

## Valuing instream-related services of wastewater



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### ABSTRACT

In the southwestern US water resources are increasingly scarce, leaving perennial habitats and associated environmental amenities vulnerable to off-channel water demands. To provide management insight, the value of two instream flow related ecosystem services are estimated for two river reaches, for two separate population centers. The specific services are preservation of instream flow extent and accompanying Cottonwood-Willow riparian forest, and improving water quality to be safe for full body recreational contact. The case study is of a highly modified effluent-dominated waterway, yet strong support for maintaining wet river habitat was documented, apparently due mainly to ecological rather than recreational motivations. In general, the more distant river reach with more trees was more highly valued on a per mile basis, and the population center closest to both river reaches more highly valued their preservation. Support was mixed for increasing water treatment to allow safe full body contact. Well-known multinomial and mixed logit models are compared with a relatively new generalized mixed logit framework, with the latter performing best. Documentation of public values associated with the posed river management options assist decision-making for the case study and similar contexts lacking quantification of the value of instream flow related ecosystem services.

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### 1. Introduction

In the southwestern United States, competing pressures on water resources are extreme. Multiple extractive water demands from the agricultural, municipal, and industrial sectors must be balanced with protection and restoration of environmental resources. The extent to which society values allocations for environmental public goods is typically poorly characterized, since there is often no direct market to “sell” such ecosystem services. Without information on public values, it is difficult to assess whether environmental resources are being appropriately managed. In many instances people have both recreational use values and nonuse values (e.g. existence value) for environmental resources, complicating management tradeoffs. The only known technique of capturing total economic value inclusive of nonuse values are stated preference valuation surveys, also known as “willingness to pay” (WTP) studies.

Stated preference surveys concerned with freshwater ecosystem services are an active area of research, with numerous studies at

regional and even national scales. In the US, a classic reference is the “boatable, fishable, swimmable” water quality ladder, and associated marginal values between rungs (Carson and Mitchell, 1993). A more recent work conducted by Viscusi et al. (2008) valued changes in US lake acreage and river miles with “good” water quality on three dimensions: aquatic life support; safe fish consumption; and primary contact recreation without illness. Innumerable regional case studies are also available, valuing a variety of freshwater ecosystem services. In addition to original data collection, there is growing interest in benefit transfer to glean valuation insights across studies (Johnston et al., 2005; Van Houtven et al., 2007).

Despite the body of previous work, continued case study research remains important for two reasons. First, the river and stream attributes that people prefer may differ by region. Only by engaging in case studies can any variability and patterns in these attributes due to geography or other contextual factors be documented. For example, in one area the foremost issue may be water quality related, in another, water quantity. Second, the actual dollar value for the same ecosystem service change may differ radically depending on regional context. Additional targeted case studies not only inform local-scale decision-making, but also improve the robustness of benefit transfer techniques that rely on numerous empirically derived estimates under varying circumstances. Indeed, Boyd and Krupnick (2013) argue insufficient

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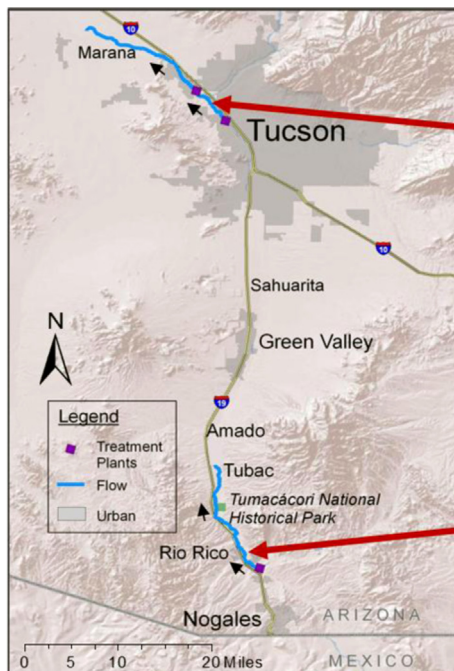


Fig. 1. Map of the Santa Cruz River watershed.

attention has been paid toward defining ecosystem service metrics for valuation, implying that existing studies may be of limited use if there has not been a defensible process for defining publicly relevant metrics, an issue also taken up by Jeanloz et al. (2016).

Our case study focuses on the Santa Cruz River in southern

Arizona (see Fig. 1). The Santa Cruz River is a classic example of southwestern riparian area loss, with layers of contemporary water management challenges. The channel once naturally carried perennial flow in some locations between the Mexican border and Tucson (Logan, 2002). These flows were dewatered by the



**NORTH**

Treated wastewater now supports about 20 miles of flow, and about 125 acres of forest along the river. The flow starts in NW Tucson near Prince Rd and I-10 and flows past Marana.

**SOUTH**

Treated wastewater now supports about 17 miles of flow, and about 460 acres of forest along the river. The flow starts in southern Rio Rico and flows past Tubac.

Fig. 2. Detail map of wastewater treatment outfalls on the Santa Cruz River and the associated perennial flow.

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