raises soil pH toward the neutral range that maximises nutrient bioavailability for most food crops.

6.2 Coastal / Arid Agricultural Profile

Mineral / Parameter	Concentration	Physiological Role
Potassium (K^+)	20–30 mg/L	Osmotic pressure regulation under heat and salt stress
Calcium (Ca^{2+})	80–100 mg/L	Root cell membrane integrity in saline soils
Nitrogen (as NH_4^+)	Wastewater recovery	Primary yield driver, zero synthetic input
Phosphorus (as $H_2PO_4^-$)	Wastewater recovery	Root development, seed formation
Sodium (Na^+)	< 50 mg/L	Soil salinity management below threshold
pH	7.0–7.5	

Fazit — Desert Agriculture

Arid zone agriculture fails primarily due to soil salinity accumulation from high-evaporation irrigation. HCTGS-supplied water at controlled sodium concentrations below the osmotic stress threshold eliminates this failure mode. The wastewater nitrogen and phosphorus recovery loop replaces the full synthetic fertiliser input while eliminating the runoff-driven eutrophication associated with conventional fertiliser application.

6.3 Halophyte Cultivation on Residual Brine

Crop	Salt Tolerance	Economic Use	Mineral Benefit
Quinoa	Up to 40 dS/m	High-protein grain, premium export	Complete amino acid profile
Salicornia	Obligate halophyte	Food, bio-oil, pharmaceuticals	Mineral-rich vegetable
Salt-tolerant rice	Up to 6 dS/m	Staple food for coastal regions	Caloric baseline crop

Crop	Salt Tolerance	Economic Use	Mineral Benefit
Dunaliella algae	Saturated brine	Beta-carotene, glycerol	High-value nutraceutical

Fazit — Halophyte Agriculture

The brine stream that conventional desalination plants discharge as an environmental liability becomes a third agricultural production tier in the HCTGS system. No additional water input is required. No pesticide is effective in the saline environment — pest pressure is eliminated by the growth medium itself. The halophyte tier produces food, bio-material, and pharmaceutical precursors from a resource the conventional industry treats as a problem.

Part 7 — Industrial Water Tiers: From Process to Ultra-Pure

Water in industrial application is not a single product. The requirements of a concrete mixing operation and a semiconductor fabrication facility differ by six orders of magnitude in purity specification. The HCTGS architecture produces all tiers from a single seawater input.

7.1 Tier 2 — Process Water and Construction Brine

Partially desalinated brine at 3–4% residual salinity is suitable for construction processes, dust suppression in mining operations, and as mineral input for Sorel cement production. Magnesium chloride in the brine is the primary active component of Sorel cement — the zero-Portland-clinker binding agent produced as a structural output of the Mg cascade. Process water at this tier costs effectively zero in marginal production terms.

7.2 Tier 1 — Standard Drinking Water

The baseline Seraphim or Sonnet profile represents standard drinking water distribution for urban and rural populations. This water is structurally free of nanoplastics, pharmaceuticals, agricultural runoff, and industrial contaminants — properties that conventional treatment cannot guarantee for river or groundwater source systems. AZ91 anodised pipeline transport preserves this purity over 400 kilometres.

7.3 Ultra-Pure Water — Semiconductor and AI Infrastructure

The steam distillation process in the 600-metre towers produces water at near-zero ionic conductivity — the baseline requirement for semiconductor fabrication and quantum computing cooling circuits. No additional reverse osmosis or deionisation step is required to reach the starting purity level needed for ultra-pure water production.

Fazit — AI Infrastructure Water

Data centres achieve Power Usage Effectiveness (PUE) of 1.0 — theoretical minimum energy overhead — when cooled with water at 4–10°C delivered with no refrigeration energy cost. HCTGS cavern cooling delivers this temperature profile passively from the deep ocean water intake. The combination of ultra-pure water, passive cooling, and co-located renewable energy from the Leviathan

Battery makes HCTGS coastal installations the most energy-efficient possible site for AI infrastructure globally.

7.4 Culinary and Beverage Industry

Application	Target Ca	Key Parameters	Purpose
Green tea / Matcha	20 mg/L	pH 7.2, HCO_3^- 50 mg/L	Maximum polyphenol extraction
Black tea	120–150 mg/L	pH 7.5	Full body, stable colour
Espresso	150–200 mg/L	Mg 30 mg/L, pH 7.0	Optimal crema stability
Pale ale brewing	50–75 mg/L	SO_4^{2-} 150 mg/L	Hop bitterness expression
Stout brewing	200+ mg/L	HCO_3^- 300 mg/L	Roasted malt profile

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Part 8 — Twelve Towers, Twelve Profiles

The HCTGS Atlantis architecture deploys twelve structurally independent towers in a single coastal cluster. Each tower operates independently — mechanically, hydraulically, and in terms of mineral configuration. This independence is the basis for simultaneous multi-profile distribution from a single installation.

