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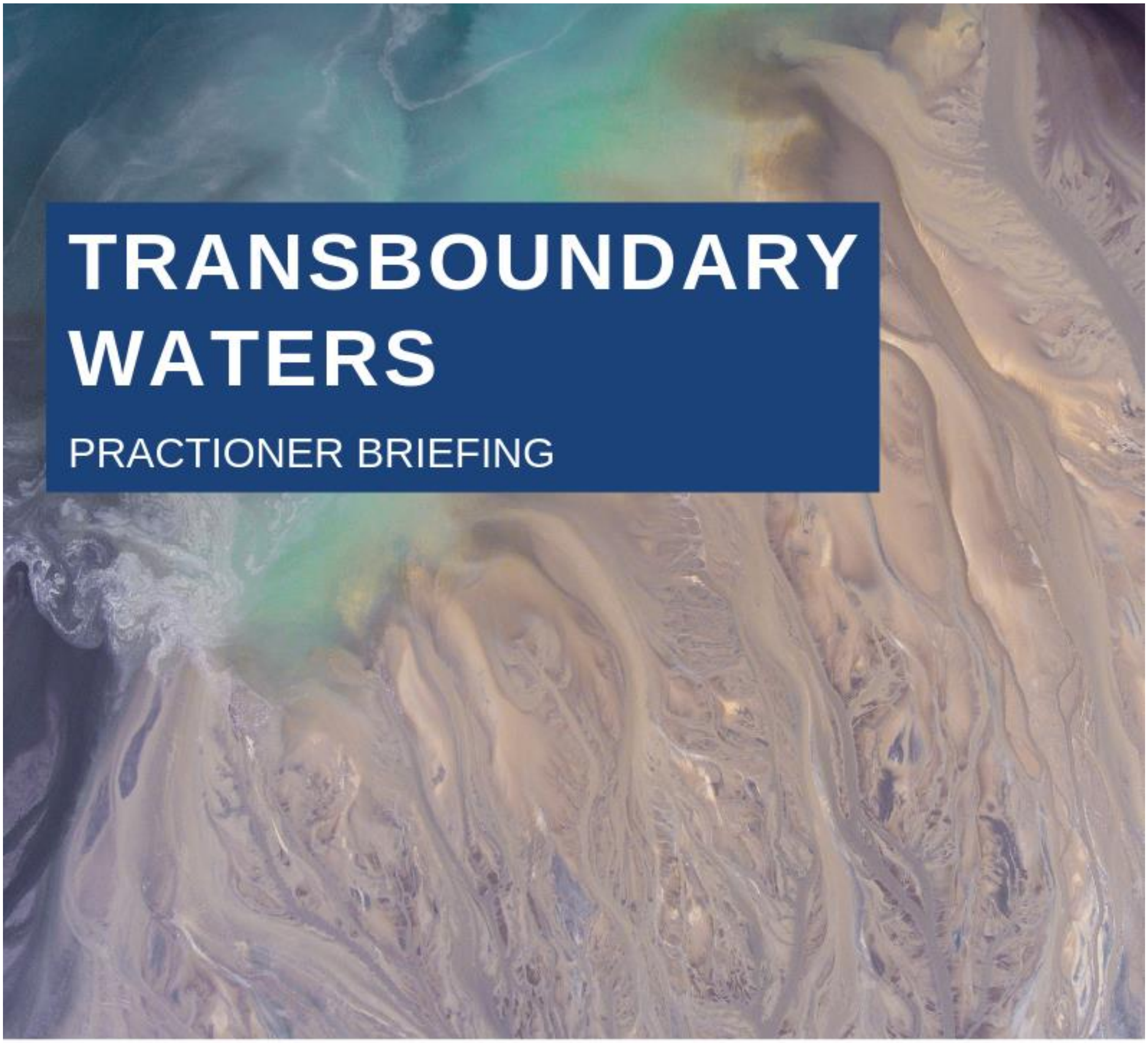


TRANSBOUNDARY WATERS

PRACTIONER BRIEFING

WASTEWATER

Issue 2

Transboundary Wastewater

One way to extend available water resources is through wastewater reuse or recycling. Effectively recycling wastewater helps to close the water-use cycle, allowing a finite water resource to be used again and again for various purposes, from drinking water to agriculture or industry.

While water recycling would appear to be an obvious means of extending the use of water supplies, effectively accomplishing this has not been as simple in practice.[i] Practical implementation of such solutions has been limited by issues arising from complexity and uncertainty. As often stated, water is a complex resource, with uncertainties that are natural/physical, economic, social, political, and institutional.

Some uncertainties are inherent (natural), while others are imposed (societal). Technological solutions can help to address some of these challenges, through better tools and methods for measurement to close information gaps. Others however, cannot be solved by technology alone, and must be solved through cooperation and dialogue, with a non-zero-sum approach to find mutually beneficial and cooperative solutions. This is particularly true with transboundary wastewater, where challenges are shared between different parties—whether different nations or different communities (public vs. private)—and the actions of each can adversely affect the other.

Shared challenges present shared opportunities. Critical to addressing these challenges are mechanisms for cooperation and communication, which are effective, and consistently utilized. Consistently shared data and information is critical to this process, as a lack of available data furthers uncertainty about the size and cycle of transboundary flows, who is responsible for them, and how to equitably price these differences.

This briefing will provide an overview of some the practical challenges of transboundary wastewater and provide examples of a few potential solutions, including example case studies where these efforts are being implemented.

Practical Summary

Water problems are complex due to natural and societal factors, and the dynamic feedback between these domains—and a changing climate further complicates these interactions.[ii] Wastewater problems are uniquely complex due to human factors, in our interaction with water resources and the water cycle.[iii]

Transboundary waters require cooperation to find negotiated solutions to conflict, and to equitably share freshwater resources. Efficient first use of freshwater resources is critical to this process. The other side of the freshwater equation is wastewater, specifically its reuse and effective management, to first protect freshwater resources from contamination, and to extend the water-use cycle with the same limited resources, particularly agriculture.[iv]

Wastewater that is well managed can extend the water resources available to all parties, and monetizing it can reduce development and maintenance costs.[v] Conversely, wastewater that is poorly managed, contaminates freshwater resources, further reducing freshwater availability and potentially leading to new sources of conflicts among riparian parties. In a transboundary context, these challenges can be complicated by different institutions, failed communication, and political divisions between communities or nations. If done well, value can be extracted from wastewater, with higher treatment standards, and better protection of freshwater.

Shared challenges require shared solutions. Determining equitable and politically acceptable solutions must account for inequalities between stakeholders—between nations, or public vs. private. Optimal solutions vary with context, and may require coordinated individual responses, fund transfers to share costs and benefits, or joint projects and shared infrastructure. Joint environmental assessments and fact-finding studies should be used to determine the best solution for each context and generate buy-in.

