

CONJUNCTIVE USE ISSUES

Optimizing Resources and Minimizing Adverse Effects

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Introduction

As a result of the recent drought, coupled with increased water demands due to on-going population growth in Colorado, water suppliers have become critically aware of the need to acquire additional water resources. Traditionally, the addition of new water supplies into an existing entity's portfolio has included the consideration of additional storage in new or existing surface water reservoirs. Limitations regarding acceptable storage locations, complicating environmental factors and regulatory requirements, among other factors, have all added to the significant increases in construction costs and project delays. As a result, water supply entities are considering alternative methods of increasing their available water supplies to their customers. One such alternative method includes the concept of conjunctive use.

Conjunctive use can be defined as the use of surface water and ground water sources in a cooperative fashion to optimize the use of both resources for an entity's water supply. For example, the dependence on either surface water or ground water supplies alone has inherent limitations. Those limitations include possible restrictions regarding diversions of surface water rights during low flow or drought conditions, evaporative losses of water stored in surface water reservoirs, and limitations due to the nonrenewable nature of certain ground water supplies. However, the combined or conjunctive use of both resources can, to some degree, overcome those shortcomings resulting in a more dependable supply. The following discussion provides some examples of how this can be achieved.

1. Typical Senior Water Rights Diversion

Let's begin by looking at a supply based on a senior water right diversion. The first diagram identifies the components of such a supply system. Typically, a community may rely on the diversion of a senior water right that was formerly used for irrigation. Such a water right might be changed in a Water Court proceeding to allow its historic consumptive use portion to be diverted, stored and used for municipal purposes. Storage would allow the use of the water right over a full 12-month period, as compared to the historic use during the irrigation season. In this example, assuming 100 units of historic consumptive use could be diverted into storage (or direct use within the development during the irrigation season), then with certain assumptions, about 50 units would be returned to the stream system following treatment. This would allow the re-capture and reuse of those 50 fully consumable units for use within the development possibly through a decreed exchange process. This example would provide the use of about 150 units of water to meet the demands of the development.¹

¹ Although a third or more reuse of return flows could be claimed and recaptured following treatment, it is recognized that evaporation from storage and other potential losses would reduce the available supply, therefore, for simplicity, only a single reuse is considered herein.

2. Typical Senior Water Rights Diversion with a Direct Diversion of Junior Water Rights

A second example looks at a supply based on a similar senior water right diversion, supplemented with a direct diversion of junior water rights. The second diagram identifies the components of such a supply system. Again, let's assume a community relies on the diversion of 100 units of senior water rights that were formerly used for irrigation, however, in this example the senior water rights are supplemented with a direct diversion of junior water rights. Let's assume in this example that the junior water rights are reliable in that they yield about 50 units per year on average.

Assume as in the first example that the senior water right was changed in a Water Court proceeding to allow its historic consumptive use portion to be diverted, stored and used for municipal purposes and the storage allows for the use of the water right over a full 12-month period, along with an exchange allowing for the re-use of 50 units of the fully consumable water rights. As a result, the 150 units of available supply from the senior water right along with the added 50 units of average annual supply from the junior water right, brings the total available supply up to 200 units.

3. Typical Senior Water Rights Diversion with a Direct Diversion of Junior Water Rights Supplemented with an Augmentation Plan

In this example, like the second example, a supply based on senior water rights diversion is supplemented with a direct diversion of junior water rights. However, in this example an augmentation plan is formulated to allow additional diversions by augmenting diversions under the junior water right. The third diagram identifies the components of such a supply system. Again, let's assume a community relies on the diversion of 100 units of senior water rights that were formerly used for irrigation and changed in a Water Court proceeding to allow its historic consumptive use portion to be diverted, stored and used for municipal purposes. In this case, instead of recapturing and reusing the 50 units of fully consumable return flows from the senior water rights, those return flows are left in the stream, allowing 100 units of junior water rights to be diverted and augmented by the 50 units of return flows from the senior water rights. Therefore, a total of 250 units of water are then available for use within the development (100 units of senior water CU rights + 50 units of junior direct flow rights + 100 units of augmented junior water rights).

