Using pragmatism to overcome the perils of monetary valuation: Applying Deliberative Q-method to understand the value of stream ecosystems in Amman, Jordan

by

Megan Peck

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Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Statement of Contributions

This thesis follows the manuscript option for Master's students in the School of Planning at the University of Waterloo. Accordingly, this thesis consists of a single manuscript, taken verbatim (with minor editorial changes) from its peer-reviewed submission to *The Journal of Ecological Economics*, currently under review.

For all aspects of this thesis I (Megan Peck) am the primary author. I also produced all of the figures shown herein except where indicated by citation. With supervisory guidance, I crafted the manuscript's theoretical and conceptual frameworks (i.e., analytical criteria), led data collection, and individually performed data analysis and interpretation. The manuscript's second author is my supervisor, Dr. Luna Khirfan, whom oversaw the work and reviewed the manuscript. Dr. Luna Khirfan and Dr. Pierre Filion also provided editorial comments to the entirety of this thesis.

The data analysis presented in this document was performed using an open-sourced program entitled *PQMethod 2.35*, maintained by Peter Schmolck, based on FORTRAN code by John Atkinon at Kent State University. For more information about PQMethod 2.35, please visit http://schmolck.org/qmethod/.

This thesis is situated within Dr. Luna Khirfan's broader research project, entitled "*The Potential of Daylighting (Deculverting) Urban Streams for Climate Change Adaptation and Mitigation and for Place-Making: Amman's Seil and Seoul's Cheonggyecheon*", which is funded by The Social Sciences and Humanities Research Council of Canada (SSHRC) via the successful procurement of the SSHRC Insight Grant competition #435-2016-0243.

Abstract

Existing ecosystem service literature is predominated by valuation studies that narrowly ascribe to either positivist or constructionist worldviews; each subject to inherent limitations that make their operationalization in practice limited. Valuation studies are lacking the pragmatism required to adequately integrate the complexity of ecosystem service values into decision-making, specifically as it pertains to sociocultural values, which do not easily translate into measurable metrics. Accordingly, this thesis aims to increase the validity and credibility of sociocultural valuation studies, both theoretically and empirically. Based on a literature review, valuation studies are lacking the concurrent embodiment of three critical themes: 1) deliberation; 2) local ecological knowledge; and 3) explicit trade-off mechanisms. Accordingly, this manuscript describes the theoretical framework that was developed, which simultaneously integrates these themes, and transcends their epistemological origins. To operationalize the theoretical framework, conventional Q-method was adapted into a deliberative process, by combining it with focus group procedures. This combined method was empirically tested in Amman, Jordan by analyzing how experts value urban water features amid severe water scarcity. The results revealed two juxtaposing opinions regarding the conception of urban surface waters in Amman. The predominant perspective is forward-thinking; valuing urban water features for their sociocultural values, supporting the application of nature-based solutions. The second perspective is backwards thinking; preoccupied with ecosystem disservices and unsustainable water management solutions. Accordingly, Amman and other developing metropolises that face rapid urbanization and climate change would benefit from greater international knowledge exchange, disseminating the benefits of

local nature-based solutions, specifically stream daylighting. The Deliberative Q-method produces easily interpretable results used by decision-makers to identify management priorities and improve the likelihood of policy success by reducing management inefficiencies and stakeholder conflict. The Deliberative Q-method is adaptable for a variety of research topics, within urban planning and beyond, which seek to understand social preferences amid complex urban realities and the diverse values of its citizens.

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List of Acronyms

ES	Ecosystem Services
MA	Millennium Ecosystem Assessment
RCM	Rational Comprehensive Model
TEV	Total Economic Value
WTP	Willingness to Pay
WTA	Willingness To Accept [compensation]
WTT	Willingness To give up Time
LEK	Local Ecological Knowledge
NbS	Nature-based Solutions
CBA	Cost-Benefit Analysis
PCA	Principal Component Analysis
GAM	Greater Amman Municipality
EBRD	European Bank for Reconstruction and Developmen

Chapter 1.0 Introduction

Global urbanization has steadily increased since the onset of the Industrial Revolution, resulting in part from the natural rise of the global population and because of the socio-economic pulls (such as better employment opportunities, health and educational services, and enhanced opportunities for cultural and political participation) drawing people to urban centres in pursuit of a "better life" (Hoffmann, Konerding, Nautiyal, Buerkert, & Walter, 2019). Today, 55% of the global population lives in cities, with this number expected to rise over 68% by 2050 (UN, 2018). As civilization becomes increasingly urban, changes in land use, economic activity, and culture ensue, but what remains constant is humans' dependency on nature for survival. The modern conception of this relationship is known as 'ecosystem services' (ES), predominantly defined as "the functions and products of ecosystems that benefit humans, or yield welfare to society" (Lele, Springate-Baginski, Lakerveld, Deb, & Dash, 2013, p. 343; Reid et al., 2005, p. vi-ix). This concept first emerged in the 1970's, originally coined 'environmental services' in the interdisciplinary report, entitled '*Man's impact on the global environment: report of the study of critical environmental problems*' (Wilson & Matthews, 1970), with the intention to highlight human's dependency on nature and increase public interest in biodiversity conservation (Gómez-Baggethun, de Groot, Lomas, & Montes, 2010; Lele et al., 2013). Re-named by ecological economists in the mid-1980's, the ecosystem service concept was mainstreamed in the literature by notable works, such as Costanza and Daly (1992), Costanza, d'Arge, and de Groot (1997), and Daily (1997) (Lele et al., 2013). The political uptake of the ecosystem service concept was largely influenced by the 2005 Millennium Ecosystem Assessment (MA), which put human-welfare at the forefront of this concept; explicating the link between different ecosystem service types (provisioning; regulating; supporting; and sociocultural ecosystem services, as defined in

Figure1.) and the constituents of human well-being (Hansen et al., 2015; Lele et al., 2013; Reid et al., 2005, p. v-101). Similarly, over the past century, urban planning discourse has demonstrated significant interest in the ecosystem service concept in hopes to redefine how ecosystems are considered in planning and policy decisions, to promote actions that actively consider, and plan for, environmental benefits (Hansen et al., 2015).

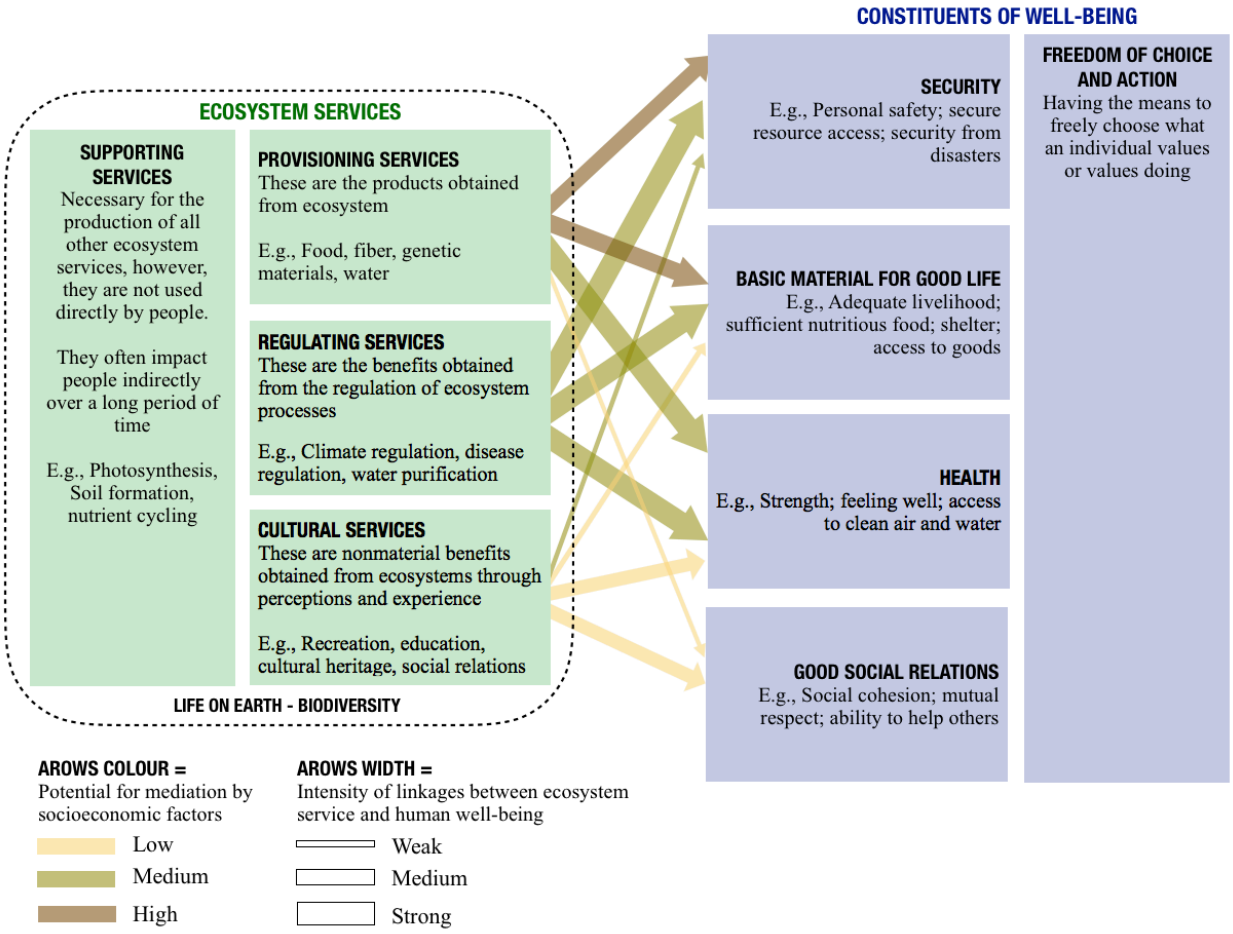

Figure 1. The linkages between ecosystem services and human well-being (adapted from Reid et al., 2005, p. vi-ix)

In this respect, urban planning is well positioned to adopt the ecosystem service concept as the profession represents the nexus between people and nature, inherently concerned with considering and deciding among competing land uses and resource allocation demands (Hansen,

2015). More recently, the concept of spatial planning has highlighted the planner's role in designing, maintaining, and recreating sustainable communities by coordinating and managing the changing environment, physically (ecologically), socially, and economically (Galler, Albert, & Von Haaren, 2016; Shaw, Lord, & Shaw, 2009). Spatial planning goes beyond traditional land use planning by integrating other policies and programmes (horizontally across sectors, and vertically between national, regional and local policy scales) that influence both the nature and function of places, often aimed at reconciling competing policy agendas (Galler et al., 2016; Shaw et al., 2009). The ecosystem service concept is considered a 'boundary object', representing information that is "adaptable to different viewpoints", used in different ways by different communities, and robust enough to maintain identity across different personal backgrounds and knowledge types (Galler, 2016, p. 118). This characteristic makes the ecosystem service concept suitable for use within spatial planning, as it can be used to facilitate cross-sectoral coordination in siloed administrative systems (Ibid.). Using the ecosystem service concept as a boundary object also encourages multi-functional decision-making by providing a mutual point of reference for participants across different disciplines (Ibid.).

Despite the concept's suitability within the context of urban planning, contemporary authors report that the ecosystem service concept is not well implemented in actual planning processes (Hasse et al., 2014; Lennon & Scott, 2014), especially at the local and regional scale (Galler et al., 2016). Furthermore, according to Hernández-Morcillo, Plieninger and Bieling (2013) few planning studies integrate their study results into real world applications (policies and programs), or develop assessment tools for practitioners. This indicates a gap in the literature with regards to empirical studies that integrate the ecosystem service concept into planning practice, hence, in order for the concept "to have an impact on decision-making, [it] must [first] spread from

academia to practice" (Hansen et al., 2015, p. 228). As such, this research aims to bridge the quintessential gap between planning theory and practice, specifically as it relates to the ecosystem service concept.

1.1 Literature Review

While the manuscript featured in this thesis contains a more detailed literature review, the following section will review the relevant literature that informed the development of the following research questions: 1) What are the key themes guiding the sociocultural valuation of ecosystem services?; 2) How can conventional valuation methods be improved to better suit planning practice?; and 3) By empirically testing a newfound method, how and why do experts in Amman, Jordan value urban water feature's ecosystem services, and how can these values inform planning policy and environmental stewardship?

Accordingly, the objective of this abridged literature review is to identify the topic's central issues, where the literature review featured Section 2.1 is used to describe how other authors' work were integrated into this thesis' research approach. The remainder of this chapter will introduce the thesis' guiding concepts, beginning with a discussion about urban ecosystems and urban ecosystem services. The concept of 'value' is then introduced, including a discussion surrounding its different conceptualizations (i.e., monetary, ecological, and sociocultural), and their guiding epistemologies. Next the barriers urban planners face in mainstreaming the ES concept is explored and the chapter concludes by stating the thesis' overarching objectives and research questions.