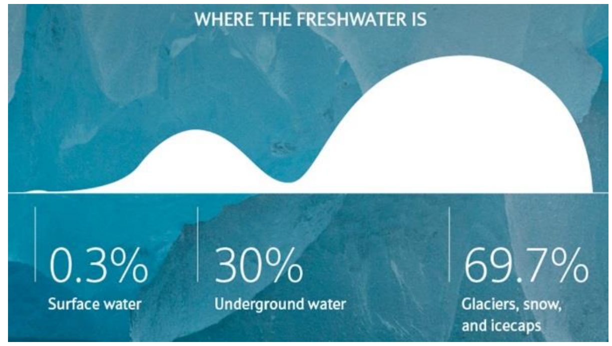
Pricing wastewater in terms of cost, potential economic value, and environmental impact, is also critical to establishing sustainable solutions with shared costing, and is critical to implementing principles such as "polluter pays." In a transboundary context, "willingness to pay" and "ability to pay" are equally important considerations to effectively achieve shared goals.

Wastewater that is monetized as recycled water for agriculture or industry can help to share cost burdens while addressing a critical need. Recycling waste has the potential to also create wealth generating business models with increasing cost recovery and profitability. If wastewater and potential byproducts are costed effectively, shared infrastructure can be developed between riparian parties that balances their unequal capacities and monetizes their resources for shared benefits. Without effective cooperation, and some sacrifice, wastewater reduces water security for all.

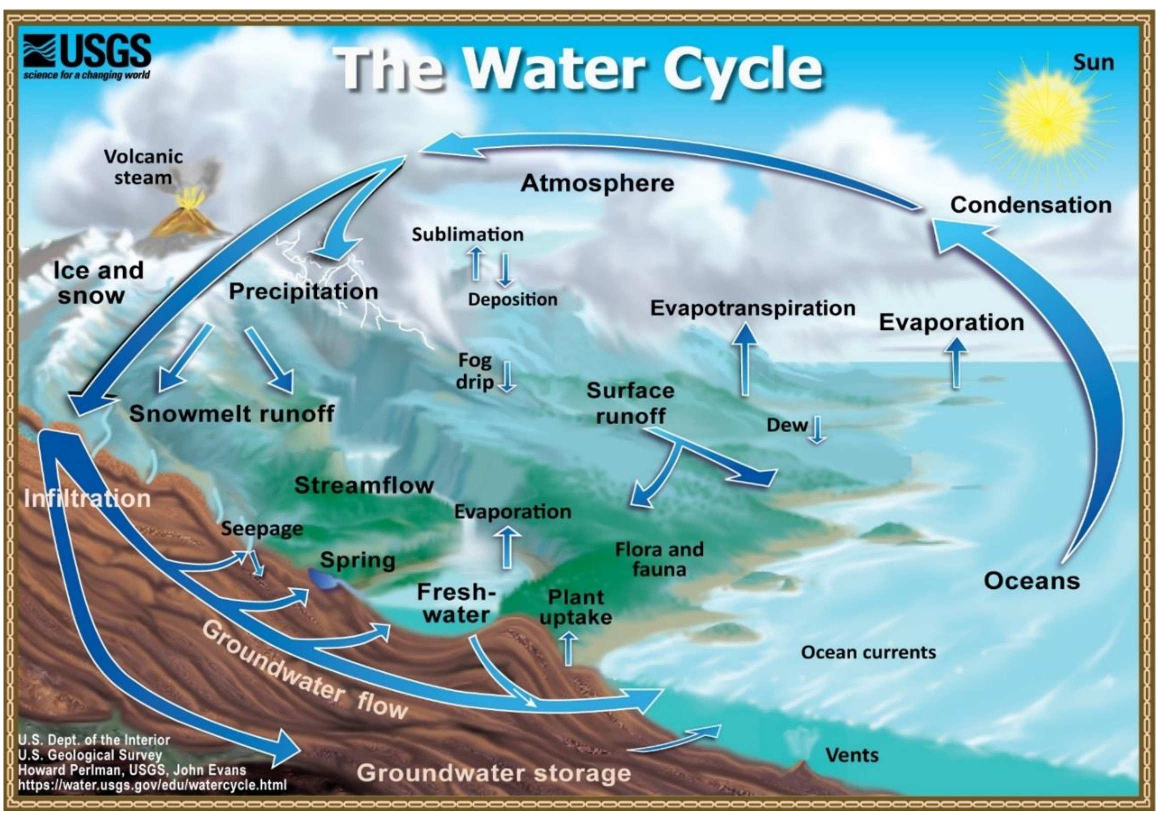
Closing the Loop – Water Use Cycle

Similar to energy, water is not destroyed, but merely changes form. To sustain life however, even subtle changes can make all the difference. It has been noted, the world does not lack water, it is simply in the wrong place. The key distinction is potable freshwater, where people need it, and when.

"Human beings are really good at taking high-quality water and turning it into low-quality water. We need to reverse that cycle as soon as we can."[vi]



While the earth's surface is 71% water, 96.5% of it is saltwater contained in the oceans. Of all freshwater on earth, 68% is in icecaps and glaciers—melting into the sea with climate change—and just over 30% is stored in groundwater aquifers—often unsustainably extracted.[vii] This leaves a 0.3% of freshwater in lakes, rivers, and swamps to support life on Earth.[viii] Where this 0.3% of freshwater is located has determined the course of human development, which is why careless contamination of this small amount is so critical.



In the natural water cycle, water changes from vapor to liquid, moving through the atmosphere to the land and below, from rain and snow, to rivers and oceans or groundwater, and then back again. Nearly all life is dependent on the 0.3% that collects in freshwater catchments, and how we interact with that system determines our future survival. Seawater desalination is one means to create more freshwater, but it cannot be the only solution.

In the urban water cycle, the natural process is complicated by human interaction and the waste we contribute into this cycle—over extraction leading to salt intrusion of groundwater aquifers, or the disposal of wastewater into freshwater sources making them unfit for consumption. Through poor management, we are poisoning the water cycle, destroying limited freshwater resources, and putting more water into the wrong place, at the wrong time.

Closing the loop in terms of waste recycling refers to the reuse of elements, and proper disposal of pollutants to limit their impact on their environment. In the water use cycle, closing the loop refers to minimizing the impacts of human activity, treating wastewater before feeding it back into the system, and reusing it for multiple purposes, such as irrigation for agriculture, or in oil and gas wells. Distributed wastewater treatment systems can effectively accomplish this on small-scale local level, reducing costs for companies or municipalities.

Establishing requirements for best practices can help to mainstream efficient water policy. For example, first-pass freshwater resources should be reserved as potable water for consumption. Second-pass/treated wastewater should be used for agriculture and irrigation, which is the leading use of freshwater, to irrigate crops, crop cooling, or pesticide and fertilizer applications. Third-pass or lower-grad treated wastewater or reused water can be used for various industrial purposes, such as fabricating, processing, washing, diluting, cooling, or transport.

