Mechanics and Strategies of Water Equivalency Analysis

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Finding yourself in the midst of a claim for injuries to a water resource can be a daunting, frustrating, and costly challenge. The steps to quantify the injury can be difficult, and to add more confusion, the injury may include a buffer zone of unaffected water around the injured resource. Translating the value of the resource injury into dollars or damage can be an expensive endeavor that may yield staggering sums. The reliability and uncertainty of such dollar-figure valuations remains the subject of considerable debate.

If one wishes to avoid settling an injury claim based on dollars, an approach based on resource equivalency analysis can be used to appropriately, and defensibly, scale a water restoration (or mitigation) project as compensation for injuries to the resource, or other penalties. Resource equivalency analysis utilizes a non-monetary standard of measurement, or metric, grounded in the resource to measure the injury to the resource and the associated reduction in services flowing from the resource.

In short, the working premise behind resource equivalency analysis is that compensation for reduced resource services can be provided elsewhere so that the aggregate resource services remain the same or are improved over time.

Careful selection of a metric by which to measure injury to a resource and benefits from a restored resource is critical to a successful negotiation, technical justification, and restoration project that satisfy the resource damage claim. Public relations can benefit for both the responsible party and the trustee by directing the public's attention to the resource enhancement project and away from dollars.

This resource equivalency alternative to the dollar valuation process was originally developed as a Habitat Equivalency Analysis (HEA) by the National Oceanic and Atmospheric Administration (NOAA) (1997). The universality of the conceptual and economic principles utilized in the HEA have allowed that approach to be successfully adapted and applied to water resources, both surface water and groundwater. These same principles also have been similarly adapted to value almost any resource, and are illustrated in the figure on page 18.

Resource Equivalency Analysis Model

The economic model behind resource equivalency analysis calculates the present value of the injured resource (service flow losses) and the restored resource (service flow gains). A compensatory restoration project developed using the principles of resource equivalency, rather than a dollar valuation of the injury, will usually be substantially lower in cost.

Parameters used in the resource equivalency analysis model are listed in Table 1, below.

Value of injured resource	Value of restored resource
Date injury occurred	Date restoration begins
Duration of injury	Life of restored resource
Rate of injury increase (service flow losses)	Rate resource is restored(service flow gains)
Rate of natural recovery, or recovery from remediation	Quality of natural versus restored services
Residual service losses	Quantity of services not restored
Discount rate	Discount rate

Table 1.Parameters used in the resource equivalency analysis model.

The resource equivalency analysis is used as a tool to equate the estimated loss of services resulting from an injury along with a predicted gain in services resulting from restoration. In this way, the calculation is used to scale the amount of restoration required to offset the injury. A variety of spreadsheet and graphical solutions to the model have been developed.

The compensatory restoration project must yield resource services at least equal to the injury or assessed damage. As an aid to negotiation and settlement, the credit, or gain in resource services, should exceed the injury, thereby reducing the significance of inherent uncertainties in the process. The resource equivalency analysis can be used to evaluate and rank a variety of potential restoration projects from the perspective of service flows and cost effectiveness.

Choosing the Appropriate Water Resource Metric

Injuries to water resources fall into two general categories: reduction in service flows to humans, or reduction in service flows to flora and fauna. For example, contaminated water may make a water resource non-potable, unusable as a drinking water source. Or, contaminated water may reduce the viability of a fishery, wetland, or vegetation. If the groundwater resource is relatively shallow, then the injury may affect both services to humans and the environment. Also, in areas where surface waters are hydraulically connected with groundwater, then a primary injury to one resource may impact the other. For example, a discharge of contaminated groundwater to surface water may have a deleterious affect on a fishery.

WATER METRIC	DESCRIPTION
Water acre-feet-year	Volume of water (ground and/or surface) with reduced/increased services each year
Pumpable water acre-feet-year services that can be pumped each year	Volume of water (ground and/or surface) with reduced/increased
Aquifer acre-feet-year	Volume of aquifer with reduced / increased services each year
Safe yield of aquifer (generally applicableto cases where injury affects a significant portion of the aquifer)	Volume of ground water available for consumption under a safe yield approach to resource management
Area of habitat (acre-year)	Area of water dependant habitat with reduced/increased services each year

Table 2. Possible water resource metrics.

The water resource metric that is chosen depends on the situation, the type of injury, and the likely restoration opportunities. Possible water resource metrics are listed in Table 2 above.

Depending on the metric selected, the assessment of groundwater injury also could include a buffer zone of unaffected groundwater around the injured resource. The buffer zone would include the consequences of a production well that could mobilize contaminated water into unaffected regions of the resource. A careful selection of the metric that excludes this type of injury would also enable a smaller compensatory restoration project.

In addition to the technical merits of the selected resource metric, other important factors should be recognized and considered. The stronger the linkage between the injured resource and the resource to be restored, the more valuable the service flows are from the restoration project. Factors affecting the linkage between the injured and restored resource include:

- Similarities between the resources and/or services.
- Geographical proximity.
- Stakeholder interests.

Ideally, the restored resource should be significantly similar to the injured resource. For example, an injured groundwater resource that provided drinking water services ideally would be compensated with additional potable groundwater. A variety of restoration projects could create potable groundwater (see sidebar, next page), such as water conservation, wellhead protection programs, cleanup of orphan plumes, etc. However, if the real injury is loss of potable water, not potable groundwater, then additional restoration opportunities come into play, such as improving available potable surface water.

