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TUCSON PHOENIX SANTIAGO DE CHILE

MEMORANDUM

DATE: **January 13, 2012** **PROJECT: 1232.057**

TO: Kathy Arnold
ROSEMONT COPPER COMPANY

FROM: Mark Myers and Taylor Shipman
MONTGOMERY & ASSOCIATES

SUBJECT: **THE POTENTIAL FOR FUTURE COLORADO RIVER SHORTAGES TO IMPACT ROSEMONT OPERATIONS**

INTRODUCTION

In the words of the Bureau of Reclamation (BOR), the Colorado River (the River) "is experiencing a protracted multi-year drought which began in October 1999."[1] While runoff into Lake Powell has ranged from a record-low of 25 percent of normal (2002) to 162 percent of normal (2011) over the last 12 years, runoff has been below average in 9 of these years. One result of the ongoing drought has been a proliferation of media reports and academic studies on the likelihood and potential effects of future shortages in deliveries to agricultural, urban, industrial, environmental, and recreational interests that utilize water from the River. Unfortunately, in many cases, such reports and studies are written in a way that reveals that it is the first time the authors have seriously considered the issue of possible shortage. Given the complex and evolving body of legal and policy constraints governing sharing of Colorado River water in shortage, normal, and surplus conditions, the tendency of commentators has been to avoid engaging with this vast and intricate system of rules and focus instead on oversimplifying the problem and predicting crises. As a result, the conclusions that many reports draw about the future of the River are inherently flawed and rarely corrected.

In contrast to the common caricature of the River system as being on the verge of collapse, the reality is that it is quite robust in terms of its governing body of law, its plumbing, its planning and problem-resolution processes, and its management. Although shortages will certainly occur along the River, they have been anticipated since the River was initially allocated 90 years ago, and levels of sequentially more specific planning for future shortages have been developed over the intervening decades. Like many other River issues (environmental protection, power generation, reservoir management, salinity control, recreation, etc.), the issue of shortage

[1] http://www.usbr.gov/uc/feature/drought.html

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TUCSON PHOENIX SANTIAGO DE CHILE

January 13, 2012

Ms. Kathy Arnold
ROSEMONT COPPER COMPANY
P.O. Box 35130
Tucson, AZ 85740-5130

SUBJECT: RESPONSE TO COMMENTS SUBMITTED BY DR. ELIZABETH BERNAYS ON ROSEMONT DEIS

Dear Kathy:

As requested, we have reviewed the comments submitted to the U.S. Forest Service by Dr. Elizabeth Bernays, Professor Emeritus, University of Arizona, concerning the Draft Environmental Impact Statement for the Rosemont Project. Because the comments were lengthy, we have prepared six separate responses to individual issues raised by Dr. Bernays. We hope that these responses will be useful to the U.S. Forest Service in addressing the comments. Enclosed are memoranda addressing:

1. Potential for future Colorado River shortages
2. Documentation of springs and seeps
3. Impact of mine on individual wells
4. Comparison of Rosemont's water use to other mines
5. Evaporation water losses from open pit
6. Water requirements for power generation

If you have any questions or need additional information or clarification, please let us know.

Sincerely,

MONTGOMERY & ASSOCIATES

James S. Davis

James S. Davis

Enclosures (6)
cc: Jamie Sturgess

SENT VIA EMAIL

1232/057/CoverLet_BernaysResponses.docx 13Jan2012 management is not immutably cast in stone. Rather, as the impact of the policies are observed, they are modified over time by all of the Colorado Basin states, stakeholder tribes, economic and water interests, environmental and public interest groups, Mexico, and the Bureau of BOR as the federal manager of the River water supply and plumbing. When consensus develops that problems are emerging with River operations, the states and federal government (and Mexico, if international issues are involved) activate their planning mechanisms to assess the problem, and to develop and implement solutions and compromises.

The reality of this decision-making process doesn't make for attention-grabbing headlines, but it works well to balance the needs of the many interests along the River. The proof of the effectiveness of this process is that only once in 90 years of River management, despite a system that is over-allocated and has had to accommodate many substantial new demands since its inception, has a major interstate River issue had to be resolved in court. That is a truly remarkable record.

The following discussion traces the history of Colorado River allocation, summarizes historic and projected River flows, and describes shortage planning efforts to date. The memo includes a discussion of the effects of a future shortage on the availability of Colorado River water to Arizona, the Central Arizona Project (CAP), and, ultimately, to Rosemont Copper. The conclusion in terms of Rosemont is that water supplies will be available in sufficient quantity to accomplish all of the planned replenishment within the time frame of planned mine operations. The only major uncertainty will be how much Rosemont will have to pay for those supplies.

The following analysis documents that a future shortage on the River will likely cause water prices to rise substantially compared to current levels. In anticipation of this, Rosemont has already taken several steps as part of its water acquisition strategy. First, Rosemont purchased a large "insurance policy" by expending millions of dollars to store more than a third of its projected future water demand. This storage program will buffer future pricing shocks. Second, Rosemont is likely to complete pre-storage during the first 15 years or so of mine operations, during a period when any shortages would likely be shallower and shorter than in later decades. Third, the quantities of water that Rosemont needs are small relative to the system capacity. Finally, Rosemont has initiated and invested millions of dollars in a cooperative regional effort to provide the infrastructure to recharge its replenishment water in close geographic proximity to its planned pumping locations in the Green Valley/Sahuarita area. Neither the committed replenishment nor the new recharge project is legally required, and these steps are being pursued voluntarily by Rosemont. It is worth noting that the two major groundwater users in the area, each of which pumps about 5 times the planned Rosemont pumping, has not taken either of these steps to offset pumping impacts on the aquifer. The Rosemont plan is the first such completely voluntary program among major agricultural and industrial users in the state to completely replace all groundwater pumping.

THE HISTORY OF COLORADO RIVER WATER SUPPLY ALLOCATION

1922 Colorado River Compact

The Colorado River Compact (Compact) was approved by Congress in 1922. This relatively short document, signed by all seven states in the Colorado River Basin, has proven to be far-sighted and resilient. It was the first interstate river apportionment compact negotiated between states sharing a river system. Previous disagreements between states over streamflow apportionment had generally ended up in court. The Compact is the foundation for all of the subsequent Law of the River (treaty, statutory, administrative, regulatory, judicial) developed in the past 9 decades.