Wastewater is a critical component of freshwater security and addressing wastewater issues can greatly help to close the loop of the water use cycle and mitigate the effects of human interaction with natural water processes.

Complexity & Uncertainty

Water is a complex natural resource and managing it or predicting its changes is a complex undertaking. Risk and uncertainty make the valuation of water difficult for various stakeholders, whether governments and communities or companies. Wastewater is another function of this complex equation.

When managed properly (captured and treated) it is another part of the water cycle, arising from human interaction with the environment. When managed poorly it is a further limiting factor, decreasing freshwater quality through contamination. The activities of different groups, such as a mining company and its surround community, can lead to conflict when only narrow perspectives are applied.

The iterative feedback loops in the natural water cycle are inherently difficult to predict and measure, and human variables in this process—from over-extraction to climate change—further add layers of complexity making it difficult to manage or form effective policy. The natural complexity of water is compounded by human factors, and transboundary contexts splits these complexities between different groups. Water however, does not recognize political borders.

Technical issues can make it difficult to accurately measure transboundary water flows, or properly assess the wastewater flows and their particular content over time.[ix] Furthermore, political issues can reduce the availability of this information when it is measured or available. For transboundary wastewater in poorly organized systems or in rapidly developing contexts, this can be difficult to track due to illegal or off-network practices, and the limited availability of information makes it impossible to accurately measure and form precise policy responses.

Information is critical to managing water resources, and public and transparent information is critical to transboundary water sources. From the amount of water used to the wastewater produced, and contents of this wastewater, to the financial claim or responsibility of either side—information is paramount to cooperation and creating equitable solutions that are politically acceptable.

Reducing complexity and minimizing uncertainty must be a priority of water authorities, both internally and across institutions or borders.

Shared Problems, Shared Solutions

With shared challenges and prohibitive costs, one solution is a joint response that shares costs between stakeholders and helps build the necessary capacity to address their shared challenges.

Shared water infrastructure can help to address regional water challenges by combining the financial resources of riparian nations, and better distributing the burdens between partners with unequal resources or technical capacity.[x] Such approaches are particularly important where wastewater is concerned, in order to achieve shared goals of sufficient standards.

For example, two neighboring groups share fresh water resources, party A and party B, where party A has the resources to develop its own water resource facilities to high standards, while party B does not. In this scenario, party A may lack incentives to support party B’s freshwater production without direct compensation.

There is no cost to party A for not addressing party B’s lack of fresh water resources—it is an internal resource management issue of party B. However, the equation changes with wastewater, particularly if party A is downstream. The safe management of wastewater presents different challenges for both parties, and different incentives. The impact of mismanaged wastewater by either party could directly impact both parties, or have asymmetrical impacts between them, realigning their incentives.

Therefore, in this hypothetical example, party A (richer, downstream) would be compelled to address the transboundary wastewater issues arising from party B (poorer, upstream), in order to protect its own freshwater resources and mitigate the impacts of transboundary wastewater.

In this example, these shared environmental problems could either be seen as areas of potential conflict, or as areas for increased cooperation. Negotiating cooperative solutions between the parties can establish dialogue and practical methods to achieve agreed goals that benefit both parties. Shared water infrastructure can provide several avenues to equitably share the costs and benefits of wastewater treatment projects, which are fair to each stakeholder while addressing a shared problem. Practical considerations include the location of the shared facilities, the financing for them, and their capacity (such as building excess capacity for future growth).

Another response can establish shared standards between each party, with an individual responsibility to achieve their shared targets and mechanism of enforcement. The mechanism for this can include payment agreements and incentives, without physically sharing infrastructure—using payment transfers to share costs and provide incentives to reach a shared standard. Making the proper costing of water, wastewater and its byproducts all the more important.

Without such mechanisms, party B upstream can have a lower standard of treatment, which party A must pay more to address to sufficient standard. In reverse, if party B upstream sets a higher standard, party A downstream can take advantage of this, without compensation as a free-rider. Formalizing this process and establishing shared goals is more likely to result in an equitable trading of costs and responsibility, while increasing water quality standards overall.[xi]

Shared WWTPs

In practical terms, the choice of dealing with transboundary wastewater is a choice between coordinated actions or individual responsibility, and achieving shared goals through individual responses, with or without coordination, or through cooperative responses, either through agreed frameworks, or shared physical infrastructure.

First, parties must agree on shared goals—whether to deal with wastewater to the same quality standards. Next, they must agree how best to reach these goals—through agreements (requiring trust, payments, and enforcement), or through shared facilities on a larger scale.

As usual, the optimal option depends on the circumstances, and how it is executed. Shared Wastewater Treatment Plants (WWTPs) can utilize economies of scale to address quality and capacity at a lower cost than each party acting alone. They can also be more viable long term by building excess capacity, with costs shared between the parties based on shared benefits and ability to pay, or allocating future capacity relative to initial funding (e.g. excess capacity of 40% allocated to party A, but not party B).

In other contexts, increased cost requirements for longer sewage systems and piping may be overly burdensome for one party compared to another, and a coordinated individual approach is preferred. In this response, a mechanism for sharing costs may still be beneficial to ensure targets are met and benefits are shared, according to ability to pay. In practical terms, the richer party may need to help pay for an individual WWTP to reach the desired quality standard, and this may be less expensive than a shared WWTP due to geographic limitations. A blended response can include individual responses, and shared nature-based solutions in border areas, to get the most from natural processes and engineered infrastructure.

Infrastructure that is designed to meet future demand will require excess capacity that is unused for significant periods of time, with greater initial cost. With shared ownership, the excess capacity and the future cost to deploy it can be structured in order to share the costs of development, operation, and maintenance, with agreements that are made adjustable to future needs. Other opportunities include the deployment of new facilities that harness wastewater byproducts to drastically reduce energy requirements, using anaerobic processes to capture methane and power wastewater treatment.

As shown in the next section, such examples have been developed between the US and Mexico, and even between local and municipal governments or regional water authorities and their communities, to benefit from economies of scale, while recognizing unequal capacity.

Customized cost sharing mechanisms that balance who pays, how much, and when, are opportunities to share burdens equitably and build goodwill, while building the necessary infrastructure to sustainability develop and treat water resources, and prevent contamination from poor wastewater practices.

Various academic models and papers have looked at these varied responses, and the most accurate conclusion is that it depends—on geography, finances, politics and desired outcomes. What is clear, is that cooperative and coordinated responses, whether individual or shared, are preferable to uncoordinated and uncooperative ones.

Transboundary Wastewater Examples

International Boundary & Water Commission

San Diego, CA USA | Tijuana, Mexico

The United States and Mexico have cooperated on water issues in some form or another since the 1800s. The primary mechanism for this is the International Boundary & Water Commission (IBWC), formed in 1889. It is an international body comprised of a U.S. section (USIBWC) and a Mexican section (MXIBWC), administered independently, under the auspices of the U.S. State Department and the Mexican Ministry of Foreign Affairs, respectively. It serves as the primary body responsible for applying boundary and water treaties between the two nations and settling differences in their applications.