1.2 Urban Ecosystem Services

All ecosystems are made up of two components: 1) biological components (e.g., plants, animals, and other forms of life); and 2) physical components (e.g., soil, water, climate), which interact with each other in a given space (Pickett, Cadenasso, Grove & Nilon, 2018). The biological components of urban ecosystems are predominated by humans, and the institutional structures, social and economic tools we employ (Pickett et al., 2018). Therefore, the physical structure of cities largely consists of modified surfaces (environmental alterations) as a result of human decision-making (Ibid.). Cities' remaining biological and physical components constitute urban 'green' and 'blue' spaces, which Bolund and Hunhammer (1999) define as 'urban ecosystems', despite their interplay, manipulation and management by humans. Bolund and Hunhammer (1999) identify seven different categories of urban ecosystem services, which include: 1) urban street trees; 2) lawns/ parks; 3) urban forests; 4) cultivated lands; 5) wetlands; 6) lakes/sea; and 7) streams (Bolund & Hunhammer, 1999).

Within urban areas these ecosystem categories are often limited, or non-existent, undermining their ability to offer benefits to society via ecosystem services (Ferreira, Esteves, Souza, & Santon, 2019). For example, the loss of natural system regulation (e.g., paving green spaces and removing their ability to infiltrate water), predisposes cities to other adverse effects (e.g., urban heat island effect and chronic urban flooding). For this reason, in highly urban contexts, some ecosystem services such as food production (provisioning service) and erosion control (regulating service) are largely considered irrelevant (Bolund & Hunhammer, 1999). Therefore, in order to narrow in on the ecosystem services relevant in urban areas, Bolund and Hunhammer (1999) identify six pertinent categories: 1) air filtering; 2) microclimate regulation (at street and

city level); 3) noise reduction; 4) rainwater drainage; 5) sewage treatment; and 6) recreation and cultural values.

Urban ecosystems are also unique compared to rural areas since they are subject to a "high intensity of demand [or] use" by a "large number of immediate local beneficiaries" (Elmqvist et al., 2015, p. 101). This increased demand coupled with urban ecosystems' limited spatial cover (i.e., benefit supply), causes many cities to rely on ecosystem provisions produced beyond their urban boundaries, transferred by man-made or natural means (e.g., migration, wind or water flow) (Gómez-Baggethun & Barton, 2013). The benefits of some ecosystem services are easily transferred from distant sources and do not necessitate close proximity (Bolund & Hunhammer, 1999). For instance, the Amazon Rainforest is a globally significant carbon sink important to all countries, near and far, as it helps to stabilize global climate patterns. However, some ecosystem services are impossible to transfer, notably cultural ecosystem services such as beautification of the urban environment. Therefore, these services must be generated close to where they are consumed (Bolund & Hunhammer, 1999). Accordingly, as stated by Bolund and Hunhammar (1999), "most of the problems presented in urban areas are locally generated", and therefore, "often the most effective, and in some cases the only, way to deal with these local problems is through local solutions" (p. 294). In this respect, the conservation of urban ecosystems is vital as it can offset cities' ecological footprint and improve the quality of urban life. This sentiment is particularly true when considering the impacts of climate change, which is anticipated to exacerbate existing urban issues. Urban ecosystem services provide important climate change mitigation and adaptation services, for example carbon sequestration and the infiltration and/or diversion of stormwater runoff, respectively. This concept is understood as the insurance value of nature, representing the future benefits gained by conserving ecosystems (e.g., protecting

against climate change adversities and food security) in the face of uncertainty and risk, over their use for short-term gain (e.g., resource extraction and land use changes) (Gómez-Baggethun & Barton, 2013; Green, Kronenberg, Andersson, Elmqvist, & Gómez-Baggethun, 2016; Pascual et al., 2015). According to Gómez-Baggethun and Barton (2013) and Green et al. (2016), there is a lack of empirical studies analyzing the insurance value of urban ecosystems and the role that 'green' and 'blue' infrastructure play in building resilient cities. The insurance value of urban ecosystems is particularly pertinent to urban planners in an era of rapid climate change.

Within complex environments, such as cities, urban ecosystems can also be perceived to negatively impact human-wellbeing. For example, urban streams, despite their role in regulating local watersheds or mitigating the urban heat island effect, can also pose health and safety risks to urbanites by acting as a drowning hazard or an environment that fosters water-born illness. These are referred to as ecosystem disservices, and extend to attributes such as "pests, litter and deterioration of infrastructure; biological hazards such as disease, animal attacks, allergic and poisonous organisms and geographic hazards such as floods, heat waves and storms" (Von Döhren & Haase, 2015, p. 491). Therefore, in order to obtain a holistic understanding of urban ecosystems and their value to society, it is important for ecosystem disservices to be acknowledged during value framing (Webler, Danielson, & Tuler, 2009, p. 17-18).

1.3 Classifying value types and valuation techniques

A review of the 'value' concept is warranted in order to contextualize urban planning's application of the ecosystem service concept. Accordingly, the following section details the different types of values and their respective valuation (i.e., measurement) techniques.

Many authors use the term 'value' exclusively in a monetary sense, ignoring the broader contributions ecosystems provide to society (Chan, Satterfield, & Goldstein, 2012; Gómez - Baggethun et al., 2014; Scholte, Van Teeffelen, & Verburg, 2015; Turner et al., 2003). However, we adopt a more general understanding of the term, referring to the concept of "value" as "the worth or usefulness of something" (Gomez-Baggethum et al., 2014, p. 6). Valuation is therefore defined as the "act of assessing, appeasing or measuring value, as value attribution, or as framing valuation" (Dendoncker, Keene, Jacobs, & Gómez -Baggethun, 2013; Gomez-Baggethum et al., 2014, p. 6). The objective of ecosystem valuation is to bolster nature conservation and mainstream basic ecological goods, services, and functions into the decision-making process (Lele et al., 2013). Because the ecosystem service concept is inherently anthropocentric, "it is the presence of human beings as valuing agents that enables the translation of ecological structures and processes into value-laden entities" (de Groot, Wilson, & Boumans, 2002, p. 395). This translation of value comes in multiple forms, but generally speaking, the literature classifies these values into three types including: 1) monetary; 2) ecological; and 3) sociocultural values (de Groot et al., 2002; Gomez-Baggethum et al., 2014).

Two questions that govern the valuations of all value types are: 1) *what* do we measure?; and 2) *how* do we measure it? Although monetary, ecological and sociocultural valuation methods are inherently different, all value types address the first question using ecosystem service indicators (Vihervaara et al., 2017, p. 93). "Ecosystem service indicators are information that efficiently communicates the characteristics and trends of [ecosystem services], making it possible for policy-makers to understand [their] condition … and rate of change" (Vihervaara et al., 2017, p. 94). Indicators can be directly observable, or require proxies for interpretation; therefore, when selecting or designing a valuation study it is important to consider the suitability of the

ecosystem service indicator and its audience (Ibid.).

The conceptual boundaries of these value types are often blurred, for example an urban ecosystems' contribution to tourism can be seen as an economic value as much as a social one (Gomez-Baggethum et al., 2014). To ease their interpretation these value types can be differentiated by their distinctive analytical categories, which are outlined in the following three sections (Ibid.).

1.3.1 Monetary value

First, 'monetary value' represents environmental values articulated or measured using currency, money, or price signals based on an open market economy (Gomez-Baggethum et al., 2014; TEEB, 2010). The so-called "Total Economic Value" of an ecosystem and its services, is understood as the sum of its use (i.e., direct use, indirect use and option values), non-use (i.e., existence, bequest or altruistic values), and option values (i.e., future or potential direct use and indirect use values), as defined in Figure 2. (Ibid.). Few ecosystem services have an explicit exchange value or price within the open market (i.e., direct market valuation), and those that do, are most commonly consumptive 'direct use values' of provisioning ecosystem services (e.g., agricultural crops, water). Under some circumstances, direct market valuation can also extend to cultural and regulating ecosystem services (e.g., recreation and water regulation, respectively) (de Groot et al., 2002; Gomez-Baggethum et al., 2014). For example, the price of recreation can be interpreted using conservation areas' land acquisition costs, whereas the price of regulating ecosystem services can be reflected in mitigation banking costs[1] (Ibid.). Many of the remaining

[1] Mitigation banking is an environmental management policy that develops a commodity market out of privately owned ecosystem services to compensate for expected environmental adversities elsewhere (Robertson, 2004).

ecosystem service values, including use-, non-use, and option values (See Figure 2.) are not easily captured by market transactions and therefore, in neoclassical economics, they are considered positive externalities and excluded from value framing (Gomez-Baggethum et al., 2014). Accordingly, in order to better incorporate these values into decision-making processes and in order to equitably cross-compare trade-offs, monetary valuations apply various techniques that use proxies to assess the demand-side (i.e., utilized ES) of ecosystem service values. Commonly applied techniques include indirect market valuation, contingent valuation and, under the umbrella of contingent valuation techniques, group valuation (as defined in Table 1.) (de Groot et al., 2002; Gomez-Baggethum et al., 2014; TEEB, 2010, p. 7-9). Both indirect and contingent valuation methods are performed in social isolation and require the "aggregation of separately measured, individual preferences", which neglects the social dimension of value, as ecosystem services are "inherently objects of ethical and normative concern" (de Groot et al., 2002; Santos-Martín et al., 2017, p. 102-103; Wilson & Howarth, 2002, p. 432). Accordingly, drawing on social and political theory, group valuation emerged as an approach used to acknowledge the social construction of value by integrating group deliberation into the value framing process; discussed in terms of the social willingness to pay (de Groot et al., 2002; Irving et al., 2016; Wilson & Howarth, 2002). Yet, all monetary valuation approaches have been criticized for extending market values to incommensurable use and non-use values, specifically as it pertains to cultural ecosystem services (Chan et al., 2012; Gómez -Baggethun et al., 2014; Scholte et al., 2015; Turner et al., 2003).

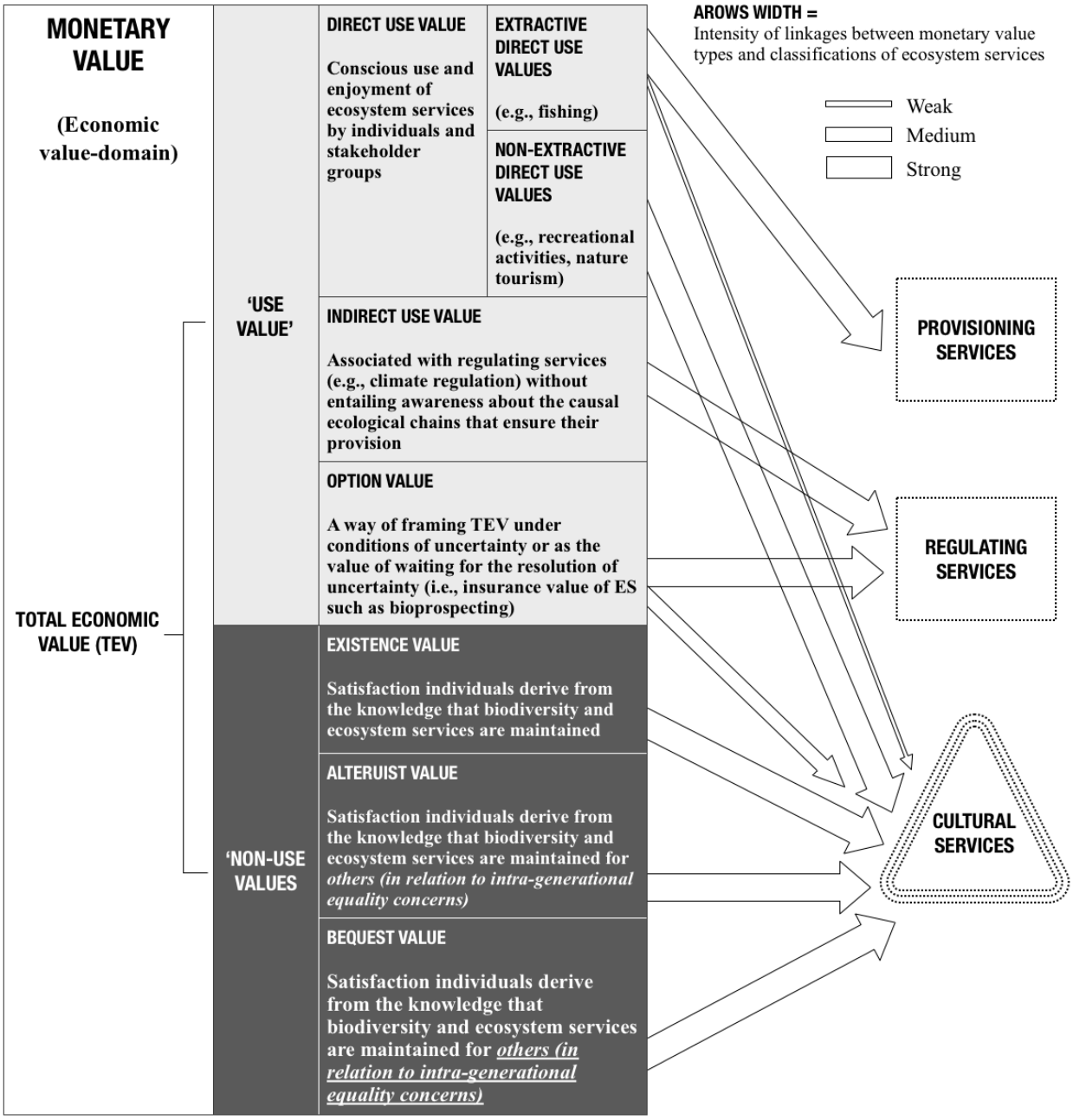

Figure 2. Monetary values and the constitutes of Total Economic Value, whereby the 'cultural services' category indicates warning, as criticism abounds the valuation of cultural service or sociocultural values using monetary metrics (TEV) (Gomez-Baggethum et al., 2014; TEEB, 2010) (Gomez-Baggethum et al., 2014; TEEB, 2010, p. 7-9)