The Compact divides the Colorado basin into the Upper Basin and the Lower Basin, with the dividing line at Lee Ferry in Arizona (Article II(e)).[2,3] The first level of apportionment of River supplies is included in Article III of the Compact. Subsection (a) allocates the "exclusive beneficial use of 7,500,000 acre-feet (AF) of water per annum" each to the Upper and Lower Basins.[4] The compact states that, "The States of the Upper Division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 AF for any period of 10 consecutive years…".[5] This provision effectively gives the Lower Basin states (Nevada, California and Arizona) priority over the Upper Basin states for the first 75,000,000 AF every 10 years, which in operational criteria has been translated to 7,500,000 AF per year.

Priority under future shortage conditions was also considered in the Compact, although it would take more than 20 more years to quantify it. In any future treaty allocation of River water to Mexico, that obligation shall first be met from any surplus supplies available, and then split evenly between the Upper and Lower Basin. Specific language states, "…whenever necessary the States of the Upper Division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized *in addition to that provided in paragraph (Subsection) (d)."*[6] (Italics added for emphasis.) Thus, in addition to the 75 million AF every 10 years, the Upper Basin has an additional obligation to deliver up to one-half of any future Mexican treaty obligation every year in which system surpluses do not cover the treaty requirement.

The Compact further protected the rights of the holders of present perfected rights, which refer to beneficial uses of River water that were already established at the time of the Compact approval.[7] These rights, in whichever state they were located, were assigned first priority for available

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[2] Colorado River Compact, 1922, Article II(e) – (g)

[3] Note that Lee Ferry in this context refers to the hydrologic divide between the Upper and Lower Basins, and is located 1 mile downstream from the location of Lee's (or Lees) Ferry that is commonly shown on maps. More detail on this historical fact can be found at http://wwa.colorado.edu/treeflow/lees/compact.html

[4] Colorado River Compact, Article III (a)

[5] Colorado River Compact, Article III(d)

[6] Colorado River Compact, Article III(c)

[7] Colorado River Compact, Article VII

supplies. Since the majority of these rights are located in the Lower Basin, the Compact also provides an overlapping protection to the present perfected rights holders.[8] The Compact also provides the basic outlines of the River management and dispute resolution processes that have since evolved over time.[9]

1928 Boulder Canyon Project Act

The primary focus of the Boulder Canyon Project Act, passed in 1928, was to authorize the construction and operation of Boulder Canyon Dam (now Hoover Dam), the All American Canal and its diversion dams, and attendant flood control and power generation facilities. The law also formalized the apportionment (later confirmed by the U.S. Supreme Court in 1963) of Lower Basin water between California, Arizona and Nevada.[10] The annual apportionments, with no specific prioritization between states, were 4.4 million AF to California, 2.8 million AF to Arizona, and 0.3 million AF to Nevada.

1944 Mexican Water Treaty

The Mexican Water Treaty, passed in 1944, provides 1.5 million AF to Mexico in a normal flow year, and up to 1.7 million AF in a surplus year.[11] With respect to shortages, the treaty also provides that, in the event of "extraordinary drought", the water allocated to Mexico "will be reduced in the same proportion as consumptive uses in the United States are reduced."[12]

Relating this back to the 1922 Compact provisions that required the Upper Basin to deliver one-half of Mexico's obligations, the combined body of law now required that the Upper Basin deliver at least 8.25 million AF per year to the Lower Basin (including Mexico's share). At the same time, the Lower Basin obligation to the states and Mexico total 9 million AF per year. Thus, a high certainty of future shortages of 0.75 million AF per year for the Lower Basin states was created. Lower Basin state water interests have always recognized that this meant that the first 0.75 million AF per year of shortages would fall mostly on their shoulders, with Mexico likely assuming a small share of the shortage.[13] For the Upper Basin, it meant that if the total River system shortfall was more than 0.75 million AF, the Upper Basin would have to absorb the entire remaining balance.

[8] Colorado River Compact, Article VII
[9] Colorado River Compact, Articles V and VI
[10] Boulder Canyon Project Act, 1928, Section 4(a)
[11] Mexican Water Treaty, 1944, Article 10
[12] Mexican Water Treaty, Article 10
[13] The actual shortage-imposed reduction of deliveries to Mexico will depend on future international negotiations and an authorized treaty minute. It is estimated that a future Mexican shortage reduction from the obligation to deliver 1.5 million AF could be between 10 and 17 percent, depending on if deliveries will be reduced during shortage by an amount proportional to Mexico's share of total basin U.S. obligations of 15 million AF (10%) or just to the Lower Basin allocation of 7.5 million AF (17%).

1948 Upper Colorado Water Basin Compact

Only a few years after the Mexican treaty, the Upper Basin states completed the allocation of their River supplies.[14] The allocation (with the exception of the Arizona Upper Basin allocation, which was a flat 50,000 AF per year) was a pragmatic recognition of the shortage rules outlined in the Compact and the Mexican treaty. The Upper Colorado Water Basin Compact provided that, "To the States of Colorado, New Mexico, Utah and Wyoming, respectively, the consumptive use per annum of the quantities resulting from the application of the following percentages to the total quantity of consumptive use per annum apportioned in perpetuity to *and available for use each year by* (italics added for emphasis) Upper Basin under the Colorado River Compact…"[15] The percentages assigned in the compact are 51.75 percent to Colorado, 11.25 percent to New Mexico, 23 percent to Utah, and 14 percent to Wyoming. The adoption of these percentages, rather than quantified allocations, effectively institutionalized the fact that future shortages might create wide variability in the quantity of water legally "available for use" each year in the Upper Basin.

At this point in history, the basic outlines of the River's shortage management program have emerged. The Lower Basin plus Mexico have priority over the Upper Basin for 8.25 million AF per year. In order to meet that delivery obligation, the Upper Basin (except for the small number of present perfected rights) must limit its usage to water supplies in excess of that delivery requirement. In a shortage year, the Lower Basin states must absorb the 0.75 million AF per year differential between the 8.25 million AF of guaranteed Upper Basin deliveries and 9.0 million AF of apportionments and treaty commitments. If an international shortage-sharing agreement is reached with Mexico, Mexico will share in a small portion of this shortage (estimated to be between 10 and 17 percent).