4. Typical Senior Water Rights Diversion with a Diversion of Junior Water Rights Supported by an Augmentation Plan Utilizing Return Flows from Senior Water Rights, and Additional Diversions Supplemented with Conjunctive Use of Denver Basin Water Supplies

This example illustrates one concept of conjunctive use, and how that concept allows for additional supplies when this approach is implemented. In this fourth example, like the third example, a supply based on senior water rights diversion is supplemented with a diversion of junior water rights augmented by return flows from the senior water rights. In addition, in this example, a second augmentation plan has been developed to

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incorporate the use of Denver Basin ground water as a conjunctive use supply, with the return flows used to augment an additional diversion from the junior water rights source.

The fourth diagram identifies the components of such a supply system. Again we assume a community relies on the diversion of 100 units of senior water rights that were formerly used for irrigation and changed in a Water Court proceeding to allow its historic consumptive use portion to be diverted, stored and used for municipal purposes. The senior water rights are supplemented with a diversion of 100 units of junior water rights augmented by 50 units of fully consumable return flows from the senior water rights which are left in the stream.² Assuming the additional diversion of 100 units of nontributary Denver Basin water rights into the supply system, the resultant return flows of approximately 50 units of this source following use would allow an additional diversion of 100 units of junior water rights by augmenting those diversions from the treated Denver Basin effluent left in the stream. Therefore, a total of 400 units of water are then available for use within the development (100 units of senior water CU rights + 100 units of junior water rights augmented by 50 units of return flows from senior CU rights + 100 units of Denver Basin water rights + 100 units of junior water rights augmented by 50 units of return flows from the Denver Basin water rights).

Although this example allows for more diversion when it is implemented than the other three examples presented above, because of the non-renewable nature of the Denver Basin supplies, this concept would most likely only be utilized in times when there is limited flow of water to the junior direct flow right under its very junior priority, or when other junior water rights are unavailable or storage amounts are reduced to low levels.

5. Typical Senior Water Rights Diversion with a Diversion of Junior Water Rights Supported by an Augmentation Plan Utilizing Return Flows from Senior Water Rights, and Additional Diversions Supplemented with Conjunctive Use Utilizing an Alluvial Ground Water Recharge Project

This example also provides an example of conjunctive use, and how that concept allows for additional supplies when this approach is implemented. In this fifth example, like the third and fourth examples, a supply based on senior water rights diversion is supplemented with a diversion of junior water rights augmented by return flows from the senior water rights. In addition, in this example, a second augmentation plan has been developed to incorporate the use of an alluvial ground water recharge project.

The fifth diagram identifies the components of such a supply system. Again we assume a community relies on the diversion of 100 units of senior water rights that were formerly used for irrigation and changed in a Water Court proceeding to allow its historic consumptive use portion to be diverted, stored and used for municipal purposes. The senior water rights are supplemented with a diversion of 100 units of junior water rights augmented by 50 units of fully consumable return flows from the senior water rights which are left in the stream. In this case, let's assume that 50 units of junior water rights are diverted in-priority from the South Platte River during high flow times (i.e., spring

² In this example, we assume the direct diversion of 50 units of junior water rights are not in priority.

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runoff) and transferred to a location where that supply is recharged back into the alluvium. By calculation, the return flows recharge back to the South Platte River over a period of time. This method would allow the diversion of up to 100 units of water from the South Platte based on the calculation of the timing of the recharge back to the River.

In this example, up to 300 units of water are then available for use within the development (100 units of senior water CU rights + 100 units of junior water rights augmented by 50 units of return flows from senior CU rights + up to 100 units junior water rights augmented by the recharge component from the alluvial recharge system). While this conjunctive use concept may not provide as much supply as the fourth example, it does rely on renewable sources and would, at times, provide more supply than the first, second or third examples shown above.

6. A Water Supplier Relying on Denver Basin Supplies as its Primary Source of Supply Supplemented with Conjunctive Use Utilizing Junior Surface Water Supplies

Another example of conjunctive use is a water supplier relying on Denver Basin supplies as its primary source of supply, supplemented with conjunctive use utilizing junior surface water supplies. In this example, let's examine a water supplier in Douglas County that historically relied on Denver Basin water for its primary supply. In this case, suppose the water supplier relied on 1500 units of Denver Basin supply to meet the typical demands of its customers, with about one-half of those 1500 units (about 750 units) re-used for golf course irrigation. Since, over the past 15 or more years, the Denver Basin supplies have become more expensive to develop from an infrastructure cost and operation and maintenance standpoint, suppose that the water supplier acquired a right to divert water from a stream such as Plum Creek based on a relatively junior application date. Let's further suppose that those decreed junior surface water rights, when able to be diverted, can be used directly in the development to meet demands, or can be injected into the underlying Denver Basin aquifers when demands are met by other supplies. This would allow the injected water to be withdrawn at any time in the future to assist in meeting peak demands. In this example, the 2250 units of total useable annual supply from the Denver Basin aquifers can effectively be reduced by about 500 units per year (or the 500 units could be added to the available supply). As a result, of this conjunctive use approach, average water supplies are enhanced over the Denver Basin supplies alone (or reliance on Denver Basin supplies alone is reduced), declining water levels in the Denver Basin aquifers are reduced, and evaporation from surface storage is eliminated.