Table 1. Classification of monetary valuation techniques (de Groot et al., 2002; Gomez-Baggethum et al., 2014; TEEB, 2010, p. 7-9)

<table>
<tr><td rowspan="4">INDIRECT MARKET VALUATION
(i.e., Observed preference model)

A method used to assess individuals' preferences, whereby one of a variety of techniques is applied to reveal people's Willingness To Pay (WTP) or Willingness To Accept (WTA) compensation for the availability or loss of an ecological good, service or function</td><td>Avoided costs</td></tr>
<tr><td>Replacement costs</td></tr>
<tr><td>Factor income</td></tr>
<tr><td>Travel costs</td></tr>
<tr><td rowspan="2">CONTINGENT VALUATION
(i.e., Stated preference model)

Renders monetary value by asking people directly, typically using a social survey questionnaire, to report their Willingness To Pay (WTP) in order to obtain or conserve an ecological good, service or function

Used to shed light on the value of ecosystem services' non-use values, which have no behavioural market trace</td><td>Social science surveys</td></tr>
<tr><td>Group valuation
(i.e., Deliberative monetary valuation)

Incorporates deliberative group elements (information provision, discussion, time for reflect in a group setting) into the valuation process in order to elicit a Social Willingness To Pay</td></tr>
</table>

1.3.2 Ecological value

The ecological importance of an ecosystem represents its capacity to sustain life and provide natural goods and services through biotic and abiotic functions, inclusive and exclusive of humans, based on ecological criteria such as ecosystem quality, integrity, resilience and

resistance (de Groot et al., 2002; Gomez-Baggethum et al., 2014; Vihervaara et al., 2017, p. 93 & 95).

Therefore, the ecological importance of an ecosystem includes instrumental values (i.e., values servicing life on Earth and provisioning ecosystem services), intrinsic values (i.e., the value inherent to biodiversity and ecosystems themselves) and insurance values (conserving nature for future procurement over short-term gain) (Gomez-Baggethum et al., 2014).

Based on this definition, valuation studies measuring ecological values use biological quantification to measure ecosystem service indicators such as ecosystem structures, processes, functions and service flows; expressed in numerical amounts, magnitudes, and/or quantities (e.g., tons of sequestered carbon). Biological quantification is concerned with the supply of ecosystem services (i.e., offered ES) as relevant indicators measure an ecosystem's stock or flow, whereby the former refers to an ecosystem's capacity to deliver social benefits (e.g., available timber stock for harvest) and the latter refers to the actual use of such benefits (e.g., the volume of timber cut per hectare in one year) (Vihervaara et al., 2017, p. 95). Biological quantification is a non-monetary valuation technique that consists of a variety of quantitative methods that fall under one of three categories, including: (1) direct measurements; (2) indirect measurements; and (3) numerical modelling (as defined in Table 2.) (de Groot et al., 2002; Galler et al., 2016; Gomez-Baggethum et al., 2014; Vihervaara et al., 2017, p. 97-100).

To ensure ecological values are considered in environmental policies and decision-making processes, biophysical quantifications must be integrated into the governance and socio-economic systems in which they are embedded (Galler et al., 2016; Kallis, Videira, Antunes, & Santos, 2007, p. 12).

In some instances, ecological values are used directly in environmental decision-making, for example as environmental quality targets. However more generally, this value type requires some attribution to social importance to clarify why and for whom these values are important (Gomez-Baggethum et al., 2014; Santos-Martín et al., 2017, p. 104). Therefore, as stated by Vihervaara et al. (2017), "transferring the outcomes of biophysical assessments to policy is not straightforward and some additional work is required to ensure a minimum degree of consistency" (p. 101).

Table 2. Three categories of ecological valuation approaches (Vihervaara et al., 2017)

	DEFINITION	EXAMPLE	CHARACTERISTICS
DIRECT MEASUREMENTS	The actual measure of an ecosystem's state, quality, or process derived from observations, monitoring, surveys or questionnaires which cover the entire study area in a representative manner Direct measurements quantify or measure a stock or flow value	• Recording a farm's crop yield • Measuring the volumetric capacity of a flood plain • Monitoring the release of nitrous oxides by plants	• Primary data • Most accurate way of quantifying ES • Time and resource consuming • Most suitable at the site level or local scale
INDIRECT MEASUREMENTS	Indirect measures of ecosystem services deliver a biophysical value in physical units However, this value relies on certain assumptions or requires further interpretation before it can be used to measure an ES value Indirect measurements deliver a biophysical value of ES in physical units that differ from the units of the selected indicator.	• Variables collected through remote sensing. e.g., Micro-climate regulation inferred from earth surface temperatures • Leaf area index relates to canopy structure, which infers air filtration by trees	• Useful at larger scales and global trends • Often based on regularly-updated, consistent sources of information
MODELLING	Modelling can be used to quantify ES if no direct or indirect measurement is available. Within ES modelling the simulation of supply, use and demand are based on ecological and socio-economic input data or knowledge	• Estimating the quantity of soil that is not eroded due to vegetation's protective coverage	• For regulating services, modelling is sometimes the only option to quantify ES flows

1.3.3 Sociocultural value

Social and cultural value perceptions also influence people's attitudes and preferences towards ecosystems and their services (de Groot et al., 2002; Gomez-Baggethum et al., 2014). The MA defines cultural ecosystem services as "non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience" (Reid et al., 2005, p. 40). Ecosystem services' sociocultural value refers to non-use, intangible values, closely related to people's emotional, affective, and symbolic views towards nature (e.g., therapeutic, aesthetic, moral, educational and spiritual values, to name a few). Hence, "in most cases [sociocultural values] cannot be adequately captured by commodity metaphors and monetary metrics" (Gomez-Baggethum et al., 2014, p. 11). For example, a participant may refuse to assign a monetary value to the divinity of nature in a WTP model, not because they devalue the spiritual significance of this ecosystem but because the ecosystem service indicator (i.e., money) cannot adequately represent these values' magnitude (Gomez-Baggethum et al., 2014; Kelemen, García-Llorente, Pataki, Martín-López & Gómez-Baggethun, 2016). Despite this limitation, sociocultural valuation methods remain heavily influenced by monetary valuation methods. For instance the review article by Hernández-Morcillo et al. (2013), which assessed 42 peer-reviewed journal articles measuring the value of cultural ecosystem services, found that nearly half of these articles reverted to indicators that apply monetary metrics, such as funding proxies for scientific research (Wang et al., 2010), and housing prices as aesthetic value estimates (Everard & Kataria, 2011). Nevertheless, cultural values are best measured using non-monetary approaches, many of which are based on political philosophy and participatory techniques, that do not rely on market logics to assess "the importance, preferences, needs, or demands expressed by people towards nature" (Gomez-

Baggethum et al., 2014, p. 15; Kelemen et al., 2016). Such approaches have come to be known as 'sociocultural valuation', "an umbrella term for preference ranking methods [that analyze] human preferences towards ecosystem services in non-monetary terms" (Gomez-Baggethum et al., 2014; Kelemen et al., 2016, p. 2).

The sociocultural valuation literature has grown considerably over the last ten years, yet it does not yet constitute a formal methodological field, largely due to the heterogeneity of applied research approaches and their differences in methodological requirements and terminology (See: 'psycho-cultral valuation' (Kumar & Kumar, 2008); 'deliberative valuation' (Howarth & Wilson, 2006); 'social valuation' (James et al., 2013) (Gomez-Baggethum et al., 2014, p. 11; Kelemen et al., 2016; Santos-Martín et al., 2017, p. 102). Hence, as stated by Santos-Martín et al. (2017) "designing a methodological framework, able to explore ways of representing cognitive, emotional and ethical responses to nature, alongside ways of expressing preferences, need and the desires of people in relation to ES, is very much needed" (p. 102).

The methodological requirements of sociocultural valuation approaches can be roughly clustered into the following three groupings: (1) quantitative methods requiring multiple observations that are generally developed in collaboration with scholars from the same field (e.g., preference assessment, time-use, and photo-elicitation) (Santos-Martín et al., 2017, 104); (2) methods developed through collaboration with non-academic stakeholders, based on qualitative data (e.g., narratives); and (3) integrated approaches, whereby researchers gather qualitative and quantitative data by collaborating with scholars from other fields and non-academic stakeholders (e.g., participatory mapping, participatory scenario planning and deliberative valuation) (Ibid.). These methods can be further discussed using examples of seven commonly applied valuation techniques (as defined in Figure 3.) (Ibid., p. 103-104). Methods in the third category can

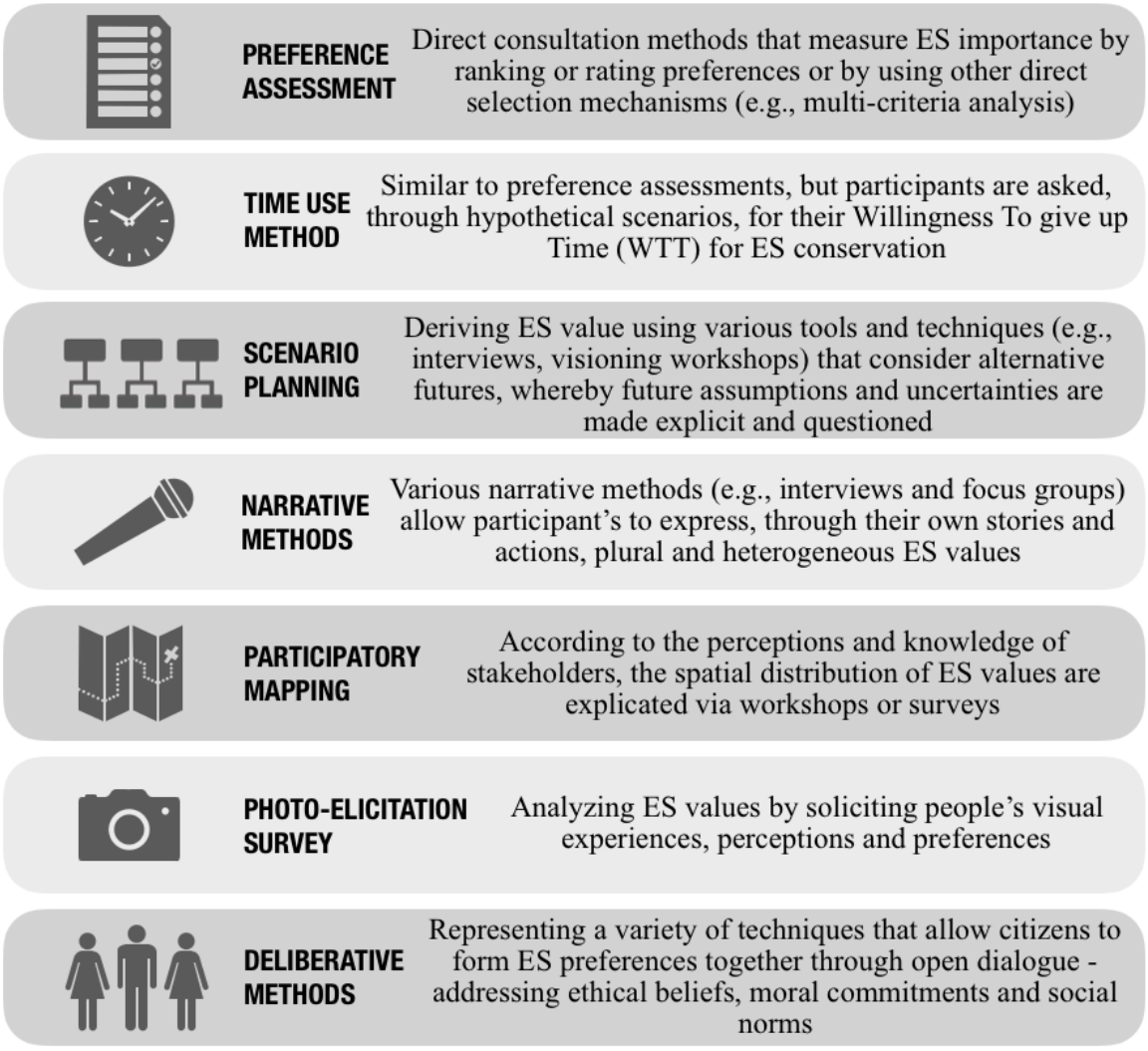

Figure 3. Seven conventional sociocultural valuation methods (Santos-Martín et al., 2017)

"contribute to social learning and knowledge co-production", fostering discussion between different stakeholder groups, revealing future ES trends and their implications for human well-being (Ibid., p. 104). Integrative approaches cover the majority of value categories, but generally speaking, sociocultural valuation methods have received criticism for their lacking ability to

simultaneously measure all value types (Table 3.), and therefore, to capture all values researchers will apply multiple methods (Santos-Martín et al., 2017, p. 105).