1964 Arizona v California Supreme Court Decree

Among other things, the 1964 *Arizona v. California* Supreme Court Decree settled the apportionments between the Lower Basin States by affirming the Congressional apportionments set forth in the 1928 Boulder Canyon Project Act.[16] This ruling set up California, which was already using much more than its apportionment, for future cutbacks if Arizona ever grew into its full apportionment.

The Court also introduced some uncertainty regarding shortage sharing, wherein it held that "…the Secretary (of the Interior) is not bound to require a pro rata sharing of shortages…", but is rather "…free to choose among the recognized methods of apportionment or to devise reasonable

[14] The Upper Basin States include Wyoming, Colorado, Utah, New Mexico and, a small portion of northeastern Arizona that is upstream of Lee Ferry.
[15] Upper Colorado Water Basin Compact (1948), Article III(a)(2)
[16] Arizona v California Supreme Court Decree (1963), Section 1

methods of his own…”[17] With this language, the Court appeared to take a step back from the trend toward increasing certainty about how shortages would be managed. It didn’t take California long thereafter to impose a much more satisfactory (to California) shortage management regime.

1968 Colorado Basin Project Act

The 1968 Colorado Basin Project Act was the culmination of the almost century-old dream of Arizona’s water visionaries. It authorized the construction of the CAP to bring water from the Colorado River into the Phoenix area, Pinal County, and, ultimately, the Tucson area. Securing that authorization, however, was only accomplished after paying a heavy price to California interests with respect to how future shortages would be managed.

This law gave California’s entire 4.4 million AF annual allocation higher priority than all of Arizona’s remaining River water supply that was not yet under federal contract.[18] This remaining water was contracted after 1968 to CAP and to users along the Colorado River. This is Arizona Priority 4 (P4) water, and amounts to approximately 1.6 million AF per year. With the exception of a small shortage allocation to Nevada and the as-yet-unquantified shortage allocation to Mexico, therefore, only the Arizona P4 water users would have to absorb the future Lower Basin shortages of up to 0.75 million AF per year, as described above.

In practice, when Mexico takes a share of shortage, the full Arizona shortage (minus the small amounts to Nevada and Mexico) is likely to be about 0.65 million AF per year, which is 40 percent of the P4 water supply contracts. Since virtually the entire CAP supply is P4, the CAP system could experience shortages that approach 600,000 AF in a shortage year, with the balance of the shortage absorbed by on-River P4 contract holders. With the passage of the 1968 Act into law, California now had a strong position in any future shortage vis-à-vis its River allocation, leaving Arizona to address shortage management issues.

SHORTAGE PLANNING

As the preceding narrative illustrates, shortages have been anticipated since the very beginning of the development of the Law of the River. Indeed, sometimes as a subtext and sometimes as a prominent theme, the evolving key milestones in the Law of the River reflected the jockeying for relative position during shortages by states and other key interests. Even more important, though, was that the basic framework for shortage sharing was fairly well defined by 1968, during the first 50 years after enactment of the Compact.

[17] Arizona v California, Section 3
[18] Colorado Basin Project Act (1968), Subchapter III, Section 1521(b),

Basinwide Shortage Management

Across the Colorado River basin, mitigating potential shortage impacts began almost 40 years ago—shortly after the passage of the 1968 Colorado Basin Project Act. The first major steps were taken with the 1974 Colorado Basin Salinity Control Act, which provided for the construction of a desalination plant at Yuma to treat agricultural return flow to a level acceptable for delivery as part of Mexico's treaty apportionment. After construction of the plant, however, the basin went into a period of high flows, resulting in annual surpluses that lasted until the year 2000. During this period of abundant supplies, the desalination plant was maintained but not utilized, and few additional shortage management steps were taken. One notable exception was the establishment of interstate water banking through the concept of "intentionally created unused apportionment" with rules adopted in 1999[19]. Additionally, though relatively inactive regarding shortage management, basin interests implemented a plan to facilitate the reduction of California's annual usage to 4.4 million AF, from about 5.2 million AF during this period. It was also during this period that the basin states began to wrestle with complex environmental preservation/enhancement issues along the River.

The period of relative inactivity in shortage management came to an end when the basin entered a period of prolonged drought starting in October 1999. During this period of below-average runoff in the Upper Colorado River Basin, though no shortages were declared, reservoir storage dropped well below half of capacity. Though storage levels have since recovered significantly (at the end of 2011, Lake Powell was at 66 percent of capacity and Lake Mead at 57 percent), this period of drought refocused the attention of basin water managers on planning for future shortages.

Building on the basic framework and institutions of the Law of the River, a number of major shortage management and resource optimization initiatives were adopted. The basin states began actively planning River supply augmentation efforts, and implemented a cloud-seeding program to enhance precipitation in the Upper Basin. The basin states also funded several water conservation and transfer initiatives. Among these initiatives were construction of Brock Reservoir along the All American Canal, the use of which prevented the release of an extra 100,000 AF of water to Mexico in 2011; lining of the All American Canal to virtually cease seepage losses; development of fallowing agreements between urban and agricultural users in California to shift water to urban uses, and between BOR and farmers in Arizona to provide water for environmental uses; and continued salinity control work throughout the River basin. During this period, BOR began to more closely monitor usage by its many contractors and require payback of excess diversions. The basin parties also agreed on a new concept called "intentionally created surplus" to allow storage of state-controlled water supplies in Lake Mead under specific tightly-defined conditions.[20] Additionally, the basin interests agreed on specific reservoir "equalization" rules that allow for joint management of Lakes Mead and Powell to

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[19] Interstate Water Banking Rule, CFR 43, part 414, 1999

[20] Colorado River Interim Surplus Guidelines, Bureau of Reclamation, Record of Decision, Final Environmental Impact Statement, January 2001

optimize the many benefits of the River system (including power generation, water supply, flood control, recreation, environmental) in normal, shortage, and surplus conditions.