CONCLUSION

The examples of conjunctive use summarized in Nos. 4, 5 and 6 above provide some insight as to how the conjunctive use concept can add to the reliability of more standard water rights plan, and may, at times and under certain circumstances, increase the yield as compared to the more typical water rights plans. Other examples of conjunctive use are possible that are not presented herein, however it is apparent that in order to solve ever increasing water demands, innovation and creative ideas are necessary.

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Advantages of conjunctive use include:

- The reduction in the need for additional surface water storage while adding to the available water supplies;
- The provision of additional augmentation supplies;
- The restoration or reduction of decreasing ground water levels in underlying aquifers;
- A reduction in evaporation from surface water reservoirs;
- Less impact to the environment;
- An increase in available water supplies is realized as compared to the reliance on surface or ground water sources alone.

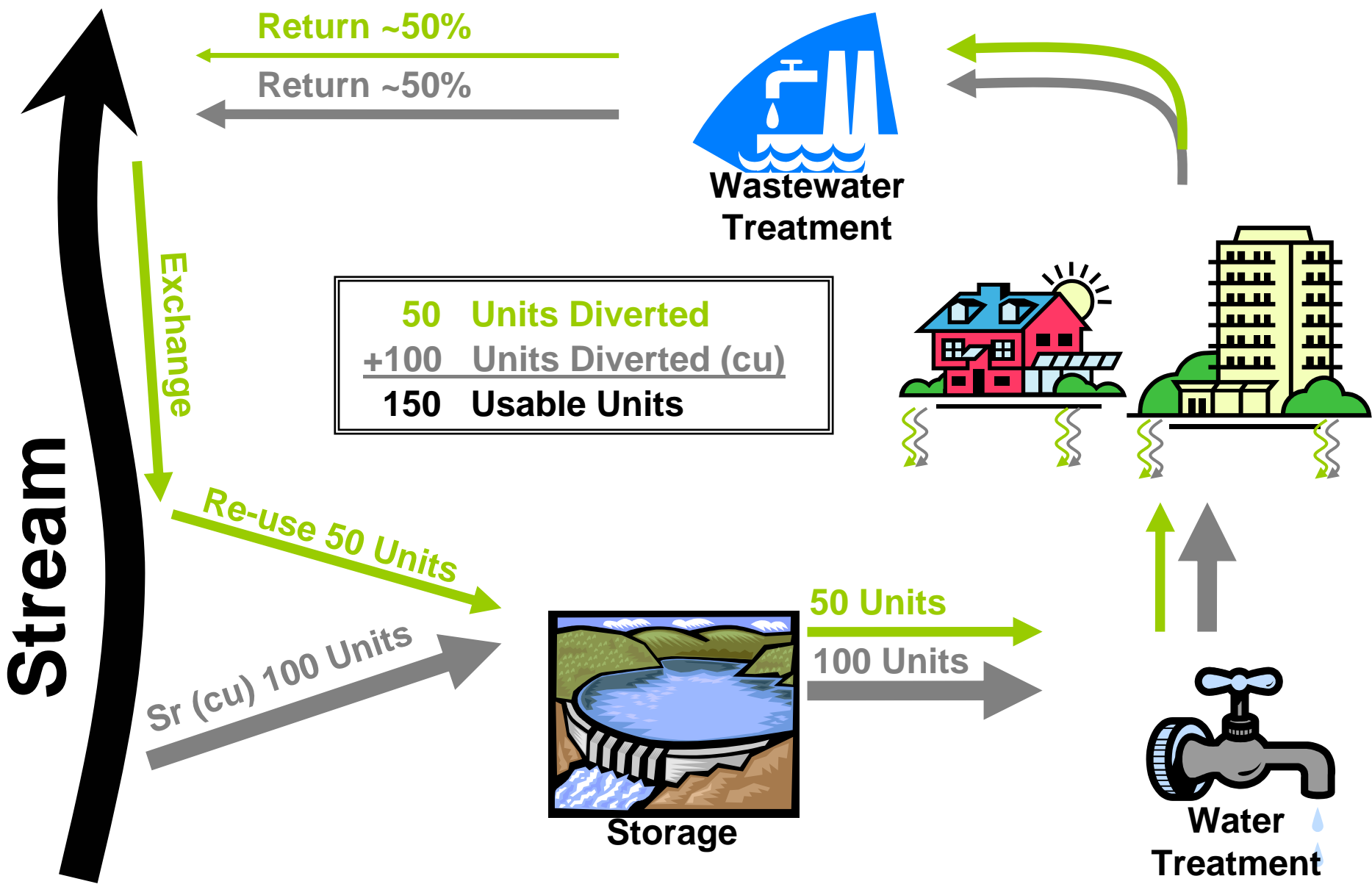
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A high-speed photograph of a water droplet falling into a pool of water. The droplet is captured mid-fall, just above the surface, creating a series of concentric ripples that spread outwards. The water is a clear, light blue color, and the lighting is soft, highlighting the droplet's shape and the ripples' texture.