A key aspect of this cooperation, is the joint development and administration of shared WWTPs. Utilizing funds from both governments, international bodies, as well as outside funders, projects are undertaken to benefit both parties or address common challenges.[xii]

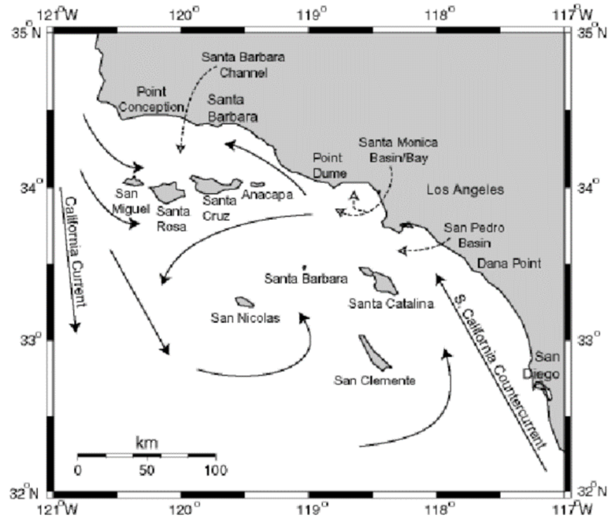
"The two Governments generally share the total costs of the projects in proportion to their respective benefits in cases of projects for mutual control and utilization of the waters of a boundary river, unless the Governments have predetermined by treaty the division of costs according to the nature of a project. In cases of man-made works in one country or operations in one country causing or threatening to cause damage in the other country, the cost is borne by the Government in whose territory the problem originated."[xiii]

For decades, the US and Mexico—more specifically San Diego and Tijuana—have made agreements and promises to cooperate on transboundary water issues through this mechanism, but transboundary wastewater has been a continuing struggle.

Sources: SanGIS; SDSU U-T

Continued urban sprawl and a chronic lack of resources have continually pressured the water infrastructure resources of Tijuana, Mexico, resulting in off-network developments that bypass the wastewater systems, and network breakages that lead to millions of gallons of untreated wastewater flowing to sea and across the border to San Diego's beaches. Further adding to this transboundary problem, the Pacific Ocean current moves the seawater up the coastline toward San Diego and into California.

The California Current in the Pacific Ocean moves water down the coastline and toward Mexico and Baja California, but a unique countercurrent called the Southern California Bight flows northward from the south to the Channel Islands and Point Conception, before moving back down the California Current. This is further accelerated in the winter, when rainfall is more likely to lead to system failures in the south.



This problem has existed for decades, and breakages can happen even with the best cooperative systems in place. However, in recent years, within a changing political environment, some residents in San Diego have said they believe the flow of untreated wastewater into San Diego is intentional, and the lack of warning or communication a sign of ambivalence as the problem flows their way.[xiv]

Tijuana is much poorer than neighboring San Diego county, and has been suffering from an exploding urban population, with chronic underinvestment in its infrastructure, including wastewater. The natural flow of the Tijuana River watershed moves from high altitudes inland, down towards the coastline at the border, and ultimately lets out to the sea along the border. When problems do arise, weak and underfunded government institutions are poorly equipped to handle it.

As with our earlier example, country A is richer and downstream, while country B is poorer and upstream.

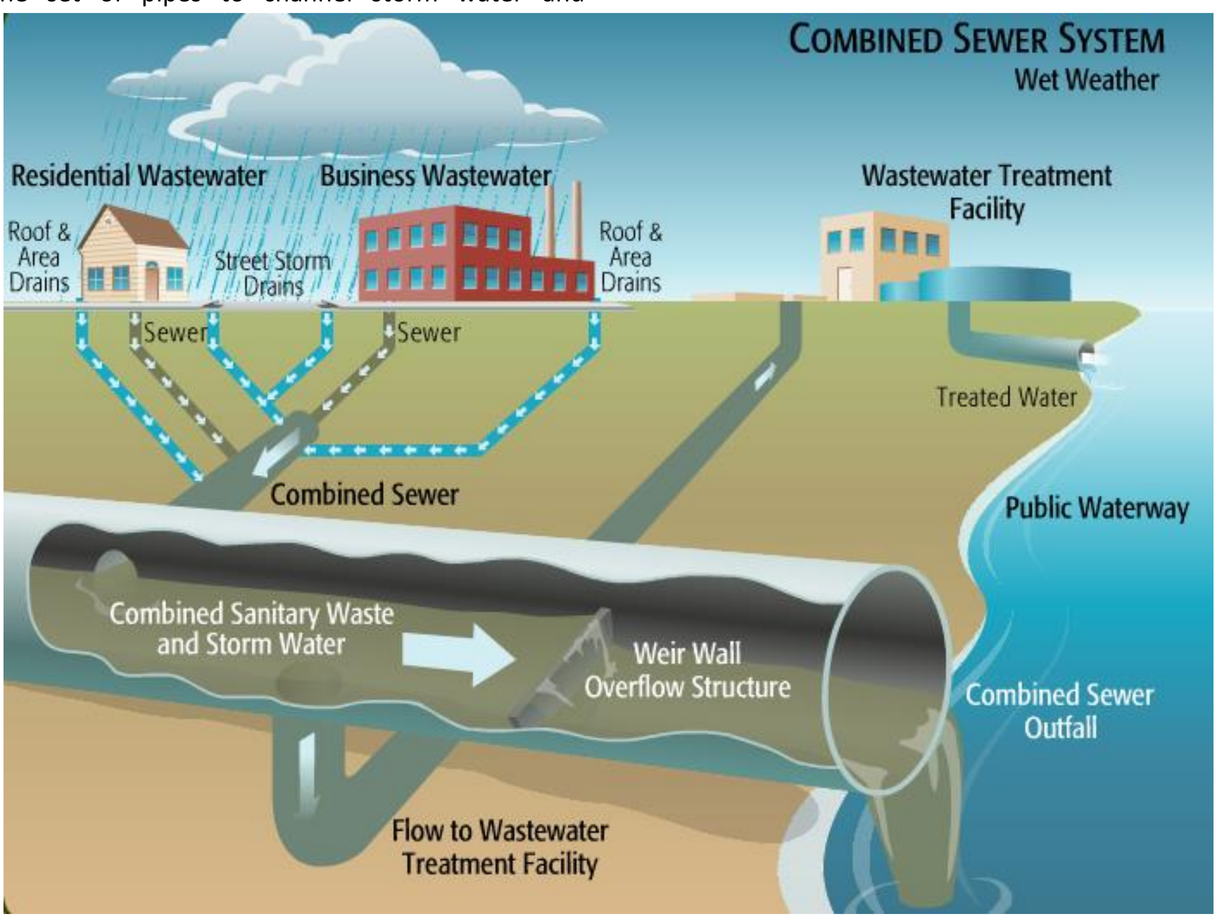
> *Communication "is getting worse," said Serge Dedina, the mayor of Imperial Beach and executive director of the environmental group Wildcoast. "All the normal things that should be happening to manage the system aren't happening. And we can see this consistent series of breakdowns and lack of notifications." The spill has put a spotlight on the need for improvements, even after years of collaboration between the United States and Mexico to minimize the cross-border flow of untreated sewage from Tijuana.*[xv]