Perhaps most important from Arizona's perspective, the basin states and federal government worked out an initial agreement for shortage sharing in the lower basin. The Interim Shortage Sharing Guidelines[21] specified the Lake Mead reservoir levels at which shortage declarations would be made, the actual amount of delivery reductions that would be required at each shortage level, and the amount of shortage Arizona would have to absorb for each of the three shortage levels. The three shortage levels are triggered when Mead's elevation drops to 1,075, 1,050 and 1,025 feet above mean sea level, respectively. Arizona Colorado River Priority 4 water contracts will be cut back from normal year deliveries of 2.8 million AF to 2.48, 2.40, and 2.32 million AF each year, respectively, as the progressively lower levels of Lake Mead elevation are reached during a drought. Referring back to the discussion above, the initial shortage reduction to Arizona of 0.32 million AF is about half of the 0.65 million AF per year of expected Arizona maximum shortage before the burden of shortage absorption shifts to the Upper Basin states.

Scripps Institution of Oceanography (Scripps) Studies

Thus far, this memorandum has attempted to provide a cursory introduction to the evolution of the Law of the River, which provides a robust framework for managing the highly variable natural flow of the Colorado River in a way that smoothes variations in flow from year to year, providing reliability to those that depend on the River for water supplies. Without the laws, policies, operational criteria, and storage capacity that have been developed over the last 90 years, the Colorado River system would not be able to provide a reliable water supply to these users. Clearly, they are integral to the system.

It is puzzling, therefore, when studies predicting the state of the water supplies in the system do not explicitly account for the complexities and detail of either the Law of the River or the institutional processes established over the past 90 years. Furthermore, because this omission would naturally facilitate dire conclusions, such studies are easily sensationalized. Two recent studies from the Scripps Institution of Oceanography are provided here as examples of this phenomenon, having garnered wide and sustained press coverage, particularly following the release of the initial study.

The Scripps press release about the initial 2008 study stated, "The researchers estimated that there is a 10 percent chance that Lake Mead could be dry by 2014. They further predict that there is a 50 percent chance that reservoir levels will drop too low to allow hydroelectric power generation by 2017." Finally, it stated, "There is a 50 percent chance Lake Mead …will be dry

[21] "Interim Shortage Sharing Guidelines", Bureau of Reclamation, Record of Decision, Final Environmental Impact Statement, Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead, December 2007

by 2021 if climate changes as expected and future water usage is not curtailed….”.[22] Although these conclusions were repeated on headlines across the country, the fundamental reality of this study is that the researchers did not actually account for how curtailment would be instituted according to the Law of the River and its planning mechanisms.

Although echoes of the initial study continue to appear in the media and commentary from the general public, succeeding events prompted the authors to issue a far less alarmist study just 14 months later in the *Proceedings of the National Academy of Sciences*. Quoting a 2009 press release, "The new study assumes instead that enough water would be retained in the reservoir to supply the city of Las Vegas, and examines what delivery cuts would be required to maintain that level." This revision was clearly designed to incorporate the basis of the Lower Basin shortage sharing agreement adopted in 2007, before the first Scripps study. Not surprisingly, after adjusting for the goal underpinning this agreement, the Scripps researchers came up with numbers similar to what the basin planners had been working with for years: "…reductions in the runoff that feeds the Colorado River… could short the Southwest of [400,000 AF] of water per year 40 percent of the time by 2025." However, despite this positive development, one of the researchers made the following comment: "People have talked for at least 30 years about the Colorado being oversubscribed but no one ever put a date on it or an amount. That's what we have done."[23] This statement indicates that the researchers were not engaged with (or perhaps aware of) the modeling predictions and planning work extending over the previous decades within the basin. This is but one example of how it is not commonly understood that basin planners have acknowledged the eventuality of shortage and have worked continuously for many decades to develop strategic approaches to managing its impacts. The system that has evolved may not be to everyone's liking, but it will have real mitigating impacts on future periods of relative scarcity, and projections that ignore these impacts are misleading at best.

SHORTAGE MANAGEMENT IN ARIZONA

In addition to and parallel with the basin-wide efforts to plan for shortages of Colorado River water, Arizona water managers and planners have developed a set of institutions, laws, and policies to plan for the unique impacts of shortage to Arizona. When the Compact was enacted in 1922, the Lower Basin states all were expected to absorb a shortage in the amount proportional to their allocation for the Lower Basin—about 40 percent of the shortage for Arizona. When forced into junior status to all of California's allocation by the 1968 Colorado River Basin Act, Arizona's water planners had to shift their contingency planning to absorbing and managing more than 80 percent of lower basin shortages. As discussed above, that quantity could be as much as 0.65 million AF per year in a severe drought. However, modeling performed by CAP and BOR indicates that level of shortage does not have a high probability for

[22] Scripps Institute of Oceanography press release, http://scrippsnews.ucsd.edu/Releases/?releaseID=876, dated February 12, 2008
[23] Scripps Institute of Oceanography press release, http://scrippsnews.ucsd.edu/Releases/?releaseID=977, dated April 20, 2009

15 years or more, though a somewhat lower level of shortage is more likely. Therefore, in the Lower Basin shortage sharing agreement that is now in place, Arizona plans for shortage of up to 0.5 million AF per year, and milestones have been established to provide several years of warning if this level of shortage appears likely.

Over the past 90 years, Arizona interests have developed, implemented, and funded a multifaceted and robust shortage planning and management program for Colorado River water users. This program is more fully developed than any similar program in a Western state. A full explanation of this program is beyond the scope of this memorandum. The following limited discussion will review a few of the key shortage management elements: the differentiation of Colorado River water supplies into multiple priorities; underground storage and recovery; development of water markets; and the flexibility to provide local solutions to shortage.

As previously discussed, the Arizona shortages must be absorbed almost entirely by Priority 4 ("P4") contract holders, which consist of CAP (about 90 percent of P4 water) and certain users along the Colorado River (about 10 percent of P4 water). In a farsighted move, CAP water was also prioritized, resulting in supplies that are well-protected against shortage (municipal and industrial (M&I) and Indian priority water) and those that get cut back first with a shortage declaration (non-Indian agricultural (NIA) priority water). The lowest priority CAP water is "excess water" and is made available only on an annual basis. Excess water is water that is not utilized in a given year by contract holders along the River and subcontract holders on the CAP system, plus some sporadic inflows from the Agua Fria River into Lake Pleasant.