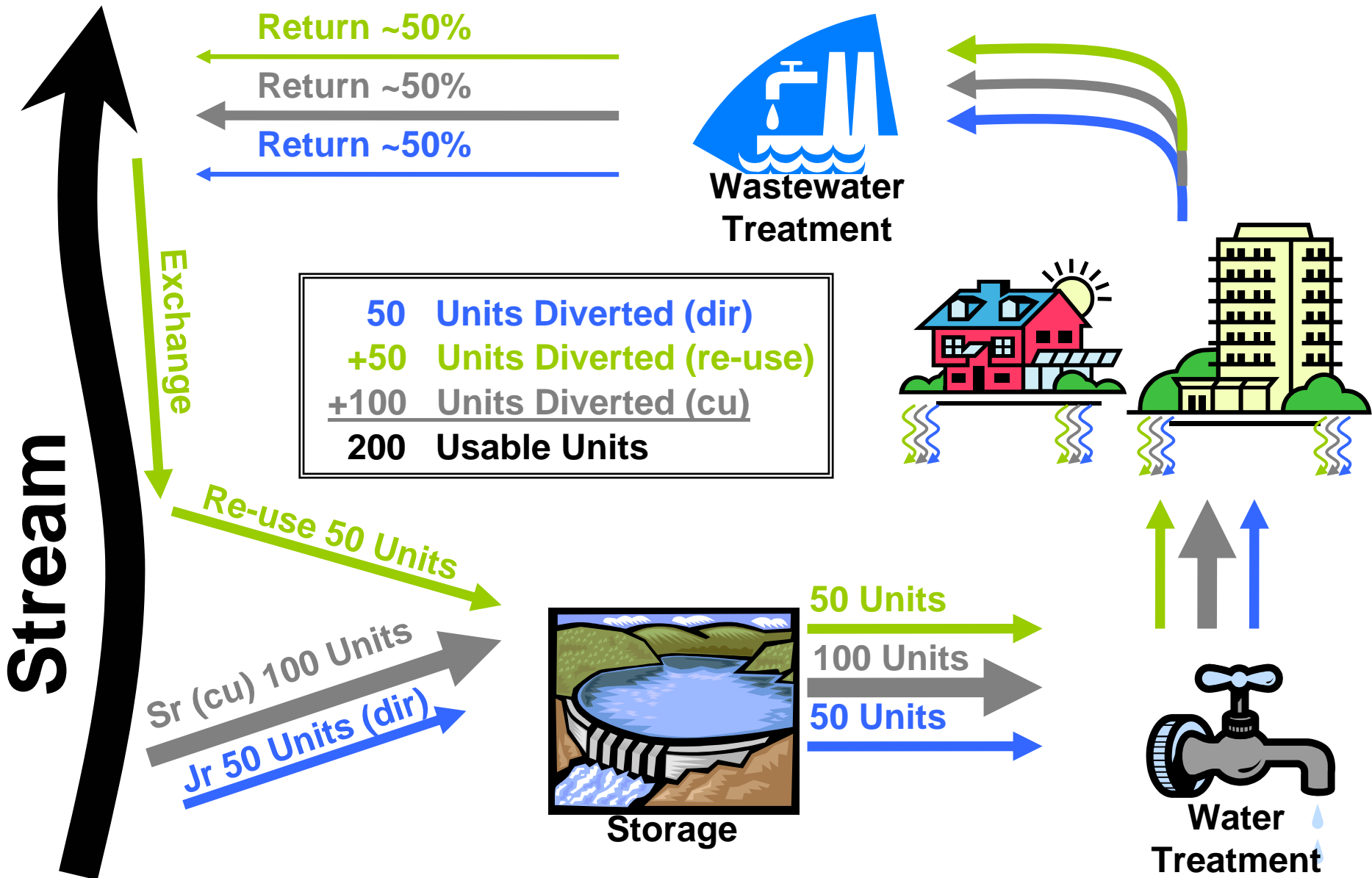
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