Challenges

One of the challenges facing many neighboring cities with transboundary wastewater is the use of a combined sewer system, versus a separated storm and sewer system. A combined sewer system (CSS) is less complicated and less costly, as it requires only one set of pipes to channel storm water and wastewater into a WWTP. A single network is always a cheaper option, and it functions as required in dry weather conditions. However, there is a limit to its capacity, which can be overwhelmed during storm conditions, creating combined sewer overflow (CSO). Furthermore, long periods of drought lead to increased run off speeds, causing less soil absorption and more water runoff into the CSS.

The limits of an urban wastewater system's capacity are set by the intake flow capacity of the WWTP, and of the pipes themselves. To prevent serious damage to either, the system outlets the CSO to a waterway, such as a river or the sea.

Under normal conditions, a weir wall retains the combined runoff and wastewater in the system so it flows into the WWTP before being discharged. However, during a storm surge, or when the maximum intake capacity of the WWTP is met and thus closed, the CSO will flow over the weir wall and into the discharge waterway, untreated. [xvi]



In the case of San Diego and Tijuana, the CSO outlets into the sea, releasing residential, commercial, medical, and storm water runoff into the sea. This toxic combination, including medical waste and industrial waste, can cause severe damage to people's health and cause a great deal of political fallout as well.

In transboundary contexts, a neighbors' wastewater system failure is a problem for all parties. The question becomes, what should be done in response, and what should be done to prevent it from occurring? In addition, what are the acceptable quality standards of wastewater effluent, and how can this be achieved and enforced? In the event of failure, who is responsible, and how are they held accountable?

Responses

An obvious response would be to move from a CSO to SSO—or a separated sewer system. This would allow for a dedicated storm water system, that routes water runoff to the discharge waterway, without combining untreated wastewater along the way.

However, an SSO system is much costlier as it requires a duplicate piping system, in a context where chronic underinvestment has already created much of the problem that exists today. Many CSO systems were originally built over 100 years ago, and the lack of funding is making it a challenge for governments to even maintain these systems.

In the US alone, hundreds of billions of dollars are needed to simply maintain current water networks over the next 20 years. For Tijuana, current systems are underfunded and the water authorities can't keep up with rapid growth. In addition, off-network systems and runoff would not be fully addressed by an SSO.

As previously mentioned, one factor making shared WWTPs less attractive, is the additional cost related to piping and sewage systems—for either type—to transport the flows a greater distance to a larger shared WWTP, compared to a smaller individual WWTP in a more local setting.

An unfortunate reality is that investing large amounts of funding for infrastructure projects is often politically difficult, particularly when they can't be seen. As such, footing the bill for a neighboring nation's invisible infrastructure projects can be outright unpalatable.

Budget shortages, weak political will, and a tendency to push problems down the road have meant decades of underinvestment. A first step, is to correct this funding gap, either through more true-cost water pricing schemes, with better metering and tariff collection, the use of public-private partnerships, or increasing public allocation for critical infrastructure. The optimal blend of shared or individual projects, large-scale or small-scale, centralized or distributed, depends on context and what can be achieved.

Among the cheapest responses to these challenges is greater communication. One of the complaints from the USIBWC and San Diego authorities has been a lack of notice or warning from their Mexican counterparts of when problems occur, either in routine overflow of the CSO, or during a failure of the system on the Mexican side. Poor internal governance can only be partly to blame if transboundary standards and protocols are not in place.

An area for improvement would be enhanced monitoring of wastewater systems on both sides, with the information shared between each entity in a more seamless fashion, such as through a shared online database, which could help coordination and the building of additional goodwill between the parties. In the most recent example, the lack of communication between the US and Mexico combined with a more toxic political climate has led to increasing tensions.

Transboundary Sewage Spill Investigation—February 2017

On March 2nd 2017, the US and Mexico commissioners of the IBWC agreed to investigate a February 2017 transboundary sewage spill that reportedly dumped millions of gallons of untreated sewage into the shared waters of San Diego, CA and Tijuana, Mexico.[xvii]

From February 6th to the 25th an estimated 143 million gallons of untreated wastewater spilled into the Tijuana River after the failure of a section of the "Insurgentes" wastewater collector, in the vicinity of the confluence between the Tijuana and Alamar Rivers in Tijuana, Mexico. Upon the bi-national investigation by the commission, three priority themes were identified as areas for further cooperation through Bilateral Working Groups (BWG), on Water Quality, Sediment, and Solid Waste.

BWG-Water Quality

Equipment for Emergency Situations: The State Public Services Commission of Tijuana (CEPST) to invest $2.12 million USD for construction and maintenance of the sanitary sewer network.

Installation of Flow Meters: Three locations along the Tijuana River—downstream of the PB-CILA pumping station diversion, upstream of the PB-CILA diversion, and downstream of the border in the U.S.

Communication: Establishing a shared international protocol for spill notifications for the responsible agencies in both countries, including requirements to notify the IBWC.

Infrastructure Assessment: $240,000 USD, financed by the US EPA, to diagnose the existing bypass and pumping system, and evaluate new infrastructure alternatives in Mexico and the United States to increase flow management capacity in the Tijuana River.

Infrastructure Works: MXIBWC installed a sandbag weir wall in the Tijuana River Channel to capture normal peak flows not captured by PB-CILA, and additional pumps to pump captured water back to PB-CILA. USIBWC to provide 4 additional pumps and control panels for PB-CILA. Hiring additional personnel to continuously attend its operation. Rehabilitation of 4 wastewater collectors in Tijuana, and 5 KMs of the "Poniente" wastewater collector.

Water Quality Monitoring: Established monitoring sites on the Tijuana River and Alamar River, as part of a national water quality monitoring network. Developed a binational water quality monitoring program for the Tijuana River and flows from transboundary fisheries, including soil sampling, and monitoring of border sites in the US and Mexico.

Binational Field Inspections: Joint tours by the IBWC Water Quality Binational Working Group of the Tijuana River channel and tributary streams, to detect potential transboundary wastewater spills in the Tijuana River and sites of interest.

BWG-Sediment

Perform studies on required actions and maintenance to control sediment in the upper part of the Tijuana River basin. Studies carried out by the US Army Corps of Engineers on both the Mexican and American parts of the Tijuana River basin. A feasibility study will consist of hydrologic/hydraulic and sediment transport modeling.