The NIA subcontracts will eventually total approximately 350,000 AF of annual supply, while the long-term excess water supply continues to decrease and will likely eventually average about 100,000 AF per year. Together, these lower-priority supplies will likely make up most or all of the CAP shortage share.

In order to manage any water shortage that might exceed the NIA subcontracts and excess supply, plus the shortages that would otherwise have to be absorbed by small cities along the River, Arizona also established the Arizona Water Banking Authority (AWBA). Among its activities, AWBA has the statutory authority to store water in Underground Storage Facilities (USFs) for recovery in times of shortage for CAP M&I subcontractors, Indian settlement water, and Colorado River P4 contractors. AWBA has received funding totaling hundreds of millions of dollars for these purposes, and to date has stored approximately 3 million AF of water for these purposes.[24] Thus, even when the shortages at some future date begin to cut into M&I supplies, Arizona holds a large bank account of credits to be recovered from aquifers when needed.

In addition to the prioritization of supplies and AWBA storage, Arizona has also permitted and, to some extent, encouraged the development of limited free market mechanisms to further

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[24] 2010, Arizona Water Banking Authority, 2010 Annual Report, submitted July 1, 2011; through calendar year 2010, AWBA has accrued 2,965,275 AF of credits for intrastate storage purposes.

facilitate allocation of supplies during shortages. Municipalities and private entities alike have stored water underground to accrue long-term storage credits like those held by AWBA. The number of credits held by these entities now exceeds the amount held by AWBA. Over the past few years an active trading market has developed for these credits. For example, significant quantities of Indian CAP water have been leased to municipalities. Additional leases, particularly short-term leases during shortages, could be entered into in the future. Though pretty well-developed in California, temporary fallowing arrangements between farmers and urban/industrial/environmental users in Arizona are still in their infancy, but will be a more important market tool in the future, particularly as shortages develop.

The final key element of Arizona's shortage management planning activity is the effort to tailor shortage responses to local geographic areas. The Colorado River P4 municipal users are entirely dependent on their River supplies. Therefore, exchange agreements have been signed that will enable these cities to use River water in a shortage that would otherwise be diverted to a more senior user, while stored water supplies in the central part of the state are recovered to replace the water the more senior user "forbears". Some communities in central and southern Arizona (notably Tucson) have robust wellfields and underground storage capacity, and may therefore agree to receive credits for groundwater pumping so their CAP supplies can go to a community like Phoenix, which needs surface water supplies for its treatment plants. As communities and industrial users each consider and plan for their own responses to shortage, a range of plans is emerging that allows for optimization of supply utilization.

How Shortages Are Mitigated: An Example from California

"Shortage" is a word that tends to invoke anxiety, particularly in association with important resources like food or water. Food shortages, for example, can have serious consequences in developing countries: if a grain shortage develops suddenly and without warning, its impacts can be severe. However, earlier sections of this memorandum have attempted to show that, contrary to popular image, shortages of water in Arizona differ from dire shortages of this sort in important ways: they develop more gradually; they are fully expected to occur at some point, providing ample lead time for planning; a proven and flexible legal and operational system is in place to manage the cascading impacts of supply shortage; and the Lower Basin water community already has considerable experience dealing with both chronic and acute water scarcity. In fact, "acute water scarcity" is probably a more useful term than "shortage" for purposes of thinking through the nature and effects of a temporary future reduction in available water supply, principally because it will be marked not by a departure from current activities, but rather an intensification of practices that occur every day in the business of water management.

Southern California's experience with shortage provides an instructive example of what happens when water supplies become acutely scarce. In the wake of the 1963 *Arizona v. California* Supreme Court decision, it was clear that the Metropolitan Water District of Southern California (MWD) would need to relinquish "squatter's rights" to the 800,000 AF/year of Colorado River water in excess of California's allotted 4.4 million AF that Arizona would soon siphon off the river as CAP water. In contrast to the irregular, temporary episodes of water shortage along the river that will impact Arizona in the future, MWD was forced to permanently reduce importation of Colorado River supplies by approximately 50 percent. As it would turn out, endangered species litigation in the Sacramento-San Joaquin Delta would develop over this same time period and present a second major supply constraint for MWD by threatening to limit water available from the State Water Project. In response to the dual threats to its two major water supplies, MWD responded with multiple initiatives, including developing additional sources of imported and local water supplies; implementing demand reduction and efficiency improvements; constructing additional surface and groundwater storage facilities; increasing the supply and reuse of reclaimed water; recovering and treating contaminated groundwater; and charging certain entities water rates that reflect the marginal cost of developing new, more expensive supplies.[25] New water sources developed by MWD included interstate storage credits; transfers of water rights from northern California; desalination; and agricultural water lease deals with Imperial Irrigation District and Palo Verde Irrigation District, two districts which together hold rights to about three-quarters of California's allocation of Colorado River water.[26]

MWD's response to shortage illustrates that even in the event of a permanent supply shift, there are numerous ways to resolve the resulting demand-supply imbalance, notably a plethora of opportunities to develop substitute supplies. The popular image of shortage desiccating the landscape is wrong because it implicitly assumes both a vertical supply curve and a lack of active managers at the helm, when in fact there are many supplies available at many different prices and managers are devoted to developing them early in anticipation of shortage. As MWD proved in the two decades between 1985 and 2005, adapting to a smaller supply and larger demand in essence means simply moving up the supply curve to more expensive supplies. As more expensive supplies are added to the portfolio, the cost of water rises. As the cost of water rises, more and more customers make decisions to reduce water use, and water demand in the aggregate falls. In light of this dynamic process, the question in shortage is not whether water will be available at all, but rather, how much it will cost on the margin?

ROSEMONT REPLENISHMENT WATER SUPPLY PLAN

Replenishment water is needed by Rosemont for two reasons. First and foremost, Rosemont made the commitment at the inception of its mine planning process, even before it closed the acquisition of the property, to replenish 105 percent of the water supply it would pump for mine operations. This commitment, plus an operation designed and engineered to be the most efficient water user among all US copper mines in terms of gallons per pound of copper produced, reflects an unprecedented breakthrough in Arizona mining operations. Rosemont was (and still is) under no legal obligation to either use the water-saving ore-processing technologies it adopted or to

[25] MWD website. http://www.mwdh2o.com/mwdh2o/pages/yourwater/supply/colorado/colorado01.html. Accessed 1/5/2012.