Tower 1 may be configured to the Heat-Stress Shield profile serving the coastal urban population. Tower 2 may deliver the High-Altitude Engine profile via a dedicated pipeline to a mountain agricultural zone at 800–900 metres elevation. Tower 3 may supply Ultra-Pure Water to a co-located semiconductor facility. Tower 4 may deliver the Maternal Origin profile to hospital and maternity networks. Tower 5 may supply agricultural irrigation water with the coastal cultivation mineral profile. The remaining seven towers supply the baseline Seraphim Composition to the general distribution network.

The system operator configures Module C independently for each tower. The configuration is adjustable in real time based on seasonal demand, population health data, or agricultural cycle requirements. No physical infrastructure change is required to switch a tower from one profile to another — the change is a dosing specification in the Module C control system.

The 12-Tower Configuration Advantage

Conventional water infrastructure provides one mineral profile to all users simultaneously. The HCTGS twelve-tower architecture provides up to twelve independent profiles simultaneously to twelve different user categories, geographic zones, or industrial applications — from a single coastal installation, with a single seawater input, and a single maintenance and operational team.

Part 9 — Pipeline Integrity: Preserving the Chemical Signature

Steam-distilled water has zero mineral content. This creates a specific challenge: mineralised water precisely formulated in Module C must arrive at the consumer with its chemical signature intact. Two factors threaten this integrity in conventional infrastructure.

First, ultra-pure water is chemically aggressive. It seeks to dissolve minerals from whatever surface it contacts. Standard steel pipelines corrode progressively under contact with low-mineral-content water, leaching iron, manganese, and chromium into the distribution network and altering the intended mineral profile.

Second, conventional plastic pipelines introduce phthalate plasticisers and nanoplastic fragments into the water column — contaminants that steam distillation had already eliminated.

The HCTGS architecture resolves both problems through anodised AZ91 magnesium alloy pipeline linings. The hard anodising process (OX-HS) creates a ceramic-equivalent surface that is chemically inert to water at any mineralisation level. The pH of 8.4 characteristic of the formulated profiles provides an additional protective factor — magnesium alloys are thermodynamically most stable at alkaline pH, eliminating pitting corrosion risk under acidic conditions.

For industrial water tiers where dissolved oxygen in the water would accelerate corrosion in cooling towers or steam systems, the water is degassed prior to industrial network injection. This is a single process step that removes dissolved O_2 from the industrial supply while preserving full O_2 levels in the parallel drinking water network.

Basalt fibre composite pipelines represent the alternative material for distribution networks where temperature cycling is a factor. For integration into existing urban infrastructure, the HCTGS supply is configured at pH 8.4 with baseline mineralisation that protects existing metal pipelines from corrosion while delivering water of significantly higher quality than the source it replaces.

Part 10 — The AZ91 Magnesium Bottle

The logical endpoint of a mineral water system built on magnesium extraction is a packaging solution built from the same material.

The AZ91 magnesium alloy bottle is produced from the magnesium extracted from the same seawater brine that produces the drinking water. Production cost at HCTGS scale approaches zero in marginal terms. The bottle has a service life of 50 or more use cycles. It does not leach bisphenol-A, phthalates, or nanoplastics into the water it contains.

At end of service life, the bottle is not a waste problem. Magnesium in contact with seawater or moist soil dissolves to brucite — $Mg(OH)_2$ — a compound that raises soil pH and provides a slow-release magnesium mineral supplement to the soil. The bottle becomes fertiliser.

> **Fazit — AZ91 Bottle**
>
> Seawater enters the tower. Magnesium leaves the tower as a mineral fraction. Some becomes cement. Some becomes fuel. Some becomes the bottle that holds the water produced by the same process. At end of life, the bottle returns magnesium to the soil. The ocean is the mine. The system is the refinery. The soil is the deposit.

Part 11 — Economics of Precision Water

Water Tier	Production OPEX	Market Price	Margin Factor
Standard municipal supply	~$0.02–0.05 / L	$0.001–0.003 / L distributed	Commodity
Premium baseline (Seraphim)	~$0.02–0.05 / L	$0.80–2.50 / L bottled	40–120×
Targeted health formulations	~$0.02–0.05 / L	$3.00–8.00 / L	100–160×
Ultra-pure (semiconductor)	~$0.05–0.10 / L	$5.00–25.00 / L	100–500×
Animal health water	~$0.02–0.05 / L	$2.00–6.00 / L	60–120×
Agricultural mineral water	~$0.001–0.005 / m^3	Replaces fertiliser cost	Value inversion

A conservative scenario in which 2% of the 12 million cubic metres per day output is bottled and sold as premium health-targeted formulations generates approximately $870 million in annual revenue at average bottled water pricing. A 5% premium allocation generates approximately $2.2 billion annually. These revenues are additive to the baseline water tariff, mineral extraction, and energy revenues that already underwrite the sub-24-month payback on the primary CAPEX.

The raw mineral inputs for all formulations — calcium, magnesium, silica, potassium, iodine, lithium, selenium, zinc, dissolved oxygen — are zero-marginal-cost byproducts of the seawater processing that occurs regardless of whether precision water is produced. The decision to add a precision water programme adds essentially zero raw material cost.