BWG-Solid Waste

Upon secured funding a binational study on the feasibility of installing trash booms at strategic sites in the Tijuana River and its tributaries on both sides of the border.

This example shows that even when systems are in place, without continued commitment, usage, and maintenance of these mechanisms, problems will occur that can damage relations. Active participation and regular review of these mechanism should also be encouraged to promote deepening cooperation.

Water in the Mining Sector

Being Better Neighbors

Another example of approaches to transboundary wastewater comes from the mining sector, one of the most water intensive industries in the world. While we typically think of transboundary waters with respect to political or national boundaries, such divisions also apply to other areas, such as private versus public domains, or between commercial enterprises and the surrounding local communities. All such boundaries are ultimately arbitrary to the natural boundaries of water—from sea to river, or basin to basin.

For the mining sector, collaborative water stewardship is becoming increasingly important for the following reasons: water challenges are growing; it is expensive; it is a growing source of conflict; and mining directly interacts with a complex local water system. This has required consideration from mining companies to address issues related to their activities. The central role of water and need to increase efficiency has helped to further innovations in wastewater reuse for potable and non-potable applications.[xviii]

Mining & Water by the Numbers

Roughly 70% of mining operations of 6 of the largest mining firms are located in water-stressed countries.[xix] The mining industry is probably the second largest industrial user of water in the world after the power generation industry. It uses between 7 and 9 billion cubic meters of water per year, which is about as much water as a country like Nigeria or Malaysia uses in total in a year.

Water related infrastructure accounts for up to 10% of the mining industry's capital expenses. Since 2000, 58% of complaints on mining companies to the IFC's Compliance Officer Ombudsman have been on water-related issues. The cost of these trends amounts to billions of dollars for the industry and increasingly difficult work environments due to reputational harm and protests from local communities. From coal and iron to rare earth elements for high-tech electronics, mining remains crucial to development.

Therefore, it is critical for mining companies to address their own water issues, and to do so in a transboundary focused manner, even if only for their own interests. Innovation to increase efficiency is one component. Some responses to these challenges have focused on efforts in communication and planning, proactive community engagement, catchment-based governance initiatives, and collective infrastructure.

> *"Water has always been important for mining, but suddenly it has become a board-level issue. Shareholders now expect companies to have identified the operational and environmental risks they face as a result of their water usage, and show that they are pursuing strategies to minimize this risk."*[xx]

Oyu Tolgoi

One such example of public-private cooperation on transboundary wastewater issues in the mining sector is of the South Gobi region of Mongolia. Water is precious to this region, and mining has complicated matters for the communities that depend on it. While mining begins to form the economic backbone of Mongolia and receives large-scale government support, "herders have lived for thousands of years without gold, copper, coal and metals, but haven't lived a week without water."[xxi]

Mining companies active in the area have taken steps to reduce their water usage and improve efficiency, to minimize losses and maximize recycling potential. These savings have helped to reduce overall water consumption to less than half of the global average at the Oyu Tolgoi copper mine.

In spite of such efforts, public dissatisfaction with the mining companies was rising, primarily due to a lack of communication between mining firms and the local communities. Most Mongolians lacked an understanding of South Gobi's water cycles, and how the mining companies used the water resources. Communication and collaboration between stakeholders were key to addressing these concerns and also sharing the companies' good water practices with the public.

Water accounting, and better approaches to data sharing with government authorities was key to creating a collaborative approach to productive dialogue.[xxii] Developing a *Voluntary Code of Practice* helped to set the standards for the region, increase transparency, to increase confidence in the regulatory environment of the sector. Importantly, efforts to establish and improve best practices were shared between the private-sector mining companies and the water governance entities.

Canadian Runoff

From Alaska to Montana, upstream mining activity in British Columbia, Canada has caused continuing environmental damage in several US states, even from mines that have been closed over 60 years. This has led US lawmakers to call for binding international agreements to mandate a transparent environmental review process agreed to by the US, Canada, and Tribal governments.[xxiii]

Community demands include enforceable financial assurances from mining companies and governments for mine safety long-term, as well as funding to conduct baseline water quality studies, collect data, and assess fish and wildlife in transboundary watersheds. Establishing such agreements across governments and communities will require a broad-based approach.

Tribal governments would be most disadvantaged in these negotiations, subject to the wills of two large developed nations that they reside within, and international mining companies with annual revenues large than some countries GDPs.

Chilean Drive to Desalination

Decreasing freshwater availability has led the Chilean government to prioritize domestic access rights over those of the mining industry, requiring companies to procure their own water resources by shipping desalinated seawater hundreds of kilometers to the Atacama Desert to supply their operations, at 2-3x the normal cost.[xxiv]

> *"The risk is not so much an individual mine's access to water. The risk is that if a mine's access to water, or the wastewater it produces, either despoils the environment or brings it into conflict with local communities, then the politics of water are such that the mining company might lose its right to operate."*[xxv]

Stalled in Peru

Fierce community opposition led to the delay and stalling of the largest copper mine by reserves, the Tia Maria mine in Peru in 2015.

> *"Peru's $1 billion Tia Maria copper project has been stalled after farmers and environmentalists rebelled over concerns that the project would despoil water resources in the region. Three people died in related disturbances in April this year, forcing the government to cancel the project pending a new environmental impact assessment. Even though the project will import desalinated seawater to meet its needs, the mine developer, Southern Copper, has failed to convince the local community that the mine does not represent a threat to the local water system."*[xxvi]

Southern Copper has continued to work with Peruvian authorities to obtain the final license and open the plant, working to grow support for the project in the southern region of Arequipa, including conducting a new environmental impact assessment after fatal protests. Once approved it would take two years to build the mine.

Learning Lessons

Each of these examples from the mining industry show the business case for transboundary water considerations, the lessons of which can be directly applied in practices between nations and various stakeholders. Among these are understanding the value of water from different perspectives of different stakeholders. Water is variable in time and space, while future availability is uncertain. Water is a finite but renewable resource, physically constrained by infrastructure, and historical water rights and legal systems. Potable water cannot be substituted, and even the most efficient operations can still have an impact. That water is essentially a regional product—heavy, bulky, and expensive to move, limiting distance it can travel. And finally, fundamental flows upstream and downstream require a catchment-based approach.

The International Council on Mining and Metals (ICMM) has compiled a practical guide to catchment-based water management, which begins from the natural boundaries of water, and promotes how to address the problems of mining wastewater and efficient water management across boundaries.

Awareness | Assessment | Response

Taking a catchment-based approach helps to fully conceptualize complex water challenges, seeing the full picture and taking specific actions, as opposed to focusing on narrow national issues and responses that miss the feedback loops of the full watershed.

> *"A catchment-based approach encourages organizations to consider holistically how competing demands on water resources from a range of stakeholders (domestic water users, industry, regulators, politicians) can create pressures and lead to conflict if not appropriately managed. It also requires that people from different sectors be brought together to identify issues and agree priorities for action, and ultimately build local partnerships to put these actions in place."*[xxvii]

In order to prevent water risk from combining with mining risk, mining firms are being forced to be better neighbors and take holistic approaches outside of their immediate activities.