[26] Zetland, 2011. A tale of marketing irrigation water: California's PVID and IID. American Water Resources Association Annual Meeting, November 9, 2011.

replenish any of the water it will utilize in the mining and processing operations. These actions were part of Rosemont's business plan to develop as sustainable a mining operation as possible. The second reason Rosemont needed a replenishment supply was the fact that the southern portion of the CAP delivery system (from Picacho Peak to the terminus at Pima Mine Road south of Tucson) was engineered to require annual maintenance shutdowns (and therefore no water deliveries) for several weeks up to nearly 3 months every autumn. Since the CAP system could not deliver a reliable, continuous source of mine water supply, a production wellfield was a requirement for mine operation. Therefore, in order to meet its replenishment commitment, Rosemont would have to be prepared to acquire and recharge enough water to replenish all the pumped groundwater plus 5 percent.

The Rosemont water planning team is committed to acquiring approximately 120,000 AF of total replenishment water supply. This planning team was formed in 2006 to address both the replenishment water supply and the actual mining water supply/transmission issues at the same time. With the Law of the River elements described above either in place or under development, with all long-term Arizona CAP water supplies either allocated or unlikely to be accessible to an industrial user, and with the River basin in the midst of a multi-year drought that had all planners in the basin anticipating and beginning to plan for possible shortages, it was clear that the replenishment program would have to rely on the ability to acquire and combine water supplies on a shorter-term basis to meet the commitment. For economic and strategic reasons, it was also important to get started on replenishment before the mine was operating to ensure that, in any given year, Rosemont did not have to purchase replenishment supplies, but instead utilize supplies that had been pre-stored. Thus, the water planning team designed, and Rosemont implemented, a replenishment plan that has now been in effect for 4 years.

The replenishment plan has several key goals:

(1) Replenish 105 percent of the amount of groundwater used by Rosemont in its mine operations.
(2) Utilize primarily short-term water supplies available through the CAP system to accomplish the replenishment program.
(3) Stay ahead of the actual mine water utilization so that Rosemont never plays "catch-up".
(4) Recharge in the closest available facility within the Tucson Active Management Area (AMA) to the mine production wellfield at the time of recharge.
(5) Work with Green Valley-area interests to try to develop a recharge facility in close hydrologic proximity to the Rosemont wellfield, if possible.
(6) Recognizing that opponents to the Rosemont mine have attempted to prevent development of the local recharge facility and might potentially be successful in that opposition, ensure that alternative recharge locations are available for recharge within Tucson AMA.
(7) Accomplish the replenishment program goals at the lowest feasible cost.

In pursuit of goal #5 listed above, Rosemont responded several years ago to a request to consult with Community Water Company of Green Valley (CWC) regarding Rosemont's stated intent to recharge water as closely as feasible to the location of the mine water supply wells. CWC, a mid-sized cooperative water utility, has a CAP allocation, but is located several miles south of the CAP aqueduct terminus and does not have the financial capability to build facilities to deliver its CAP water to its service area. Since the beginning of the planning process with CWC, Rosemont has funded the engineering, institutional, and environmental work necessary to enable CWC to advance the development and operation of a pipeline and recharge facility in proximity to both the Rosemont planned production wells and CWC service area. Agreements are close to completion between Rosemont and CWC for these facilities, including Rosemont's funding of the project and its construction and future operation. Subject to remaining regulatory and jurisdictional approvals, construction of portions of these facilities could begin in 2012, with a planned completion of the facilities in 2013.

All of the other listed goals are advanced by the replenishment activity that Rosemont has conducted to date. Rosemont entered into agreements with CAP to purchase excess water and to store it at CAP-operated recharge facilities in the Tucson AMA. Rosemont also acquired the necessary water storage permits for those recharge facilities from the Arizona Department of Water Resources (ADWR).

Through 2010, Rosemont has purchased 45,000 AF of CAP water under its excess water contract, and has paid to have it recharged in the Tucson AMA. The recharge facilities utilized to date are the Pima Mine Road facility, near the CAP terminus, and the Lower Santa Cruz facility in Marana. Because very little capacity has been available at Pima Mine Road, the large majority of the storage to date has been at Lower Santa Cruz.

The 45,000 AF of replenishment accomplished to date constitutes more than a third of the total projected mine demand—or approximately 9 years of the projected usage during construction and subsequent mine operation. As specified in goal #3, Rosemont is now almost a decade ahead of its projected demand, which will serve it well in accomplishing goal #7. Additional early storage not in proximity of Green Valley has been suspended for now in hopes that the CWC partnership will result in completion of the local facilities (and therefore future Rosemont recharge utilizing those facilities) within a reasonable timeframe. If opponents are successful in blocking those facilities, however, Rosemont will need to restart its program to store in the other, more distant Tucson AMA-area facilities to meet its commitment.

The remaining questions about the Rosemont replenishment program are whether water supplies will be available to meet the commitment, and whether Rosemont will be able to afford those water supplies. These questions are addressed in the following sections.

Renewable Water Supplies Potentially Available to Rosemont During Shortage

The central point described above in the California example regarding supply substitution during shortage also holds true for Rosemont Copper. Thus far, Rosemont has been able to acquire CAP Excess Water to store approximately one-third (about 45,000 AF) of its projected cumulative water demand over the life of the project. Over time, the supply of excess water is expected to decline as M&I and Indian CAP subcontractors order a greater share of their allocation.[27] The excess pool has declined in recent years in proportion to increased federal and M&I CAP subcontract orders. Since part of the excess water supply comes from Colorado River water left unused by on-river contractors, at least some excess water is expected to remain available for the foreseeable future in non-shortage years. However, much of this supply will be set aside for the obligations of the Central Arizona Groundwater Replenishment District and the Arizona Water Banking Authority.[28] Therefore, Rosemont will likely need to develop alternative sources of renewable water for normal and shortage years going forward. What follows is a hypothetical discussion of likely alternatives available to Rosemont and potential costs for its water supply in the event excess water is not available. Rosemont has not endorsed a specific plan or approach since future actions will depend on specific circumstances.