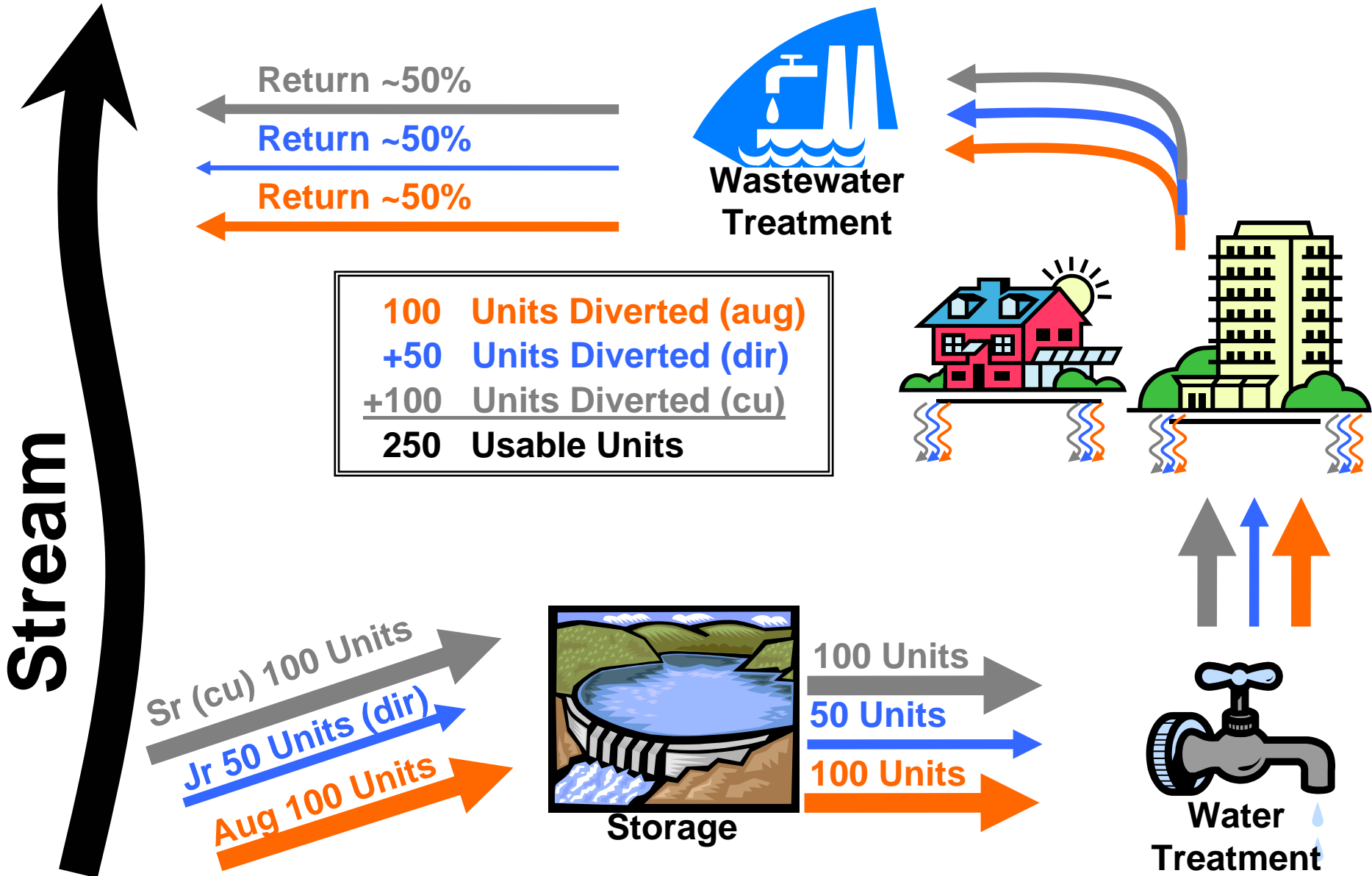
Typical Senior Water Rights Diversion