Sociocultural valuations are also criticized for having an underdeveloped conceptualization phase and for their application of un-rationalized or undefined ecosystem service indicators that make study results difficult to operationalize in practice (Gomez-Baggethum et al., 2014; Hernández-Morcillo et al., 2013).

Table 3. Conventional sociocultural valuation methods' ability to integrate different values and value types (adapted from Santos-Martín et al., 2017)

SOCIOCULTURAL METHODS	Intrinsic	Relational	Instrumental	Ecological	Sociocultural	Monetary	Direct use values	Indirect use values	Existence values	request values	Option values	Integration Potential
PREFERENCE ASSESSMENT	●	●	●	●	●	○	●	●	●	●	●	◑
TIME UES	●	●	●	●	●	●	●	●	●	●	●	◑
PHOTO-ELICITATION SURVEY	●	●	●	●	●	●	●	●	●	●	●	◑
NARRATIVES	●	●	●	●	●	○	○	○	●	●	●	⊕
PARTICIPATORY MAPPING	●	●	●	●	●	●	●	●	●	●	●	●
SCENARIO PLANNING	●	●	●	●	●	●	●	●	●	●	●	●
DELIBERATIVE VALUATION	●	●	●	●	●	●	●	●	●	●	●	●
DEGREE OF VALUES CAPTURED BY ALL METHODS	⊕	◑	◑	◑	●	⊕	⊕	⊕	◑	◑	◑	

Method's ability to capture different types of value…and accordingly, methods capacity to integrate different values

● high; ● moderate; ● low; ○ not appropriate ● high; ◑ medium; ⊕ low

Compared to monetary and ecological values, the literature has paid less attention to cultural and non-material ecosystem services (Chan et al., 2012; Gomez-Baggethum et al., 2014; Kelemen et al., 2016; Santo-Martín et al., 2017). Accordingly, sociocultural valuation has been noted by Chan et al. (2012) as one of the most difficult and least accomplished undertakings in ecosystem service research. Yet, it is critical that social and cultural values are recognized in urban planning, since the loss of cultural services have the least potential for mediation by socio-economic factors (compared to provisioning and regulating ES), meaning that once degraded, cultural ecosystem services are the least likely to be replaced by technical or man-made processes (Hernández-Morcillo et al., 2013). In fact, as areas urbanize, humans' dependence on cultural ecosystem services grows, while their dependence on substitutable provisioning services decreases, since the production of these services are pushed to the urban periphery (Ibid.).

1.4 ES implementation barriers

This section of the literature review explores the barriers facing the uptake of the ecosystem service concept in contemporary discipline of urban planning.

As previously stated, a suitable ecosystem service indicator is one that is fit for the purpose of the process and target audience (Santo-Martín et al., 2017). For example, in urban planning, where value considerations are derived from democratically legitimized laws and directives, norms, and standards, ecosystem indicators should be easily digestible by decision makers and non-experts (Galler et al., 2016). However, contemporary urban planning has predominantly applied monetary and ecological valuation indicators, which are incompatible with many of the social and political theories underpinning the field. For example, since elements of good governance has become integral to spatial planning (e.g., using public participation and

government transparency to limit the distorting effects of money in politics), these valuation approaches remain inherently incompatible, as the willingness to enter into economic or biological calculations is typically limited to experts within these respective fields (Ibid.).

In this respect, monetary and ecological valuations share the same criticisms of the rational comprehensive model, otherwise known as synoptic planning. Like synoptic planning, these valuations have a deterministic philosophy (positivism) whereby "causes probably determine effects or outcomes" (Creswell, 2014, p. 36). Methods based on this epistemology observe or measure the "objective reality" of the world by relying on numerical analysis over lived experiences and socially constructed values (Creswell, 2014, p. 36; Hudson, Galloway & Kaufman, 1979). However, numerical and quantitative results are not always suitable in real-world planning applications. For example, valuation studies that produce quantitative information on cardinal scales (i.e., number counts representing a quantity; e.g., 2000 tons of sequestered carbon) are generally of little use to spatial planners seeking to identify land use or policy priorities, as an importance value is generally all that is needed (Galler et al., 2016). Additionally, cardinally scaled information, specifically under circumstances of uncertainty, such as planning in the face of climate change, "bears the risk of expressing a false accuracy if uncertainties are not communicated" (Ibid, p. 120). Hence, valuation studies that produce ordinal-scaled information (i.e., information denoting rank or position, such as 1^{st}, 2^{nd}, 3^{rd}, etc.) are more applicable to practicing planners (Galler et al., 2016). Moreover, monetary and ecological valuations' limited ability to measure sociocultural values results in biased decision-making that hampers the inclusion of cultural ecosystem services and multiple knowledge types in environmental management and policy development (Chan et al., 2012). Similar to how transactive and collaborative planning theories emerged in response to the synoptic model's

criticism, sociocultural valuation emerged in reaction to the shortcomings of monetary valuation (Kelemen et al., 2016). Sociocultural valuation aims to integrate lived human experiences into the decision-making process, hence, it ascribes to a constructionist worldview, whereby individuals construct meanings as they engage with the world, and researchers "look for [a] complexity of views rather than narrow meanings" (Creswell, 2014, p. 37). Similar to transactive planning, some sociocultural valuation methods (e.g., participatory scenario planning, narratives), specifically deliberative valuation, are aimed at integrating different knowledge types into the value-framing process and focus on interpersonal dialogue marked by a process of mutual learning. Yet, many of these methods have undefined scopes and often lack the circumscribed logic of the synoptic model or the positivist approach (Hudson et al., 1979).

1.5 Overarching objectives

There is a prevailing lack of interest in, and awareness of, the ecosystem service concept among today's planning practitioners (Galler et al., 2016). Urban planners experience a deficiency in available data and resources for assessing the value of ecosystem services and therefore there are difficulties in integrating the ecosystem service concept within existing planning and management instruments (Ibid.). This author believes that these difficulties arise from specific valuation approaches' ascription to mutually exclusive planning theories, which are incompatible with real-world planning problems - that are not so consistent or self-contained (Hudson et al., 1979). In other words, valuation methods have conflicting epidemiologies for validating information, which includes "self-reinforcing network of methods, data requirements, professional skills", and challenges for operationalizing the concept in practice (Ibid., p. 388). These barriers have led to a lack of real-world examples that operationalize the ecosystem

service concept in planning, adding value to policies or management decisions (Galler et al., 2016; Laurans, Rankovic, Billé, Pirard, & Mermet, 2013; Ruckelshaus et al., 2015).

Ultimately, the goal of this research is to mainstream the valuation of social and cultural values in urban planning, by developing a theoretical and conceptual framework that is compatible with the idiosyncrasies of real-world practice, specifically in the face of climate change risk and uncertainty. In doing so, the paper considers the need for: 1) a change in planning paradigms and routines towards a more systematic and holistic thinking about urban ecosystem services; and 2) a shift towards more interdisciplinary thinking (Hansen et al., 2015). With these considerations in mind Chapter 2.0 presents a paper, as submitted to the *Journal of Ecological Economics,* which aims to develop an empirically robust heuristic planning tool, integrating the sociocultural valuation of urban ecosystems into existing planning and management instruments.

Chapter 2.0: Overcoming the perils of monetary valuation: Sociocultural valuation of stream ecosystems using Deliberative Q-method

The term '*ecosystem services*' represents the "conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life" (Daily, 1997, p. 3). There are three categories of ecosystem services that relate directly to human well-being, these include: 1) *provisioning services,* life sustaining ecosystem benefits and functions (e.g., food, water, genetic resources); 2) *regulating services*, human benefits derived from natural system regulation (e.g., climate regulation, water regulation); and 3) *cultural services*, non-material benefits humans obtain from ecosystems (e.g., aesthetics and recreation) (Reid et al., 2005, vi-ix)

Ecosystem valuation is a process whereby policy-makers assign a value to an ecosystem or its services to better integrate environmental benefits into decision-making processes, weigh management impacts and, re-frame policy decisions accordingly (Chan et al., 2012; Nagy, 2015). In pursuit of efficient resource allocations that best represent the common good, decision-makers conventionally apply valuation approaches that embody neoclassical economics; focused on the monetary conceptualization of value, hedonistic psychology, methodological individualism and self-interest (Chan et al., 2012; Gómez -Baggethun et al., 2014; Scholte et al., 2015; Turner et al., 2003). Such studies dominate the valuation literature. Under this framework urban planners apply various approaches (i.e., direct market valuation, revealed preference valuation and stated preference valuation) to convert non-market ecosystem services (e.g., flood regulation, aesthetic value, etc.) into monetary terms, so market and non-market values can be equitably cross-compared (Gómez-Baggethun et al., 2014; Seppelt, Dormann, Eppink, Lautenbach, & Schmidt, 2011).

However, it is believed that monetary valuation approaches inadequately measure non-market, intangible values, specifically those connected to emotional, affective and symbolic views (e.g., existence, altruistic and bequest values) (Chan et al., 2012; Costanza et al., 1997; Gómez-Baggethun et al., 2014; Kumar & Kumar, 2008). First, this is due to unresolved difficulties surrounding: 1) the commodification of incommensurable values; 2) discounting future financial assets; and 3) the assumption that humans act on selfish preferences and utility maximization (Baveye, Baveye, & Gowdy, 2013; Gómez-Baggethun et al., 2014; Kallis et al., 2007, p. 16). Second, economic (monetary) valuation is underpinned by the positivist (or post-positivist) worldview (Figure 4.), whereby experts apply the scientific method to 'objectively' define the public interest (Creswell, 2014, p. 36). However, this approach relies on professional 'expertise' and disregards socially constructed values. Thus, there's a growing need for studies that more accurately capture non-market ecosystem services in decision-making, by eliciting social preferences using non-monetary valuation methods (Chan et al., 2012; Gómez-Baggethun et al., 2014; Santos-Martín et al., 2017, p. 104; Seppelt et al., 2011).

Sociocultural valuation has emerged in response to the limitations of monetary valuation; representing non-monetary forms of social preference analysis (Chan et al., 2012; Gómez-Baggethun et al., 2014; Kelemen et al., 2016; Santos-Martín et al., 2017, p. 104). Despite growing interest, sociocultural valuation does not yet constitute a formal methodological field, rather, methods are diverse in nature and may include: qualitative and/or quantitative research techniques (e.g., interviews and surveys, respectively); participatory and/or deliberative processes (e.g., focus groups, citizen juries, Delphi panels); and techniques that weigh social preferences in non-monetary, but quantifiable terms (e.g., Q-method) (Kelemen et al., 2016). Yet, sociocultural valuation methods remain heavily influenced by the positivist worldview and

quantitative research tools. For example, Scholte et al. (2015) reviewed the methods of 91 sociocultural valuation studies, and stated preference surveys were the most predominately used method. Similar to (monetary) contingent valuation, non-monetary quantitative survey methods have been criticized for their inability to measure the breadth of human values, specifically those that are socially constructed, since this method relies on the aggregation of individual responses (Chan et al., 2012).

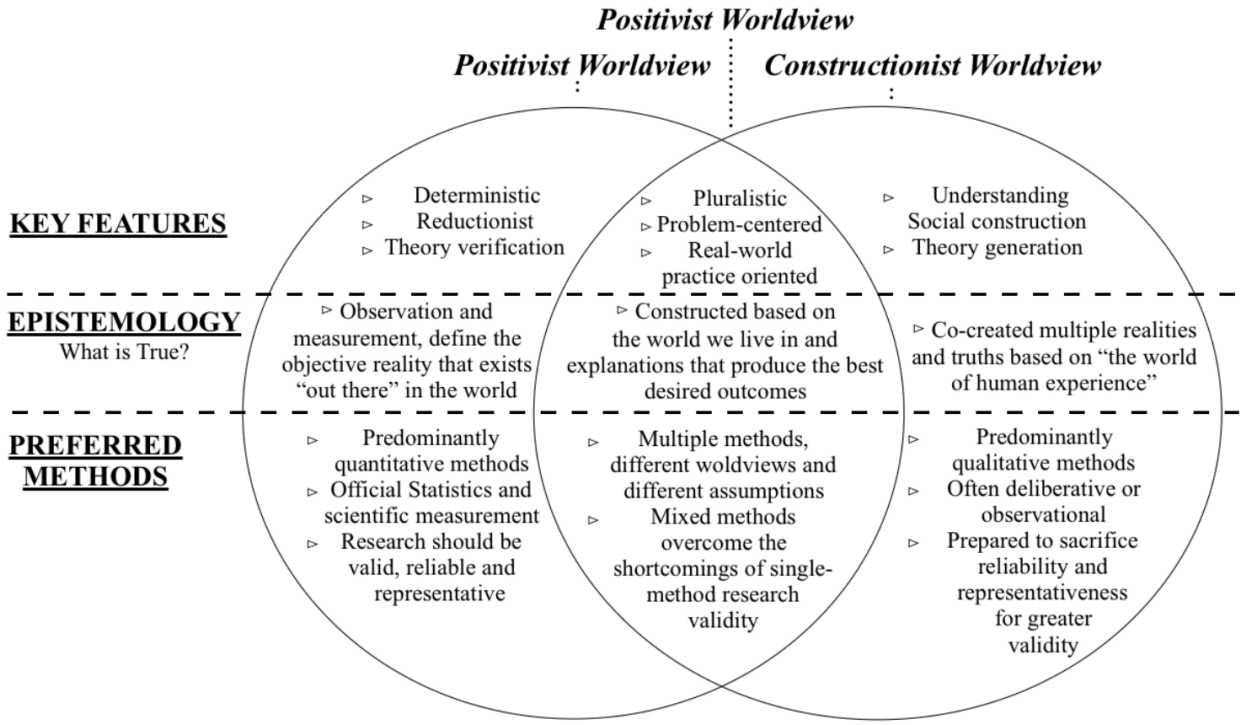

Figure 4. Philosophical worldviews, adapted from: Creswell (2014, p. 39-40); Mackenzie and Khipe (2006)

To overcome these limitations, the literature suggests adopting a deliberative approach to value elicitation (Chan et al., 2012; Wilson & Howarth, 2002). Methods under this framework are commonly qualitative (e.g., focus groups, visioning workshops) and incorporate elements of economic welfare theory, communicative rationality and deliberative democracy. Deliberative

methods of sociocultural valuation focus on structured communication, participation, social learning and negotiation to examine individuals' diverse values and subjective realities; hence, they characterize a constructionist worldview (Chan et al., 2012; Habermas, 1984, p. 85-101; Raymond, Kenter, Plieninger, Turner, & Alexander, 2014; Scholte et al., 2015). The constructionist worldview supports social construction of the 'common good', as urban planners help community members explicate their own values, rather than imposing them (Creswell, 2014, p. 37; Grant, 2005). Constructionist urban planning theories (see: advocacy, collaborative, participatory and transactive planning theories) (see: Arnstein, 1969; Checkoway 1994; Davidoff, 1965; Friedmann, 1973, p. 171-193; Godschalk & Mills, 1966) support qualitative, communicative, and/or deliberative approaches to value framing that recognize the public's diverse nature and acknowledge that truth and rationality are context specific.