Credits

Alternative sources of water may include purchase of long-term storage credits and/or lease of water rights. Voluntary transfers of water resources, both on a temporary and permanent basis, are common in Arizona. Active markets exist in the Phoenix and Tucson AMAs for long-term storage credits. ADWR data indicate that the total volume of long-term storage credits is approximately 7 or 8 million AF of credits in the Phoenix, Pinal, and Tucson AMAs, with approximately 1 million AF of credits in the Tucson AMA.[29] To accumulate this volume of credits, renewable supplies have been banked for future use at an average rate of approximately 500,000 AF per year.

For entities that have access to a renewable water supply (principally CAP water) and a storage facility, creating a long-term storage credit costs between approximately $115 and $165/AF in the Tucson AMA, depending on the type of source water and storage facility. Alternatively, credits can be purchased from sellers at a negotiated price; credit prices in the Tucson AMA have remained relatively stable at approximately $120-130/AF for the last 10 years. Several investment firms have been active in the long-term storage credit markets, enhancing the liquidity of long-term storage credits for buyers that may need them in a pinch in the future.

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[27] Central Arizona Project Excess Contracts website, http://www.cap-az.com/Water/ExcessContracts.aspx. Accessed 1/5/2012.

[28] "CAWCD Procedure to Distribute Excess Water in 2010 through 2014", adopted June 4, 2009. http://www.cap-az.com/Portals/1/Skins/cap/files/06-04-09-A2E-Adopted-Policy.pdf.

[29] These figures are inherently uncertain to some degree because ADWR has not released updated long-term storage account balances since December 31, 2008.

Multi-Year Leases

In addition to purchasing credits, Rosemont could also lease water from a number of entities that are not fully using their rights to renewable water supplies. Although most CAP subcontractors are not able to directly lease CAP water supplies for profit, many of them utilize the flexibility of the state's water storage and recovery programs to enable transfer of supplies for the mutual benefit of buyer and seller. In addition, Indian subcontractors, per their water settlements, have the ability to directly lease their CAP water. Arizona's laws and policies are sufficiently flexible to allow for creativity in arranging leases and exchanges that satisfy the interests of buyers and sellers and move water to higher-valued uses. Rosemont, like any other entity seeking to acquire water supplies, has the ability to pursue these creative arrangements. Unlike many other entities, however, Rosemont possesses two advantages in the marketplace: (1) it has already banked credits in advance to hedge against the expected higher cost of water during shortage; and (2) it will need water for a significantly shorter timeframe than many other users—less than 30 years, not 100 years like any developer or municipality needing to develop an Assured Water Supply for ADWR designation or certification purposes. A shorter leasing period is often preferred by sellers because it reduces the uncertainty of whether they will still be getting a good price in future years.

Potential Cost of Water During Shortage and Potential Impact on Rosemont Operations

Given the opportunities for marketing water in Arizona, we would expect that a rise in scarcity (in other words, a drop in supply, such as in shortage) would mean that some water would move toward higher-valued uses, resulting in a corresponding rise in market prices for water. Again, MWD's experience illustrates this point. As MWD has scrambled to live with less water coming from both the Colorado River and the State Water Project, its basic volumetric rate for bulk treated water has increased from $426/AF in 1995 to nearly $800/AF in 2012. In addition, a second tier was established in 2005 to capture the marginal cost of developing new supplies; water in this tier is $920/AF in 2012.[30] It is important to note that MWD could have suffered the full impact of the drop in supply and shorted its customers, but instead chose to make up the shortfall by developing more expensive supplies. MWD was driven to this option because it valued the marginal volume of water it purchased more highly than the sellers of the marginal volume. Although it operates in a different set of supply and demand conditions, MWD's experience illustrates that even in situations of large and unpredictable drops in supply for municipal and industrial use, there is still enough water in the system and enough of a difference in value between different water users that no municipality or industry will simply shut down due to lack of water. The differential in value between those that have water and those that need it will motivate both buyers and sellers to find ways to transfer water to the mutual benefit of both parties.

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[30] Metropolitan Water District of Southern California, Water Rates and Charges (http://www.mwdh2o.com/mwdh2o/pages/finance/finance_03.html) and Historical Water Rates (http://www.mwdh2o.com/mwdh2o/pages/finance/finance_02.html). Accessed 1/5/2012.

One recent example of voluntary water transfers in Arizona was a temporary program initiated by the Yuma Mesa Irrigation and Drainage District (YMIDD) to transfer water to BOR for 1-year lease terms.[31] BOR was interested in acquiring a supplemental source of water ultimately for delivery to Mexico, and YMIDD was willing to fallow irrigated farmland for the right price. Between 2008 and 2010, BOR paid YMIDD between $90 and $120 per AF of water that YMIDD would otherwise have consumptively used for irrigating crops. Although this transaction did not occur within a market, it illustrates that agricultural water users would be open to voluntary leases of water at a price that exceeds the opportunity costs of the transferred the water.

It is reasonable to expect that during a shortage of Colorado River water in Arizona, water prices will increase as water users in Arizona work to offset the effects of shortage by pursuing water transfers, recovering stored water, developing new supplies, redoubling conservation efforts, and so forth. The degree to which prices will increase cannot be estimated with certainty. MWD provides one possible example of price increases during shortage, but considering the vast differences between Arizona and California in water supply and demand conditions and the nature of shortage faced by each area, the doubling of water prices at MWD probably represents the high range of the potential price effect shortage may have on long-term storage credit and short-term lease prices in central Arizona. In reality, due to the myriad alternative supplies available in Arizona and the institutions, policies, and infrastructure in place to enable many different types of transfers, supply and demand conditions would be unlikely to force a doubling of prices for these water supplies.