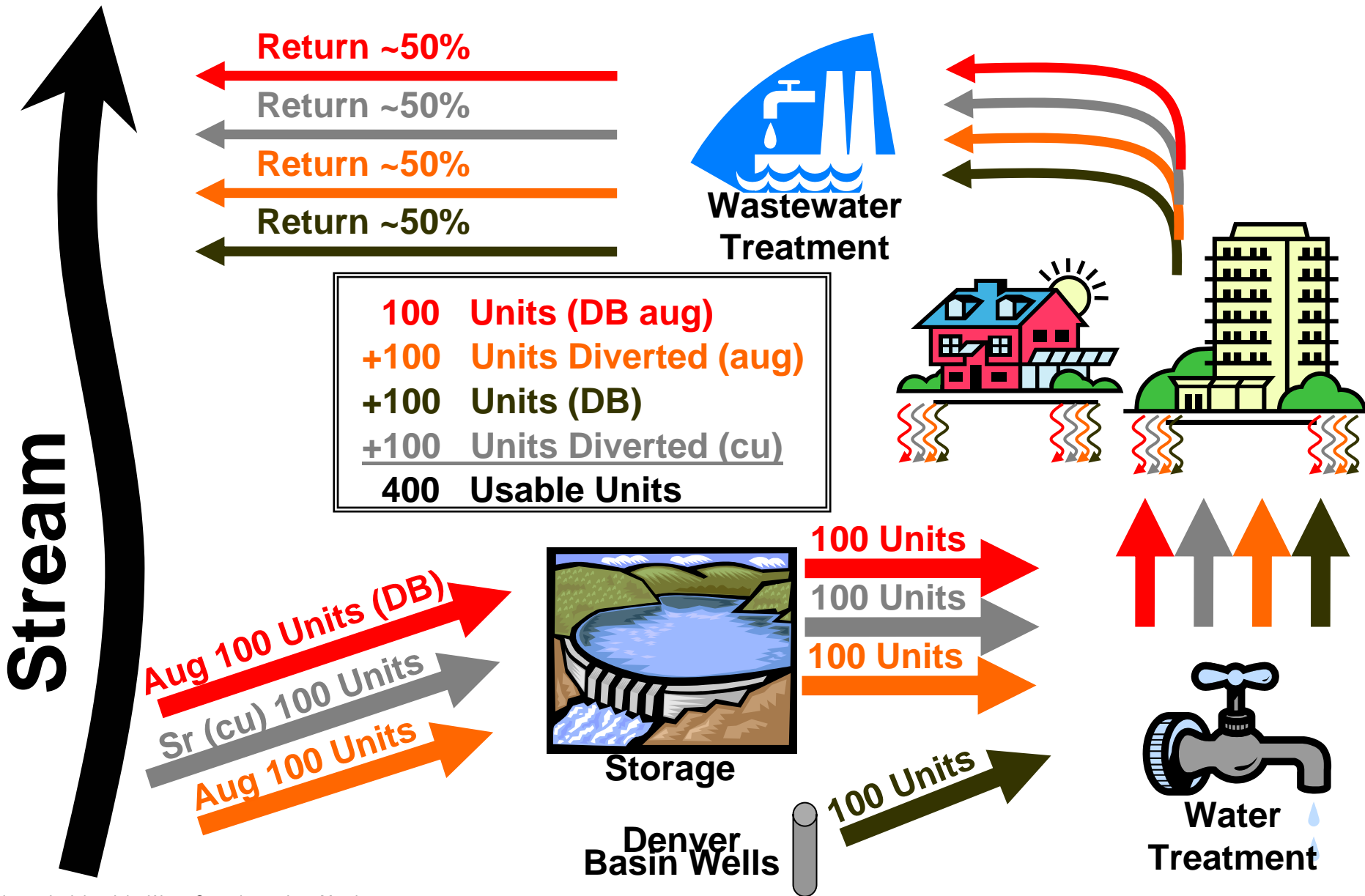
Typical Senior Water Rights Diversion with Junior Diversion