Yet, such methods have been criticized for lacking structured and replicable procedures, leading to general, loosely defined ideas that do not "address implementation issues where conflicts occur and trade-offs are necessary" (Galafassi et al., 2017; Kallis et al., 2007, p. 42; Scholte et al., 2015). Therefore, attempts at operationalizing deliberative decision-making are often ad hoc, applied after the main decisions have already been made, thus they produce un-actionable results (Galafassi et al., 2017; Kallis et al., 2007, p. 42).

This calls for studies of methodological experimentation, aimed at improving the validity, and credibility of sociocultural valuation methods. To achieve these ends, we review the literature and identify three principal themes: 1) deliberation; 2) local ecological knowledge; and 3) explicit trade-off mechanisms. These themes inform a new theoretical and conceptual framework for the sociocultural valuation of ecosystem services, whereby polarized worldviews, positivism and constructionism are combined to strengthen one another. We operationalize our theoretical

framework by adapting conventional Q-method into a deliberative process, and we empirically test this conceptual framework in the realm of urban planning vis-à-vis experts' value of urban water features in Amman, Jordan.

Accordingly, this paper aims to address the following research questions: 1) Based on the relevant literature, what are the key themes that guide sociocultural valuations of ecosystem services, as informed by both positivist and constructionist worldviews, and how can these themes inform a more pragmatic valuation method?; 2) How can conventional valuation methods be adapted to suit a more pragmatic framework?; and 3) By empirically testing our conceptual framework, how and why do experts in Amman, Jordan value stream ecosystems, and how can these values inform water management solutions?

2.1 Reviewing the literature: Key elements for value framing

2.1.1 Deliberation

The positivist worldview operates under the assumption that rational outcomes do not require social exchange. Therefore, valuation methods that ascribe to this worldview (e.g., stated preference surveys) commonly resort to the aggregation of individual values, in order to define a single answer or unity (Chan et al., 2012; Gómez-Baggethun et al., 2014; Irving et al., 2016). However, this approach to understanding social preferences is limited in its ability to address complex urban realities – such as the heterogeneity of *shared values* (Abukhater, 2009; Lane, 2001), and perpetuates an inadequate understanding of local needs and contextual differences (Ibid.). Compared to pre-formed individual values, shared values are collectively held and formulated. They represent *normative choices* about the environment that are inherently ethical and social, since individuals' preferences are influenced by contextual socialization and because

environmental impacts affect society at large (Irvine et al., 2016; Wilson & Howarth, 2002).

For instance, the notion of shared values extends to a city's 'sense', understood as "the join between the form of the environment and human processes of perception and cognition", such as the symbolic or emotional significance of space (Lynch, 1984, p. 131). For example, an Islamic city was originally understood as an expression of society's fundamental religious concepts (Lynch, 1984, p. 131). These contextual significances of place (sociocultural ecosystems) are difficult to define and measure, vary among people and cultures, and are unintelligible to the cultural stranger. Furthermore, shared values can also be transcendental and extend to issues of fairness, responsibility, uncertainty and risk (Raymond et al., 2014).

Deliberative valuation methods ascribe to the constructionist principles of deliberative democracy, encouraging "open discussion and the exchange of views [to help build] agreed-upon policies" (Young, 2000, p. 22). These methods are flexible in the face of *value plurality*, accepting the output of multiple realities that are considered equally correct and fundamental (Irving et al., 2016). Additionally, deliberative valuation approaches are advantageous for their recognition of *value transformation*, with dialogue promoting mutual understanding, and transformative learning (Chan et al., 2012; Irving et al., 2016). In other words, deliberative methods recognize the importance of experience, allowing individuals with uninformed values to formulate, or re-evaluate, their preferences based on shared experiences or information obtained through the valuation exercise itself (Scholte et al., 2015).

This transformative potential of dialogue is recognized by Friedman's (1973, p. 178-181) transactive planning theory, which highlights the necessity of *face-to-face, interpersonal interactions* through which mutual learning between experts and laypeople occur. Dialogue

entails; the acceptance of differences and of conflict; the identification of shared interests and commitments; the reciprocity and mutual obligation; the inclusion of moral judgment and empathy; the inclusion of all senses in the communication (including body language); and last, ensuring a time-binding relationship (Friedman, 1973, p. 178-181). Thus, participatory and deliberative approaches inherently broaden self-oriented values to include external entities, including fellow citizens (other-oriented values), future peoples (bequest values) and non-human organisms (i.e., existence values), recognizing *multiple types of human value* (Chan et al., 2012).

Theoretical assumptions underpinning a deliberative process also influence its methodological legitimacy. For example, academics question the validity of consensus-based deliberation within a pluralist society (Friberg-Fernros, Schaffer, & Holst, 2019; Jezierska, 2019). This is because consensus is considered empirically impossible (due to social heterogeneity), and politically perilous (oppressing marginalized interests and identities) (Jezierska, 2019). To overcome these limitations, *compromise-based deliberation* is suggested, viewing consensus as a possible outcome rather then a normative ideal. Under this framework, compromise is the objective, and voting is accepted in instances where consensus is unattainable, "safeguarding the open-ended character of deliberation" (Friberg-Fernros et al., 2019, p. 6; Jezierska, 2019).

2.1.2 Local Ecological Knowledge

Growing interest in deliberative valuation approaches has also resulted from its ability to integrate local ecological knowledge (LEK) into the decision-making process (Raymond et al., 2014; Ruckelshaus et al., 2015; Yli-Pelkonen & Kohl, 2017). The term local ecological knowledge represents individuals' socially nuanced information about the environment, which is "accumulated over one's lifetime from observations and hands-on experience interacting with

ecological systems and utilizing natural resources" (Berkström, Papadopoulos, Jiddawi, &, Nordlund, 2019, p. 2). This concept shares the assumptions within Habermas' (1984) theory of communicative rationality, whereby deliberating participants contribute their own individual histories, experiences and socialization backgrounds, hence, it embodies a constructionist worldview (Olsson & Folke, 2001).

Deliberative methods that draw on local ecological knowledge are capable of capturing external factors, such as *cultural and institutional milieus and power nexuses,* into the valuation process (Gómez-Baggethun, Corbera, & Reyes-García, 2013). This informs contextually relevant management decisions produced by *mutual learning* between the government and the public, which increases public trust in institutional governance (Andersson et al., 2014; Friedman, 1973, p. 178-181; Kallis et al., 2007, p. 12). Mutual learning is based on constructivist teaching theory, whereby learning occurs by actively participating in the process of meaning and knowledge construction, as opposed to passively receiving information (Richardson, 2003). A deliberative process can also provide opportunities for increased citizen education and stewardship in the face of climate change (Andersson et al., 2014).

Positivist methods (e.g., stated preference surveys, social network analysis) too often rely on technical expertise and data rich information bases; allowing analysts to identify, select, define and articulate the attributes under investigation, increasing the likelihood of researcher bias (Armatas, Venn, & Watson, 2014; Davis & Ruddle, 2010; Kallis et al., 2007, p. 13). *Giving participants the opportunity to contribute their own study attributes*, based on their local ecological knowledge, bolsters an accessible process without privileged technocracy (Armatas et al., 2014). In turn, resulting management decisions are better legitimized by *socially robust knowledge*, meaning information "fit for the purpose of the process"; hence, the likelihood of

stakeholder conflict is reduced (Armatas et al., 2014; Irving et al., 2016; Kallis et al., 2007, p. 13).

2.1.3 Explicit trade-offs

Sociocultural valuation studies that apply qualitative and, or deliberative methods have been criticized for their limited success in actionable decision-making (Bloomfield, Collins, Fry, & Munton, 2001; Yli-Pelkonen & Kohl, 2017). This is, in part, because their methods lack *explicit trade-off mechanisms* that outline participants' preferences among multiple values - an advantage of the positivist worldview, whereby trade-offs and action taking are commonplace (Gómez-Baggethun et al., 2010; Hudson et al., 1979).

Nature-based solutions provide a multitude of benefits, catering to different value ideologies, but in practice, these numerous services cannot be simultaneously managed or obtained. This is because ecosystem services are not necessarily complementary, meaning the provision of one service could be exclusionary of another; hence, trade-offs must be made (Galafassi et al., 2017; Grant, Hill, Trathan, & Murphy, 2013; King, Cavender-Bares, Balvanera, Mwampamba, & Polasky, 2015). Explicit trade-offs make policy decisions *transparent*, reducing management inefficiencies and stakeholder conflict, which increases the likelihood of policy success (Chee, 2004; Galafassi et al., 2017; King et al., 2015).

Despite deliberative methods' ability to uncover *why* people make trade-offs, their capacity to measure, weigh, or objectively choose among management options is limited (Chan et al., 2012; Kallis et al., 2007, p. 42). This is undesirable since nature-based solutions are commonly associated with a multitude of costs and benefits, thus valuation approaches lacking explicit trade-off mechanisms or with unfocused scopes can produce indiscernible information (i.e.,

choice paralysis or indecision) (Galafassi et al., 2017). For example, popularized valuation tools, such as Likert-style surveys, lack explicit trade-off mechanisms, allowing participants to assign a high level of importance to all value attributes – diminishing the method's operationalization power and ability to measure social preferences (Armatas et al., 2014; Scholte et al., 2015). Thus, in order to produce actionable results, sociocultural valuation methods must explicitly incorporate trade-off considerations.

In this respect, Chan et al. (2012) advocate for deliberative valuation methods that are metrically supported, hence, they integrate the positivist worldview. Under this framework, *metric-based subjective scaling* weighs social preferences and enables the assignment of value through ordinal ranking or numeric tagging of, what are in large part, intangible properties (e.g., bequest or spiritual values) (Chan et al., 2012). This process translates qualitative information into quantitative results without losing contextual information (i.e., *why* a service is preferred over another). Accordingly, behind each selected attribute "[resides] narratives, oral testimonies [along with] scientific information" describing its value (Chan et al., 2012, p. 15). These constructed indices facilitate management decisions by focusing attention on trade-offs across different value types, rendering them visible to stakeholders and decision-makers alike. Integrating quantitative and qualitative methods into heuristic planning tools can improve the validity of sociocultural valuation studies, achieved by using objective data outputs, derived from rule-guided statistical analysis, to support qualitative narratives (Creswell, 2014, p. 37-38).

2.2 Pragmatic ecosystem valuation

Sociocultural valuation approaches commonly embody either positivist or constructionist worldviews. The review of the literature reveals advantages and disadvantages of each type of philosophy, and their preferred research methods. However, based on the review, we believe

sociocultural valuations are lacking the concurrent embodiment of three key elements: 1) deliberation; 2) local ecological knowledge; and 3) explicit trade-offs.

We propose a theoretical framework that integrates these elements, and their corresponding features, under a pragmatic worldview, whereby theoretical assumptions are not committed to any one system of philosophy or reality (Figure 5.) (Creswell, 2014, p. 39-40). A pragmatic approach uses mixed methods research techniques (this study's research design uses embedded mixed methods), drawing liberally from both quantitative and qualitative techniques, to produce a method that best serves the study's research objective (Ibid.).

To operationalize the theoretical framework, we suggest a novel adaptation of Q-method, transforming it into a deliberative process, performed under focus group conditions (henceforth called the 'Deliberative Q-method'). The objective of this method is to retain the advantages of the conventional, positivist approach (i.e., transparent and rigorous framework with explicit trade-offs), while overcoming its weaknesses (i.e., non-deliberative, aggregated individual values) by incorporating elements of constructionism.