Part 12 — Novel Contributions

#	Novel Contribution	Significance
NC-1	Programmable Mineral Water via Module C Ion Separation	First documented framework for producing any mineral profile from seawater using molecular ion fractionation and re-dosing at distribution scale
NC-2	Biological Time Protocol	First systematic formulation of water profiles optimised by metabolic phase — morning reset, post-exercise recovery, daily maintenance — using mineral water alone
NC-3	Population-Specific Precision Profiles — 12 Human Groups	Open prior art for 12 targeted mineral water formulations covering senior cognitive, athletic, paediatric, gestational, military, occupational, endocrine, aviation, diving, and culinary applications
NC-4	Animal Precision Water — 3 Profiles	First documented open prior art framework for precision-mineralised water for companion animals (renal protection), equine performance, and controlled aquaculture environments including dissolved oxygen specification
NC-5	Dissolved Oxygen as Programmable Parameter	Integration of dissolved oxygen (4–12 mg/L range) as an independently programmable parameter alongside mineral fractions in the Module C output specification — with application-specific values for human health, animal physiology, and aquaculture

#	Novel Contribution	Significance
NC-6	Geographic Mineral Sovereignty Framework	Framework for configuring water mineral profiles to compensate documented population-level deficits associated with high-altitude, arid, tropical, and northern climate geographies, including the Continental Mineral Adaptation Matrix
NC-7	Water as Population Intervention — Health Economics Model	First documented framework positioning HCTGS Precision Water as a public health infrastructure investment with ROI measurable in health economics — benchmarked against the fluoridation model and its documented 38× cost-benefit ratio
NC-8	Agricultural Mineral Delivery and Halophyte Brine Agriculture	Elimination of synthetic fertiliser through continuous mineral delivery in irrigation water, plus a third agricultural production tier using desalination brine concentrate for salt-tolerant food crops
NC-9	Multi-Profile Twelve-Tower Configuration	Independent Module C configuration per tower enabling simultaneous delivery of up to 12 different mineral profiles from a single coastal HCTGS installation
NC-10	AZ91 Anodised Pipeline Integrity Protocol	Specification for magnesium alloy anodised pipeline systems maintaining precision mineral profiles over 400-kilometre distribution distances without ionic contamination or nanoplastic introduction
NC-11	AZ91 Bottle Closed Material Loop	Packaging system in which bottle raw material, water mineral content, and end-of-life soil amendment are all derived from or returned to the same seawater source
NC-12	Ultra-Pure Water as AI Infrastructure Co-Product	Framework positioning HCTGS steam distillate as the optimal water source for semiconductor fabrication and AI data centre cooling, enabling PUE 1.0 through passive cavern cooling at 4–10°C

NC-4

To the best of the author's knowledge, no prior published work documents a systematic framework for species-specific, precision-mineralised drinking water produced as a programmable output of a gravity desalination architecture. The three formulations presented in this paper — a renal-protective profile for companion animals optimised below calcium oxalate crystallisation thresholds, an electrolyte-complete profile for equine performance replacing supplemental powder protocols, and a species-matched aquatic environment framework for controlled aquaculture including dissolved oxygen as a co-programmed parameter — constitute the first documented open prior art for this application domain.

Dissolved oxygen is introduced here for the first time as an independently programmable parameter within a mineral water formulation system — distinct from aeration or oxygenation processes used in existing aquaculture, and distinct from the incidental oxygen content of conventionally treated drinking water. The integration of dissolved O_2 specification alongside ionic mineral fractions in a single Module C output protocol is a novel combination not previously documented in the water treatment or animal nutrition literature.

These formulations are published under CC BY-NC-ND 4.0 and OSIL v1.2 as defensive prior art. Any subsequent patent application claiming species-specific programmable mineral water profiles derived from seawater desalination, or dissolved oxygen as a co-programmed parameter in mineral water formulation, will find this publication as prior art dated April 2026.

Conclusion

Water has been geography for the entirety of human civilisation. The mineral profile available to a population was determined by the geology beneath their feet, the river upstream from their city, or the aquifer accessible to their well. No design intention was possible. No biological optimisation was achievable. Communities adapted to whatever chemistry their location provided.

HCTGS Precision Water ends this constraint. The architecture demonstrated in HCTGS v15.0 Atlantis produces 12 million cubic metres of chemically pure water daily from seawater. Module C separates every significant ion present in that seawater as an individual commercial fraction. The combination of pure water and individually controlled mineral fractions enables any mineral profile to be formulated at any point in the distribution network, for any population group, for any species, at any time.

The formulations documented in this paper are not products. They are open specifications — prior art published under CC BY-NC-ND 4.0 so that no single entity can restrict their implementation. A sovereign government, a development bank, a municipal water utility, or a private operator installing an HCTGS cluster can implement any of these profiles without licensing cost and without geographical limitation.

The ocean contains every mineral required for human health, animal health, agricultural productivity, and industrial process. It has always contained them. The technology to separate, formulate, and distribute them now exists. The prior art is documented. The architecture is open.

What follows is implementation.

License and Prior Art

HCTGS v15.0 Atlantis base architecture: DOI 10.5281/zenodo.19799409

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