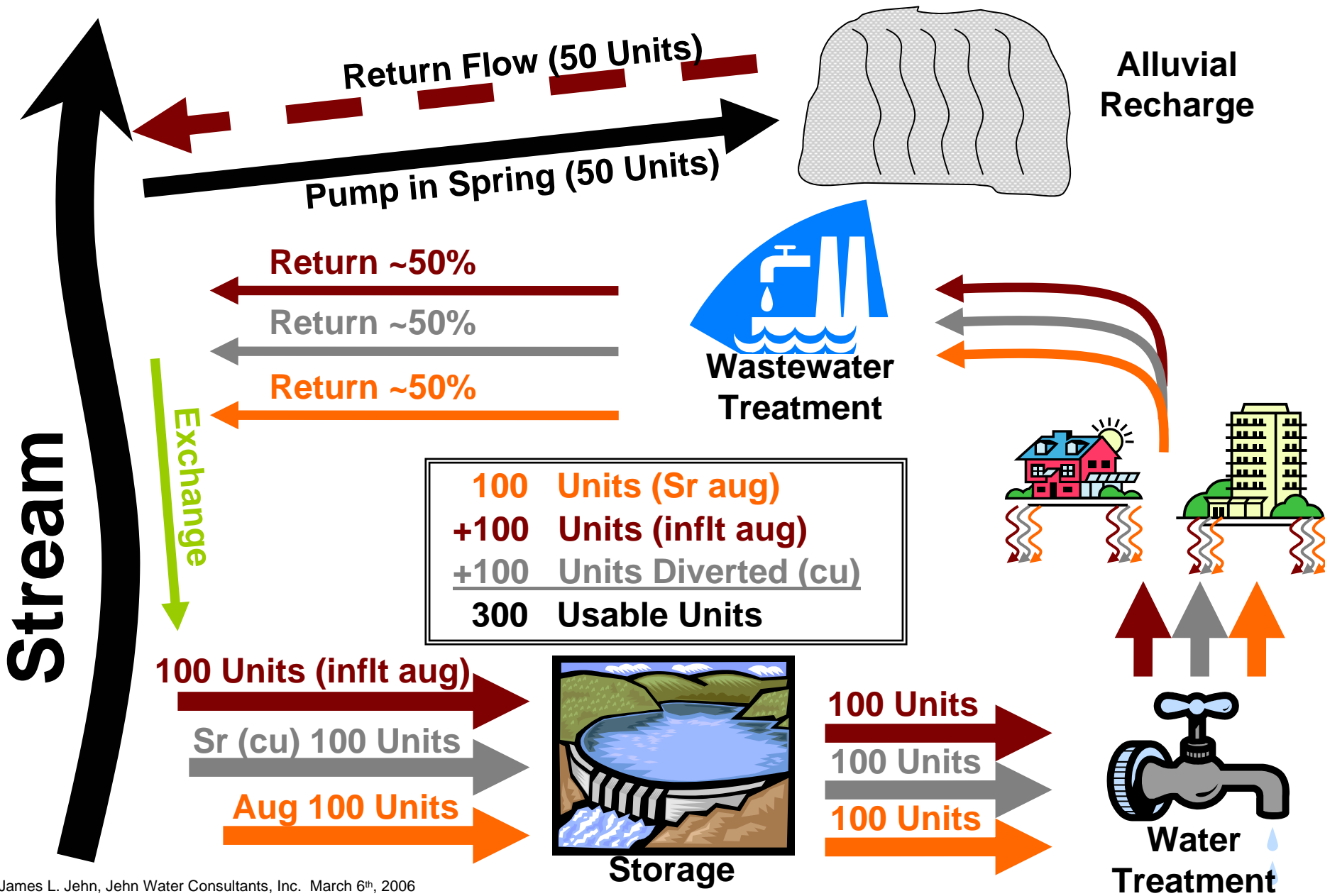
Typical Senior Water Rights Diversion with Junior Diversion and Augmentation Plan



Typical Senior Water Rights Diversion with Junior Aug Plan and DB Conjunctive Use Plan



Typical Senior Water Rights Diversion with Alluvial Conjunctive Use Plan



Denver Basin Supply with Conjunctive Use of Surface Water