Although Q-method is widely applied in conservation research (Buchel & Frantzeskaki, 2015; Rastogi, Hickey, Badola, & Hassain, 2013; Webler et al., 2009, p. 14; Zabala, Sandbrook, & Mukherjee, 2018), it has had limited use in urban planning (Swaffield & Fairweather, 1996), and to the best of knowledge, its adaptation as a deliberative process has yet to be explored. Furthermore, despite focus groups' established application within valuation studies, its role outside of scoping and pre-testing procedures remains minimal (Lienhoop, Bartkowski, & Hansjürgens, 2015).

The following discussion details the empirical application of the Deliberative Q-method by analyzing citizens' social preferences of urban water features in Amman, Jordan.

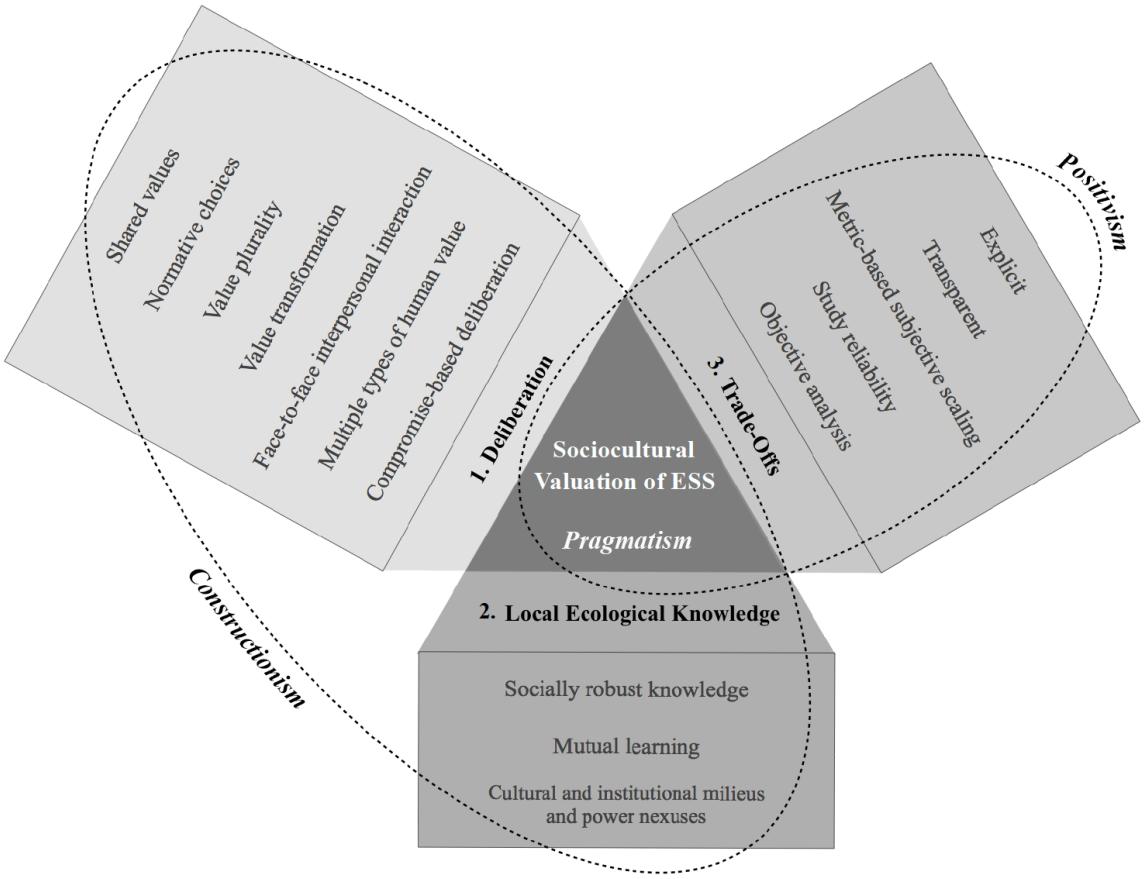

Figure 5. Pragmatic framework for the sociocultural valuation of ecosystem services: Integrating 1) deliberation; 2) local ecological knowledge; and 3) explicit trade-offs

2.3 The fallacy of Amman's water narrative

Global water scarcity has led to the commodification of water at a high monetary value, exposing difficulties associated with monetary valuation (e.g., protest answers, disillusion of income constraints) (Chan et al., 2012; Schyns, Hamaideh, Hoekstra, Mekonnen, & Schyns, 2015). Hence, water-stressed countries like Jordan provide an ideal context to test the Deliberative Q-method. Jordan's external water issues, including its predominantly arid climate, overconsumption of shared (trans-boundary) surface waters, and influx of political refugees from

neighbouring countries, contribute to a water narrative fixated on uncontrollable scarcity (Masoud, Margolis, & Khirfan, 2011; Schyns et al., 2015). Yet, this narrative neglects local water mismanagement, a critical cause of urban water shortages in Jordan, specifically in its capital Amman, whereby its effects are exasperated by rapid population growth and the impacts of rapid climate change (Al-Bakri et al., 2013; Masoud et al., 2011).

The Hashemite Kingdom of Jordan (previously the Transjordan) has maintained an open door policy on immigration since the 19th century. Major emigration events affecting Amman include: the Russian conquest (1879); the Great Arab Revolt (1916-1918) (Hamarneh, 1996, p. 58-87); the foundation of the State of Israel (1948); the occupation of the West Bank and Gaza strip (1967); the Gulf War (1990) (Brand, 1995); the Lebanese Civil War (1975-1990); and the US invasion of Iraq (2003) (Potter, Darmame, Barham, & Nortcliff, 2009; Samha, 1996, 191-208); as well as more recently, Syria's and Libya's civil wars (both started in 2011); and the war in Yemen (since 2015). Resultantly, Jordan has absorbed approximately 750,000 registered refugees, with unofficial statistics nearing two million people. Eighty-four percent of these refugees have assimilated in urban areas such as Amman, placing a strain on the government's provision of services (Turnbull, 2019; UNHCR, 2019).

Amman's growing population (now roughly four million people) is increasingly exposed to the effects of climate change. Based on scientific estimates, Amman is expected to receive an increase in annual rainfall over the next 30 years. Torrential rainfall peaks will increase stormwater volumes, causing flash floods and stormwater overflows, partly due to the city's hilly typography and inadequate stormwater drainage network (Al-Bakri et al., 2013; Al-Houri & Al-Omari, 2012; Al-Qatarneh, Al-Smadi, Al-Zboon, & Shatanawi, 2018). Amman is already experiencing these effects, as annual flooding is now commonplace. For example, in November

of 2015, Amman experienced flash floods after 40 mm of rainfall precipitated over a 45-minute time span; a figure that represents five to ten percent of the city's seasonal rainfall expectancy (Obeidat, 2015). More recently, in March of 2019, Amman's historic downtown was inundated causing roughly JD3 million in damages and resulted in the overflow of three of the region's water collection dams (also demonstrating an incomplete capture of rainfall) (Al-Nawas, 2019; Ayyoub, 2019).

Hence, Amman's urban flooding is the combined effect of climate change and poor stormwater management decisions, notably the coverage of open outfall channels such as Amman's Seil. Amman's Seil is a perennial stream, once the cornerstone of the city (Figure 6.), that begins at Ras el Ain Spring and flows northeast in a deep-set valley (wadi) flanked by projecting hills (jebels). Intermittent streams, springs and stormwater runoff transversely join the Seil to eventually form the Amman-Zarqa River basin, part of the larger Zarqa River Watershed (Figure 7.) (Farhan & Al-Shawamreh, 2019). However, Amman's Seil was removed from the urban landscape with its downtown reach covered in two phases. The first covering took place in 1968, whereby 1.3 km of the stream was covered over sanitary concerns, from the Greco-Roman theatre in Downtown Amman to the historic Hamman Bridge (Sagf el-Seil) (Hacker, 1960, p. 27). The second covering occurred in 1997 with 2.7 km of the stream covered, starting from its source at Ras el-'Ain Spring to Sagf el-Seil (Farhan & Al-Shawamreh, 2019) (Figure 8.).

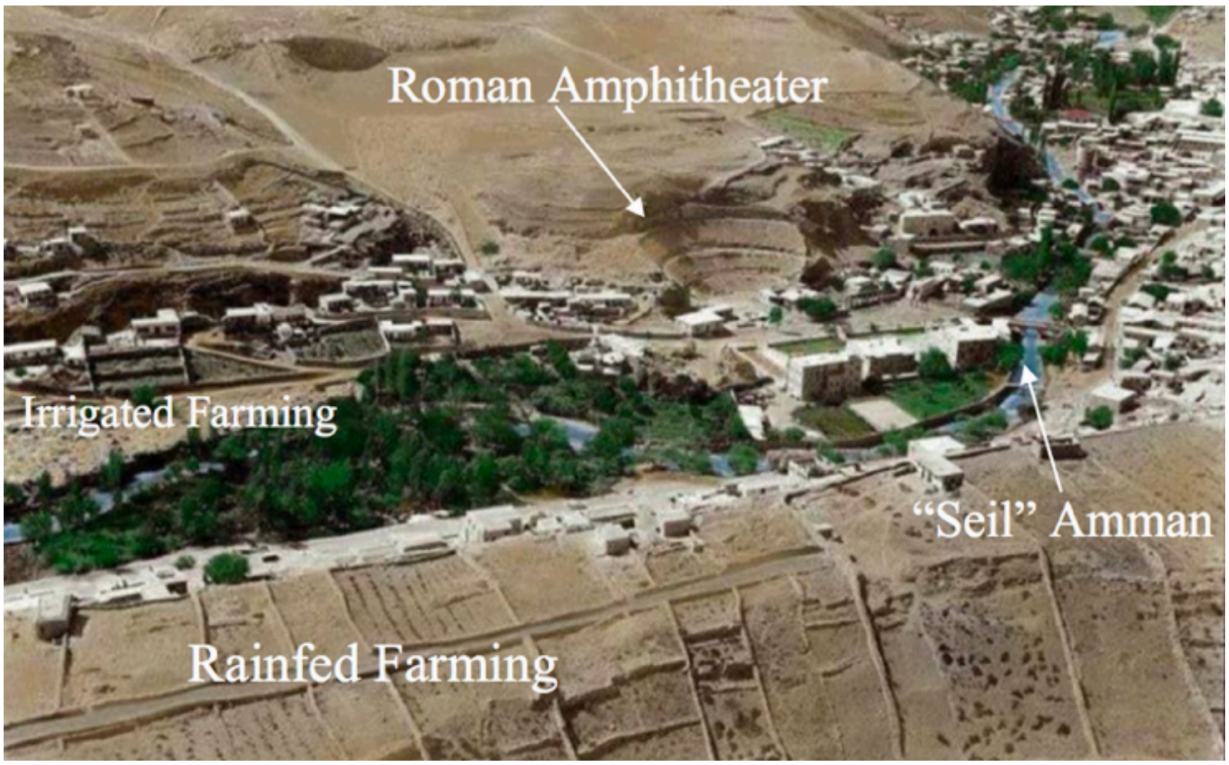

Figure 6. Seil Amman (1920) north and south of the Greco-Roman amphitheatre (Farhan & Al-Shawamreh, 2019)

Amman's water mismanagement is also characterized by the city's lack of micro-sale water recycling and harvesting systems (i.e., surface water catchments), and an over reliance on non-renewable, remote sources of water (Masoud et al., 2011; Wade et al., 2010). Regarding the latter, following the exploitation of Amman's regional groundwater basin (i.e., Amman-Zarqa Basin), for nearly a decade the city has relied on the Disi aquifer as its main source of potable water. The Disi is a non-renewable fossil aquifer located in Jordan's southern Wadi Rum desert, whereby water is imported to Amman via a 300 km pipeline (El-Naqa, Al-Momani, Kilani, & Hammouri, 2007). At its initial extraction rate, the Disi was estimated to have a 50-year water supply, yet, this forecast was made prior to the immigration of Syrian, Libyan and Yemeni refugees, and now the longevity of this supply remains unclear (Schyns et al., 2015).

Figure 7. The Zarqa River Watershed (EXACT, 2008)

Amman's long-term water management plan is also unsustainable, placing a disproportionately heavy reliance on projects that transpose significant amounts of distant-sourced water. This includes the Red Sea-Dead Sea Water Conveyance project, a proposal that will provide potable water to Jordan, Israel and the Palestinian territories through desalination, achieved by pumping water via a 200 km pipeline north from the Red Sea to the Dead Sea (Schyns et al., 2015). Accordingly, Amman needs localized water management strategies that adapt to climate change and shift the narrative from water scarcity to local sustainability.

The application of a pragmatic valuation framework is advantageous in Amman due to the city's cultural heterogeneity and the complexity of the problem context. Regarding the former, immigration acts as a vehicle of knowledge transfer, hence, participants with diverse backgrounds will likely bolster more unique insights.