ICMM Principles for Water Stewardship

- Be transparent & accountable
  - Meaningful disclosures & clear party accountabilities
- Engage proactively & inclusively
  - Identify stakeholders & understand concerns
  - Provide basis for partnership to mitigate risk
- Pursue effective water resource management
  - Optimize for efficiency
- Adopt a catchment-based approach
  - Holistic view of current & future water users

Mechanisms for implementing this cooperation can be formal, informal, or formalized over time with buy-in and some initial success to build goodwill. Establishing Working Groups can be effective tools to address specific actions and concerns of a community, which can later be expanded to include a holistic water mandate.[xxviii]

Mapping a catchment to include its full hydrology profile and its relevant stakeholders, including all users as well as their perceptions, can identify concerns and prevent later conflicts. ICMM and IFC provide community development tools for stakeholder identification and early engagement.

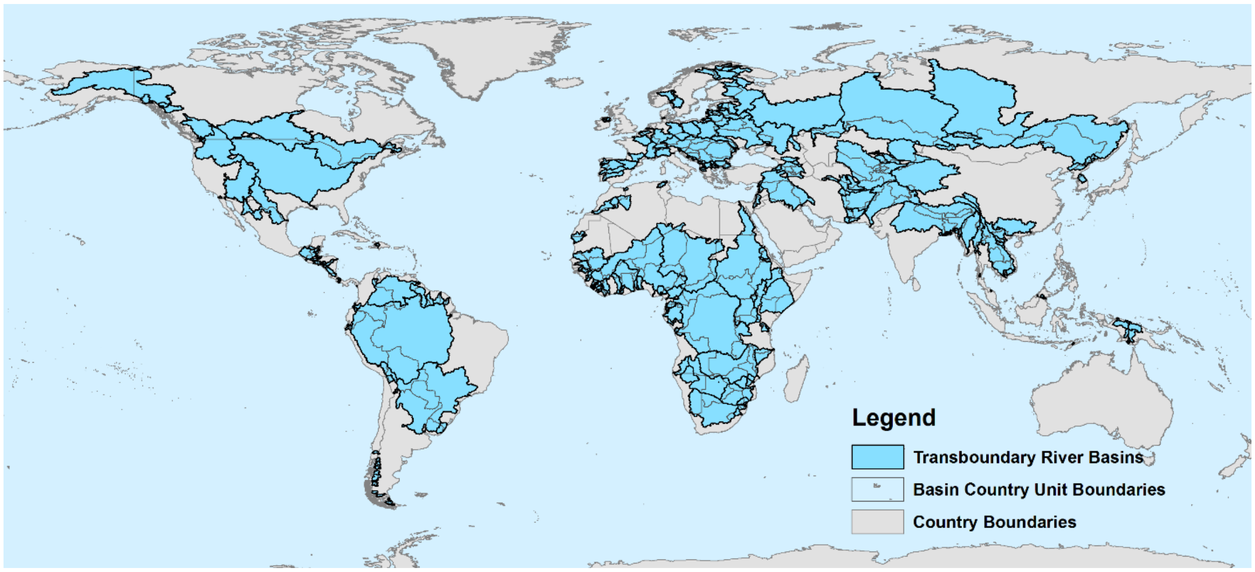
Having a full catchment-based picture, apply multi-scenario analysis over various lifespans of the mine, or of a city, community or country, to identify risks and pressure points. Are funds available to address these scenarios? Is there capacity to deal with increased wastewater flows of varying grades? How will climate change factors change this risk assessment? How do climate events such as flooding impact the wastewater treatment plan? Are their contingency plans in place to address such events?

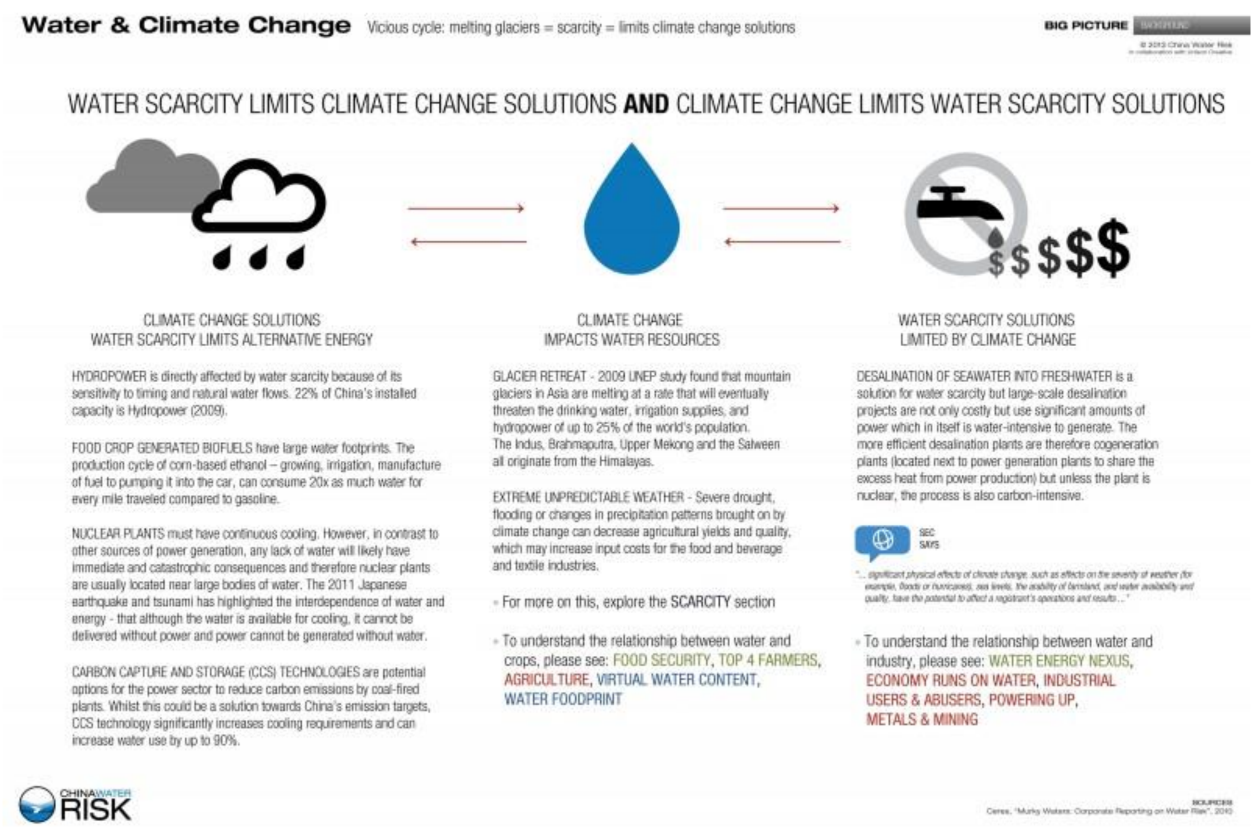
The mining sectors experience with water and particularly transboundary wastewater provides many lessons and case studies of how planning and valuation must be conducted, and what happens when it is not. When insufficient water treatment infrastructure exists, it is up to the mining company to provide these facilities. In the Cerro Verde copper mine in Peru, a public-private partnership was formed to guarantee the necessary supply of water to the mine, and to also treat the city's wastewater—providing needed infrastructure to the city, while securing the water needs of the company.[xxix]

From small communities, to relations between cities or nations, or business and the public, these lessons should be better understood and incorporated into transboundary wastewater practices to create negotiated solutions that provide improved water security for all.