Yet for the sake of argument, let us assume that prices for long-term storage credits *quadruple* during years of shortage to $520/AF. Let's further assume that Rosemont has already used up its bank of credits and is forced to buy more credits at this shortage premium. What would be the economic impact of this price increase on Rosemont's production costs? Annual production costs are expected to average $301 million during the 20-year production period, or $1.20 per pound of produced copper.[32] Average groundwater use per year will be approximately 5,000 AF; Rosemont has pledged to offset 105 percent of this pumping with renewable water supplies, equivalent to an annual renewable water supply requirement of 5,250 AF per year. At a price of $125/AF for long-term storage credits in a normal year, storing renewable water supplies to offset groundwater pumping will cost Rosemont approximately $656,000 per year, or about 0.2 percent of total production costs. Assuming a quadrupling of long-term storage credit costs during a shortage year, this annual cost would rise to $2.6 million, representing less than 0.9% of estimated annual production costs. Another way of thinking about the price impact of water shortages on Rosemont would be to put it into context of its revenues: at a copper price of $3 per

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[31] Agreement can be found at http://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2009/Agreements/BR-YMIDD%20System%20Conservation%20Agreement%2010-7-2008.pdf.

[32] Singh, M.M. "Study of mineral production with reference to the Rosemont Copper Project, including an assessment of the economic impacts of the Rosemont Copper Project prepared by the L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University". Arizona Department of Mines & Mineral Resources Special Report 24, July 2009.

pound and assuming production of 125,000 tons (250 million pounds) of copper annually, the cost of replenishing 105 percent of its water use would be 0.35 percent of Rosemont's annual revenues. Recharging renewable water supplies is an important element of Rosemont's overall mine plan that will remain a relatively insignificant component of its overall production budget, even in years of water shortage.

The economics of the Rosemont project are not a barrier to acquiring renewable supplies during a water shortage. In fact, it could be argued that Rosemont is more motivated to acquire renewable water supplies for its operations than nearly any other water user. **Table 1** provides estimates of the average gross product per AF of water for a range of water uses in Arizona. These data indicate that the average acre-foot of water used at Rosemont will generate more gross economic output than almost any other potential use. While average gross product does not equate to average or marginal willingness to pay for water in any of the sectors included in the table, this metric is nonetheless useful for understanding the average economic value of water used at Rosemont versus other current uses. The data demonstrate that Rosemont's incentive to acquire renewable water supplies is both inherently and relatively very strong.

Table 1. Comparison of average gross product per acre-foot of water used at the Rosemont Mine versus other potential uses of the water

Application	Average Gross Product per Acre-Foot of Water Applied
Rosemont Mine[33]	$150,000
Statewide average, non-agriculture[34]	$91,590
Statewide average, mining sector[35]	$46,450
Statewide average[36]	$33,150
Statewide average, golf courses[37]	$5,520
Statewide average, agriculture[38]	$310
Cotton[39]	$1,120
Alfalfa[40]	$290

[33] Based on annual production of 125,000 short tons, annual water use of 5,000 AF per year, and a copper price of $3.00/lb. The figure for the entire mining sector (see note 11 below) is based on an average copper price in 2010 of $3.42/lb. Copper prices have remained above $3.00/lb since August 2009.

[34] Based on 2010 Arizona non-agricultural gross domestic product of $251.9 billion (source: Bureau of Economic Analysis, www.bea.gov), and total statewide non-agricultural water use of 2.75 million AF (source: ADWR, Arizona Water Atlas, Volume 1, p. 61; and Smith, 2008).

[35] Based on 2010 gross domestic product of Arizona mining sector of $5.07 billion (source: Bureau of Economic Analysis, www.bea.gov), and total statewide water use by the mining sector of 109,192 AF (source: ADWR, Arizona Water Atlas, Volume 1, p. 67). The average price of copper in 2010 was $3.42/lb on the London Metal Exchange.

[36] Based on 2010 Arizona gross domestic product of $253.6 billion (source: Bureau of Economic Analysis, www.bea.gov), and total statewide water use of 7.65 million AF (source: ADWR, Arizona Water Atlas, Volume 1, p. 61).

[37] Based on estimated total direct economic revenues of Arizona golf courses of $806 million and estimated total water use of all Arizona golf courses of 146,000 AF (source: Schmitz, T.G., "Economic impacts and environmental aspects of the Arizona golf course industry." Arizona State University, Morrison School of Agribusiness and Resource Management, Faculty Working Paper Series MSABR 05-01, March 6, 2006).

[38] Based on 2010 gross domestic product of Arizona agricultural sector of $1.74 billion (source: Bureau of Economic Analysis, www.bea.gov), and total statewide agricultural water use of 5.61 million AF (source: ADWR, Arizona Water Atlas, Volume 1, p. 65). This average gross product estimate is inflated somewhat because the numerator (sector GDP) includes "forestry, fishing, and related activities" in addition to crop and animal production, whereas the denominator (water use) does not.

[39] Based on cotton yield of 1,400 lbs/acre, water duty of 2.5 AF/acre, and market price of $2.00/lb.

[40] Based on alfalfa yield of 8 tons/acre, water duty of 7 AF/acre, and market price of $250/ton.

MONTGOMERY & ASSOCIATES

SELECTED COLORADO RIVER REFERENCES
(Listed in chronological order)

The following documents are provided on the enclosed CD. Additionally, most documents are available at http://www.usbr.gov/lc/region/pao/lawofrvr.html

1922, Colorado River Compact, signed November 24, 1922.

1928, Boulder Canyon Project Act, Public No. 642-70th Congress, H.R. 5773, approved December 21, 1928.

1944, "Mexican Water Treaty", Treaty Series 994, Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, Treaty between the United States of American and Mexico, signed February 3, 1944, effective November 8, 1945.

1948, Upper Colorado Water Basin Compact, signed October 11, 1948.

1964, Arizona v. California Supreme Court Decree, March 9, 1964.

1968, Colorado Basin Project Act, Public Law 90-537, 90th Congress, S. 1004, approved September 30, 1968.

1974, Colorado Basin Salinity Control Act, Public Law 93-320, H.R. 12165, approved June 24, 1974.

1999, "Interstate Water Banking Rule", Code of Federal Regulations, Title 43: Public Lands: Interior, Part 414 – Offstream storage of Colorado River water and development and release of intentionally created unused apportionment in the lower division states, 1999.

2001, Colorado River Interim Surplus Guidelines, Bureau of Reclamation, Record of Decision, Final Environmental Impact Statement, January 2001.

2007, "Interim Shortage Sharing Guidelines", Bureau of Reclamation, Record of Decision, Final Environmental Impact Statement, Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead, December 2007.

2010, Arizona Water Banking Authority, 2010 Annual Report, submitted July 1, 2011.