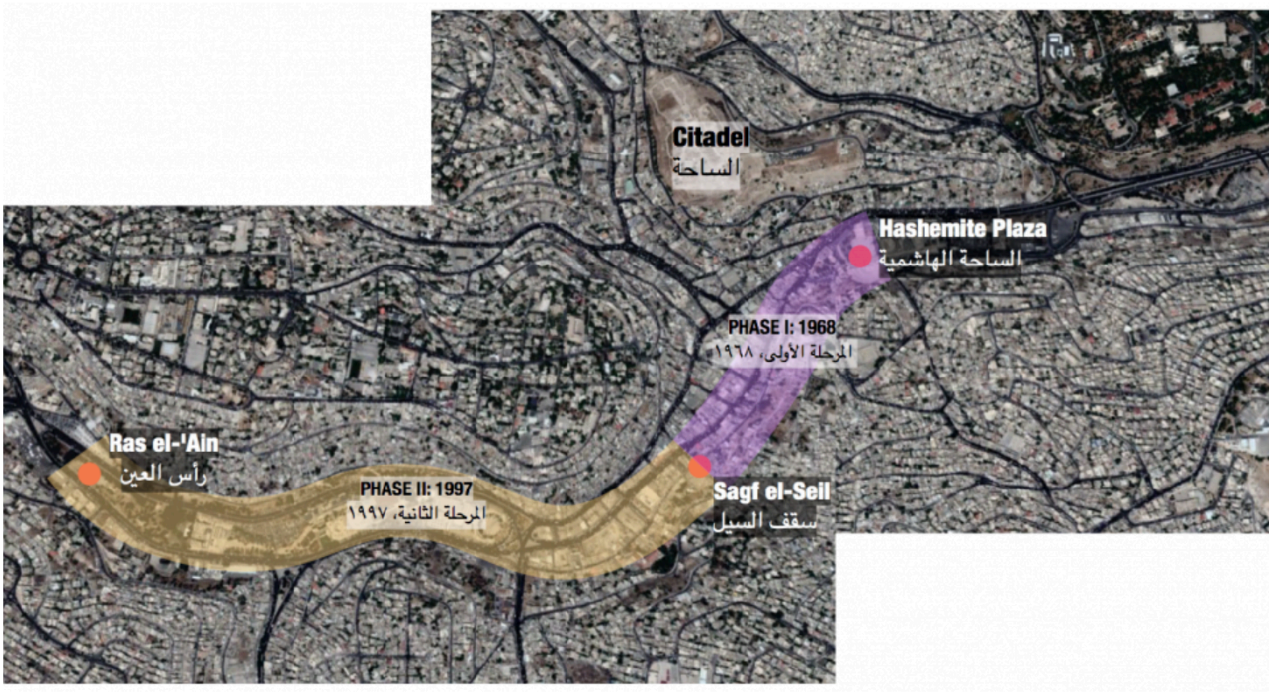

Figure 8. The covering phases of Amman's Seil - Phase I in 1968: from the Hashemite Plaza to Sagf el-Seil; and phase II in 1997: from Ras el-'Ain to Sagf el-Seil

2.4 The Combined Method

Q-method combines qualitative and quantitative research techniques aimed at understanding first-person perspectives in non-monetary, metric terms (Armatas et al., 2014; Watts & Stenner, 2012, p. 3-4). This method is characterized by a rank-order exercise, conventionally performed *individually***,** whereby participants arrange normative statements across a forced distribution (Figure 9.). This distribution resembles a pyramidal, quasi-normal grid (Q-grid), which provides the 'terms of reference' for sorting (or ranking) statements. The Q-grid features columns with distinguished levels of salience, ranging from "most how I think" (+4) to "least how I think" (-4). The grid's opposing poles have fewer rows which are reserved for statements that participants deem significant, compared to the neutrality signified at the centre of the distribution (Coogan & Herrington, 2011; Webler et al., 2009, p. 6; Zabala et al., 2018). Since participants rank

statements simultaneously, this method is ideal for analyzing trade-offs (Watts & Stenner, 2005). The resulting statement arrangements (Q-sorts) are then aggregated and analyzed both quantitatively (statistically) and qualitatively (inductively through inference) to identify groups of people who share a common view (Coogan & Herrington, 2011; Watts & Stenner, 2005).

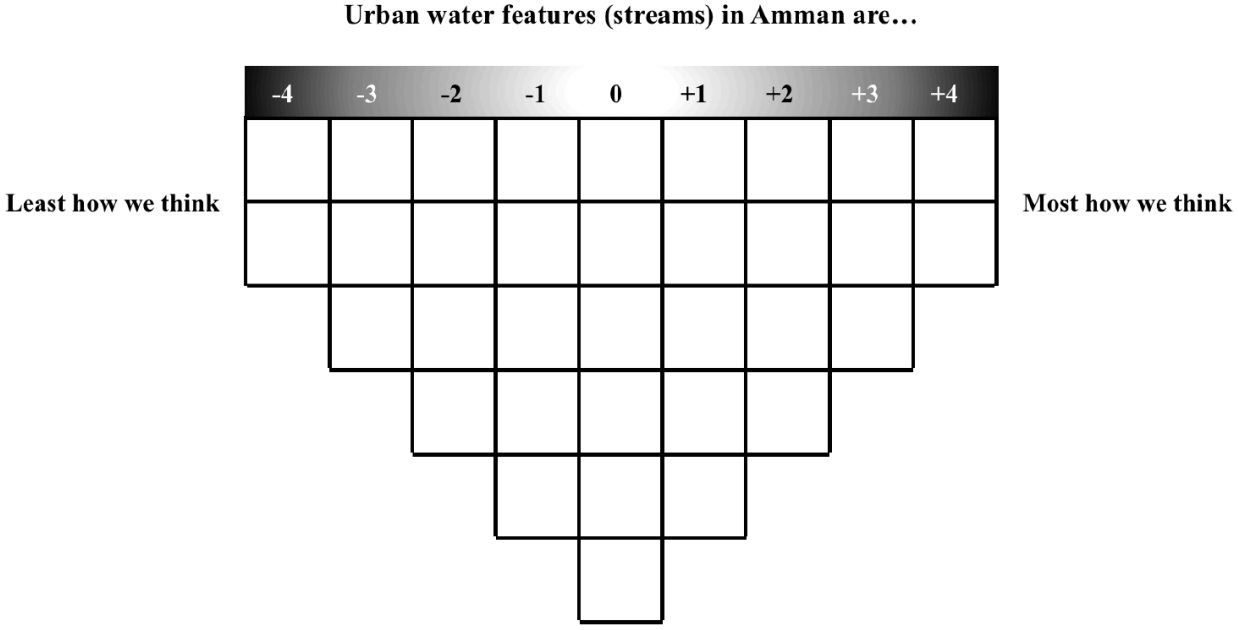

Figure 9. Q-grid: where right and left of the middle column ranking (0) indicates positive and negative salience values respectively, and the middle column (0) represents neutrality or indifference

In order to integrate plural and social values into ecosystem valuation, we transform conventional Q-method into a deliberative process, whereby focus groups provide an ideal forum for integrating deliberation into Q-method procedures. Accordingly, we deploy a combined framework amalgamating Q-method's seven procedural steps (Armatas et al., 2014; Brown, 1980, p. 92-124; Watts & Stenner, 2005) with the five steps of focus group development (Breen, 2007; Tynan & Drayton, 1988) (Table 4.). The combined method is distinguished by *collectively* performed Q-sorts, whereby through deliberation, groups of people mutually complete the rank-order exercise (Figure 10.). This combination allows data to be generated collectively rather than

aggregated across individuals and enables face-to-face participant interaction, promoting synergistic interpersonal relations and mutual learning (Nyumba, Wilson, Derrick, & Mukherjee, 2018). Accordingly, the combined method consists of three phases (Pre-phase; Conduct-phase; and Post-phase) that organize one or more of five procedural steps: 1) preparation; 2) attribute development; 3) data collection; 4) data analysis; and 5) interpretation. In the following discussions the terms ‘factor’ and ‘perspective’ are analogous, as both terms represent shared ways of thinking.

Figure 10. Deliberative Q-method’s data collection: Sorting the statements

Table 4. Deliberative Q-method's conceptual framework

Q-method (Adapted from Weber & Tuler, 2006; Watts & Stenner, 2012)	**Focus groups** (Adapted from Tynan and Drayton, 1988; Stewart et al. 2007)	**Deliberative Q-method**	
1. Study objectives ▸ Establish topic ▸ Define study population ▸ Participant recruitment	1. Preparation ▸ Establish research question(s) or hypothesis ▸ Define study population ▸ Participant recruitment ▸ Select & obtain moderator(s)	1. Preparation ▸ Establish research objective/ topic ▸ Define study population ▸ Participant recruitment ▸ **Specify facilitator roles, obtain facilitators, note-takers & translators**	*I. Pre-phase: Before the focus group*
2. Attribute development ▸ Establish a concourse ▸ Select and edit rank-order statements (Q-set)	2. Develop interview questions ▸ Create moderator's guide	2. Attribute development ▸ Establish a concourse ▸ Select and edit rank-order statements (Q-set)	
5. Data Collection (Q-sorts) ▸ Participants *individually* rank statements across the quasi-normal distribution (Q-grid) ▸ Document final Q-sorts ▸ Conduct exit interviews	4. Data Collection (focus groups) ▸ Moderated-managed: - Following moderator's guide - Foster participant engagement & equalize power dynamics ▸ Audio taping or discussion transcription	4. Data collection (deliberative Q-sorts) ▸ **Participants *collectively* rank statements across the quasi-normal distribution (Q-grid) deliberating on where each item is placed** ▸ **Facilitator-managed:** - **Foster participant engagement & equalize power dynamics** ▸ **Transcription of deliberative comments** ▸ Document final Q-sorts	*II. Conduct-phase: During the focus group*
6. Data Analysis (mixed methods) ▸ Correlation matrix ▸ Factor extraction (PCA or Centroid FA) - Select no. of factors ▸ Factor rotation (manual or automatic) ▸ Factor arrays	5. Data analysis (qualitative) ▸ Data coding and interpretation of focus group discussion	5. Data analysis (mixed methods) ▸ Correlation matrix ▸ Factor extraction (PCA) - Select no. of factors ▸ Factor rotation (varimax) & manual flagging ▸ Factor array	
7. Interpretation & reporting ▸ Produce crib sheet for each factor ▸ Interpretation of item scores (distinguishing and consensus statements) ▸ Factor write up - Informed by exit interviews - Interpret commonalities and differences between factors		6. Interpretation & reporting ▸ Produce crib sheet for each factor - **Integrate focus group comments into each factor's crib sheet** ▸ Interpretation of item scores (distinguishing and consensus statements) ▸ Factor write up - **Informed by deliberative comments** - Interpret commonalities and differences between factors	*III. Post-phase: After the focus group*

*** Bolded font indicted methodological adaptation diverging from conventional Q-method**

2.4.1 Phase One: Pre-phase

The method's first phase, 'Pre-phase', takes place prior to the focus groups and consists of two steps, beginning with *'Preparation'*, whereby: 1) a research objective is established; 2) the study population is defined; 3) participants are recruited; and 4) facilitator roles are specified. First, Q-method does not necessitate a priori postulation, hence, the research objective is exploratory in

nature, aimed at understanding how Amman's experts value ecosystem services supplied by urban water features; defined as fountains, ponds and streams (Coogan & Herrington, 2011; Dziopa & Ahern, 2011). Next, we established the study's target population. Ideally, Q-method participants have well-informed opinions about the study topic, which helps improve research reliability (Webler et al., 2009, p. 5), therefore, we purposely selected Amman's natural and built environment experts. This includes private and public sector employees with affiliates within urban planning, engineering, architecture and environmental consulting firms, municipal and national governmental agencies (e.g., German Society for International Cooperation; the Greater Amman Municipality), local and international NGOs (e.g., Wild Jordan; Arab Forum for Environmental Development; Friends of the Earth Middle East), and academics at public universities (e.g., The University of Jordan; German Jordanian University; Hashemite University). Next, we consulted with local liaisons and performed an exhaustive online search to identify suitable organizations, which were contacted, and further asked to identify suitable individuals within their organization. This information was used to create a participant database detailing participant's job title, affiliations and contact information. This database was used to invite participants to the focus groups, and also requested that they identify additional experts known to them - whom the researchers screened and invited based on relevancy. These purposeful methods yielded a total of 20 participants, which were organized across four categories: 1) natural environment experts (e.g., landscape architects, ecologists and conservationists); 2) infrastructure/built environment experts (e.g., civil engineers, architects and urban planners); 3) water resource experts (e.g., water resource engineers); and 4) socio-political experts (e.g., social geographers, environmental policy experts). Q-method is a data reductionist approach, which renders a few (two to seven) common perspectives (factors) from a number of

data inputs (Q-sorts). Accordingly, 20 participants gave rise to five, four-person focus groups, resulting in five Q-sorts and two social perspectives (factors). Lastly, due to the deliberative nature of the combined method, a moderator-mediated approach was applied, with facilitators acting as knowledge brokers, guiding participants through the rank-order exercise, fostering engagement, and equalizing the power dynamics among participants (Nyumba et al., 2018). Accordingly, focus groups were equipped with a facilitator, note-taker and a translator, all of which received prior training to ensure consistent application of the method.