Transboundary Wastewater Exhibits

The following exhibits provide some examples and infographics on transboundary wastewater regions and applications, including country or basin case studies, and the mining sector.





MEDRC

The Voluntary Code of Practice: principles of good water management for mining companies in the South Gobi

Mission

We acknowledge that access to water is a basic human right and voluntarily commit to the responsible, legally compliant and sustainable use of water. We will be efficient in our use of water, transparent in our monitoring, maintain water quality and will provide broad participation in our water management activities.

Vision

We will be responsible companies and build trust by working together to relieve water stress, support the development of sustainable communities and bring benefits to Mongolia.

Signatories

Energy Resources
Erdenes Mongol
Erdene Resource Development
Erdenes Tavan Tolgoi
Gobi Coal and Energy
Oyu Tolgoi
South Gobi Sands
Terra Energy

Signatories file annual reports to assess performance across six pillars.

1. Act transparently and with accountability

1.1 Publicly report water risks, management activities and performance using recognized metrics

1.2 Organize project site visits for communities and vice-versa

1.3 Develop a community grievance mechanism and ensure it is accessible for communities

2. Comply with national law and international standards

2.1 Comply with Mongolian law, catchment governance requirements (RBAs/RBCs), and international standards on water management

2.2 Support the government of Mongolia in developing and implementing its legal and regulatory framework for water resources management

2.3 Incorporate good international industry practice for mine-water management in business operations

3. Engage proactively and inclusively

3.1 Develop participatory monitoring programs for communities adjacent or near to exploration and mining activities

3.2 Organize community discussions and information sharing, including the results of any monitoring programs

3.3 Support public education and awareness raising through communications materials in a format that is accessible to the given audience

4. Effective water resource management and conservation

4.1 Maintain a water monitoring program that respects local customs; monitoring reports will include information on water levels and water quality in wells

4.2 Optimize water efficiency and conservation at mine site operations and minimize water waste

4.3 Identify, monitor, and manage high value biodiversity assets that are dependent on water to ensure their safeguard

4.4 Maintain a site water balance to report annually on key metrics pertaining to water performance; use report to inform long-term mine planning and closure plans

5. Create positive impacts

5.1 Support impacted local communities to maintain or improve access to water resources

5.2 Support local communities to improve traditional ways of protecting wells

5.3 Support access to water for livestock in times of stress

6. Support local water infrastructure and services

6.1 Rehabilitate or improve impacted water resource infrastructure in pastureland to pre-project status

6.2 Engage communitymembers to improve water management practices in pastureland themselves

6.3 Support community projects to develop sustainable water supplies in areas of impact

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Outcome

Clarity on the relevance and value of a catchment-based approach

1.2 Corporate approaches to water stewardship

1.2.1 Review what water stewardship means for your company 20

1.2.2 Be aware of how peers are approaching water issues 21

1.2.3 Consider water stewardship across the mine life cycle 22

Outcome

Clarity on what water stewardship would entail for your company across the mine life cycle

1.3 Broader catchment activities, processes and regimes

1.3.1 Be aware of catchment institutional arrangements 23

1.3.2 Be aware of catchment management planning and strategies 24

Outcome

Clarity on institutional and catchment management issues that may be relevant for your company

Stakeholder engagement

Internal action
Motivate a team and assess governance 25

External engagement
Identify stakeholders, clarify concerns and aspirations 26

Key content of this step

2.1 Define the operation's functional boundary and identify major issues

2.1.1 Identify physical, social, economic and environmental elements 29

2.1.2 Identify stakeholder concerns and perceptions 30

Outcome

Identification of the operation's functional boundary and associated major issues

2.2 Understand the water issues in the catchment

2.2.1 Assess the biophysical character of the catchment 32

2.2.2 Clarify the regulatory and institutional framework 33

2.2.3 Evaluate the socioeconomic and ecological aspects of the catchment 34

Outcome

A clear understanding of the catchment characteristics and how they may evolve over time

2.3 Understand water issues across the mine life cycle

2.3.1 Understand how water supply requirements change over the mine life cycle 36

2.3.2 Understand management requirements of mine-impacted water 37

2.3.3 Consider regulatory, development and social aspects of operations 38

Outcome

A clear understanding of the vulnerability and total cost of managing water for the operation

2.4 Understand the operation's catchment risks

2.4.1 Identify water-related risks 40

2.4.2 Assess the pathways associated with the key risks 41

2.4.3 Prioritize and identify material risks 42

Outcome

Prioritization of the operation's water risks in the catchment across its life cycle

Stakeholder engagement

Internal action
Engage cross-functional teams 44

External engagement
Clarify engagement objectives and initiate iterative consultation 45

An explanatory note on Step 2

This step provides guidance on the water issues that may arise both from a catchment and operational lens. It will provide users with a series of prompts and questions to ensure that the most relevant information is being collected and considered. It should be noted that although the following steps are laid out sequentially, this is not a purely linear process. Constant iteration and refinement is needed in light of new information and changing circumstances.

An Excel-based action register (see the attachments panel) has been developed as a resource to help users note down responses to the questions and prompts contained in the Assessment step of the guide.

Key content of this step

3.1 Understand response options to mitigate water risk

3.1.1 Determine if water risks can be mitigated by internal action 48

3.1.2 Identify potential external response options 50

Outcome

Evaluation of potential response options to mitigate priority water risks

3.2 Evaluate potential responses

3.2.1 Consider opportunities for engaging other partners 51

3.2.2 Assess risks and opportunities for potential responses 55

Outcome

Evaluation of potential interventions, including partners, risks and benefits

3.3 Develop a response strategy

3.3.1 Develop a response strategy, plan and governance 57

Final outcome

Development of response strategy and water risk governance arrangements

Stakeholder engagement

Internal action
Communicate strategy and promote champions 58

External engagement
Communicate intentions, evaluate progress, maintain engagement 59

Sources for Further Learning

Websites

CEO Water Mandate - Corporate Water Reporting Guidelines – http://pacinst.org/publication/corporate-water-disclosureguidelines

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