The resource to be restored should be geographically close to the injured resource. Usually, the public and trustees will assign a greater value to restored resources that are near the injured resource than to those that are more distant. The local public will likely perceive a greater utility to locally restored resources, and therefore a greater value, because the public can more readily receive the services with greater ease and lower cost. Simply, people in a water basin that has been injured will consider a groundwater restoration project in that same basin to be more valuable than a restoration project in another basin.

Recognition of stakeholder interests is important in most projects that receive public review and comment. Because the settlement of resource damage undergo public review and comment, the trustees and the responsible party(s) should at least

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consider, if not incorporate, stakeholder interests in the selection and design of the compensatory restoration project. If significant stakeholder concerns can be addressed, then public acceptance of the settlement package is more likely and improved public relations may result.

Summary

In summary, resource equivalency analysis is a valid and useful approach to settling water resource damage claims. There are several potential resource-based metrics available to measure both the resource injury (service loss) and restoration benefit (service gain). The resource equivalency model is used to select the most effective water restoration project. Selection of the water resource metric should consider a variety of factors, including similarities between the resources and services, geographical proximity, and stakeholder interests. A successful compensatory restoration project can be performed for significantly lower costs than a dollar valuation of the injury and may facilitate public acceptance and relations.

For additional information, see page 31.

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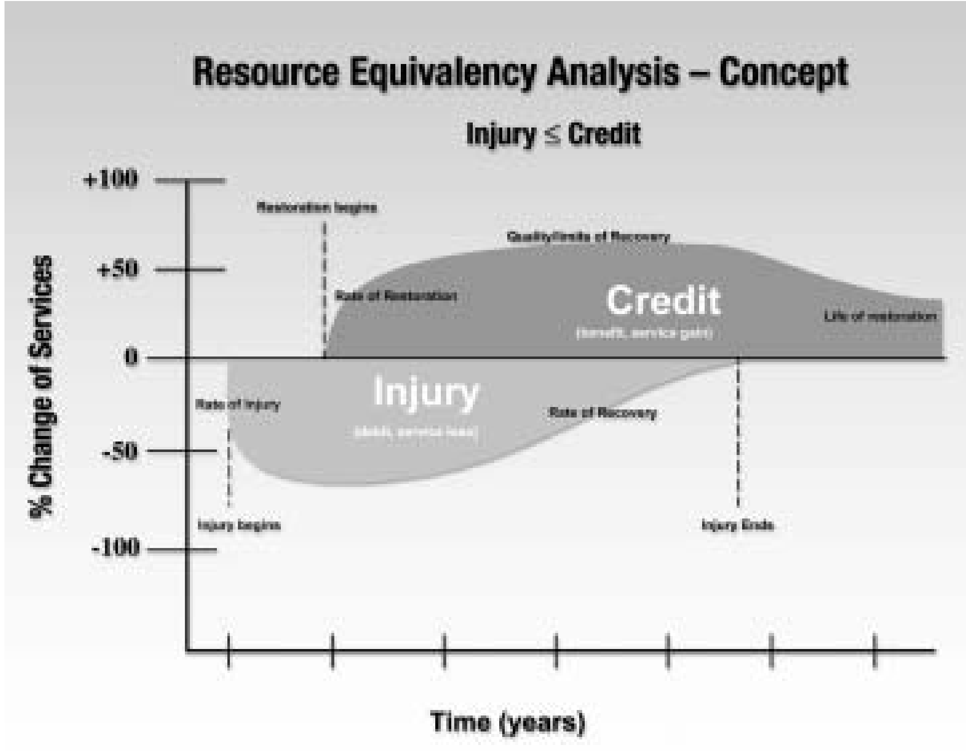

HOW TO CREATE WATER

Unlike habitat creation, it is generally not cost effective to literally "create" water for the purposes of mitigation. While potable water can be "created" by desalination plants, an increase in groundwater service flows and the volume of water typically can be achieved through a variety of more cost effective projects. Some types of projects that may increase available water include:

- ***Conservation programs that result in lower consumption of groundwater.*** *These programs can be of several types: (1) improving agricultural irrigation practices; (2) employing more water-efficient practices and infrastructure (toilets, shower heads, etc.) in municipal, residential, commercial, and industrial settings; (3) taking a waste minimization approach to industrial water uses; and (4) managing storm water as a resource instead of as a waste.*
- ***Groundwater recharge basins, infiltration galleries, or injection wells that increase the supply of water.*** *These capital costs and water resource benefits should be evaluated against potential resource costs, such as reduced surface water flows.*
- ***Reclaimed water treatment programs*** *that distribute "gray" water for use instead of consuming potable groundwater for non-potable purposes.*
- ***Remediation of an orphan groundwater plume*** *would decrease the volume of groundwater contaminated in the future. An orphan plume would be one without a known or financially competent responsible party.*
- ***Management of groundwater resources and watersheds to improve (if not begin) the management of the resource.*** *Conduct studies to better understand the hydrology of a watershed or groundwater basin and enable more efficient use of the resource. Implement wellhead protection programs. This approach presumes that improved resource management practices would yield a net increase in the services provided by the basin.*
- ***Cloud seeding to stimulate increased precipitation.*** *The increased precipitation has a wide variety of potential benefits, including increased groundwater recharge, improved habitat quality, and improved agricultural yields and reduced irrigation pressures.*