The second step of the 'Pre-phase' is *'Attribute development'*, whereby a set of normative sorting statements (Q-set) was developed. To ensure ample topic coverage and statement diversity, sorting statements were derived from a concourse – representing an exhaustive list of pertinent statements related to the research topic (Coogan & Herrington, 2011). The concourse was informed by the relevant literature, including sources related to: 1) urban water features' ecosystem services and disservices (Bolund & Hunhammer, 1999; Costanza et al., 1997; de Groot et al., 2002; Gómez-Baggethun & Barton, 2013; Green et al., 2016; Reid et al., 2005, p. vi-ix); and 2) different types of human values (Chan et al., 2012; Iniesta-Arandia, García-Llorente, Aguilera, Montes, & Martín-López, 2014; Kumar & Kumar, 2008; Vierikko & Niemelä, 2016). Researchers reduced this concourse to 34 final sorting statements, organized across seven categories of interest (See Figure 12.). To ensure proper interpretation and contextual relevancy, statements were reviewed by three residents of Amman and pilot tested by four students from the University of Waterloo. These statements were placed on sticky-notes for participants to sort during the actual deliberation exercise (Coogan & Herrington, 2011).

2.4.2 Phase two: Conduct-phase

The method's second phase ('Conduct-phase') takes place during the focus groups and consists of one step: *'Data collection'*. In April 2018, over two days, five one-hour focus groups were conducted at Columbia Global Centre, Amman. The focus groups began with the facilitator reading a randomly selected statement aloud to the group. Participants then discussed how closely this statement aligned to their values, and collectively sorted it into one of three preliminary piles: 1) positive salience; 2) negative salience; and 3) neutral salience, narrowing in on each statement's approximate location across the Q-grid. Facilitators repeated this process for all 34 statements, after which, each statement was revisited individually and participants were asked to discuss, in greater detail, which distinguished column ranking the item belonged to and why. When consensus could not be reached, the groups deferred to majority-rule voting (Friberg-Fernros et al., 2019). After all of the statements were preliminarily placed, the participants made final adjustments so that the statement configuration accurately represented their values. After all of the pre-selected statements were ranked, participants were encouraged to write, discuss and replace any statement with their own subject-related comment (representing attributes unidentified by the researchers) (Coogan & Herrington, 2011). Interestingly, none of the participants acted upon this opportunity, suggesting adequacy and comprehensiveness of the original 34 statements. The statements' final configurations (rankings) were digitally recorded, constituting the quantitative study variables (Webler et al., 2009, p. 7). In lieu of Q-method's conventional exit interviews (Brown, 1980, p. 101), focus groups provide an opportunity for in-situ comment dictation. Therefore, researchers recorded the qualitative comments associated with each statement, making instances of value transformation known (Subramony, Lindsay, Middlebrook, & Fosse, 2002).

2.4.3 Phase three: Post-phase

The method's third and final phase ('Post-phase') takes place after the focus groups and consists of two steps, beginning with '*Data analysis'*. The statistical procedure (factor analysis) follows conventional Q-method techniques; accordingly, the data was analyzed using PQMethod 2.35, an open-source program developed by Peter Schmolck (2014). Although this program semi-automates factor analysis, the process can be described by four conceptual stages (Figure 11.). The first is 'correlation'; whereby intercorrelating the numerical arrays of each Q-sort (-4 to +4 configurations) produces a correlation matrix that identifies the focus groups that arranged their statements similarly (Watts & Stenner, 2012, p. 97). The data gathered from the focus groups in Amman revealed two correlation groupings, first between focus groups B, D and E and second between focus groups A and C. This correlation matrix was then subjected to 'factor extraction', an apt title for the second stage of analysis. Under this stage the numerous Q-sorts are analyzed, producing groups of statement configurations that are strongly correlated across Q-sorts, known as 'factors' (or perspectives) (Webler et al., 2009, p. 10). A Principal Component Analysis (PCA) was applied to extract a two-factor solution, which explains 78% of the study variance, considered a sound solution by Kline (1994, p. 28-42)[2]. The decision to extract two factors was confirmed by statistically objective criteria, including: 1) Kaiser-Guttman Criterion[3]; 2) Humphrey's Rule[4]; and 3) accepting factors with two (or more) significant factor loadings[5] (±0.44 at $P<0.01$) (Watts & Stenner, 2012, p. 104-107). A Principal Component Analysis (PCA)

[2] Kline (1994, p. 28-42) considers any solution explaining 35-40% of the study variance a sound solution

[3] Factors with an un-rotated eigenvalue (EV) greater than 1.00 should be extracted (Watts and Stenner, 2012, p. 104; Webler et al., 2009, p. 10)

[4] Factors are significant when the cross product of their two highest factor loadings (irrespective of sign) exceeds twice the standard error, or when less strictly applied, the cross product simply exceeds the standard error (Watts and Stenner, 2012, p. 108)

[5] Factor loadings represent the correlation strength between each Q-sort's actual sorting configuration and the respective factor that it informs. Factor loadings are considered significant at the 0.01 level when the factor loading are is ≥ 2.58 x (1 ÷ √no. of items in Q-set) (Watts and Stenner, 2012, p. 104-107)

was run over a centroid analysis since its algorithm considers both the commonality and specificity of the study variables (i.e., Q-sorts) (Webler et al., 2009, p. 11). The third data analysis stage is entitled 'factor rotation', which simplifies the data interpretation by orienting each factor's viewpoint onto the most meaningful perspective, akin to drawing a line of best fit. We performed a computer-automated factor rotation entitled "varimax" to improve the study reliability and to reduce researcher bias (Webler et al., 2009, p. 10 & 29). We manually 'flagged' all Q-sorts with significant factor loadings, which were used to inform the two-factor solution. Lastly, a single Q-sort representing each factor's typological perspective was produced, known as a 'factor array'[6]. The statistical program normalizes the factor arrays' weighted statement scores and transforms them back into whole number rankings (-4 to +4), which we used to cross-compare factors (Watts & Stenner, 2012, p. 150-161).

The second and last step in the method's 'Post-phase' is *'Factor interpretation'*, whereby researchers combine quantitative and qualitative data findings to make abductive inferences; informing 'how' and 'why' participants ranked each statement. We adopted Watts & Stenner's (2012, p. 150-161) crib sheet approach to ensure a systematic interpretation process that accounts for all statements and their interrelations (See Appendix E, H & I).

[6] "A factor array, is, in fact no more or less than a single Q-sort configured to represent the viewpoint of a particular factor" (Watts & Stenner, 2012, p. 140)

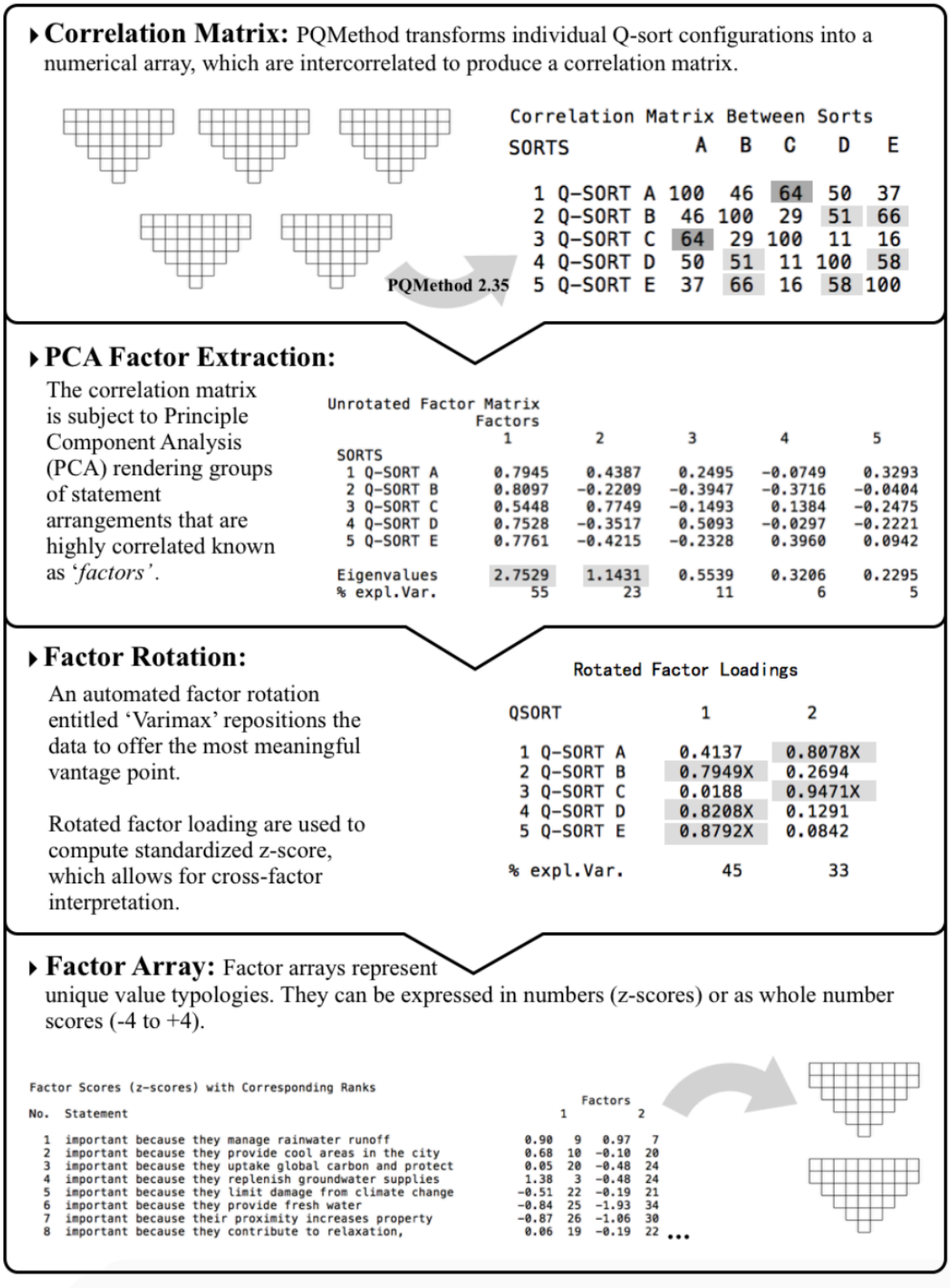

Figure 11. Deliberative Q-method's four data analysis stages (Watts & Stenner, 2012: 97-140)

2.5 Experts' valuation of ecosystem services in Amman

The five Q-sorts loaded significantly onto one of two perspectives (factors), with zero instances of confounded or null variables. Each perspective was named based on its characterizing viewpoint, including: 1) 'Recreation and water regulation'; and 2) 'Health and safety concerns'. In the results section, the numbers in parentheses indicate identifying statement numbers corresponding to the statements listed in Figure 12, and their respective factor's rankings.

2.5.1 Perspective one: 'Recreation and water regulation'

The first perspective has an eigenvalue of 2.75 and explains 55% of the study variance. Three focus groups (B, D and E), with a combined number of twelve participants, informed this factor (See Appendix D, E & I).

The results reveal that perspective one strongly values Amman's urban water features for their sociocultural ecosystem services, as seven of these nine statements (78%) are given positive or neutral salience rankings. The sociocultural ecosystem services valued the greatest by this perspective are urban water features' supply of recreation (11: +4) and social gathering spaces (15: +3). Deliberative comments suggest that participants value all water features regardless of size, since they are socially enjoyed entities. The results also indicate that this perspective values Amman's urban water features for their inspiration to art and culture (10: +1), likely due to this service's connection to social gathering. However, deliberative comments indicate that Amman's existing water features commonly have no water flow, neutralizing their ability to supply natural beauty (12: 0), ecological habitats (18: 0) and opportunities for people to learn from nature (14: 0). This rationale was also used to communicate why this perspective does not positively value

socio-economic ecosystem services, such as urban water feature's ability to increase property values (17: -2) or contribute to urban tourism (16: -3).

Perspective one also values Amman's urban water features for their historic and cultural heritage significance (21: +1), but not for their representativeness of the local identity (23: -1). Deliberative comments reveal that this historic and cultural heritage value is attributed to participant's local ecological knowledge, as it pertains to Amman's Seil; with one participant describing it as the location "where the story of the city began". However, participants expressed their belief that Seil Amman's heritage significance has diminished over time, following its two-phase covering in 1968 and 1997. In light of this, participants expressed interest in improving the representation of Amman's Seil, to highlight its historic connection to the city. Deliberative comments suggest this is because the city's sense[7] was also diminished after the Seil's covering, as landmark structures (e.g., Roman Nymphaeum) and locations (e.g., Ras el-'Ain meaning "*head of the spring*") were disconnected from the time and space in which they originated. However, this perspective did not value Amman's urban water features for their religious or spiritual significance (22: -1), as this significance is believed to be greater for historic (past) citizens, considering the city's Hellenistic (Greek) archeologically ruins that depict the former divinity of water (exemplified by Amman's ancient Nymphaeum).

Perspective one assigns a slightly negative value ranking to the idea that Amman's urban water features provide fresh water (8: -1). Yet, participants value Amman's water features for their contribution to the local water cycle, and climate. Accordingly, positive salience values were

[7] "Sense" is the clarity in which a place can be perceived and identified, and the ease in which these elements are mentally represented in space and time (Lynch, 1984, p. 131)

The Q-set: 34 Sorting statements organized across seven categories of interest

1. Regulating Ecosystem Services	***4. Existence values***
(1) important because they manage rainwater runoff	(18) important because they supply habitats for creatures
(2) important because they provide cool areas in the city	(19) important because they are important in their own right
(3) important because they uptake global carbon and protect against climate change	(20) important because they are rare in the city
(4) important because they replenish groundwater supplies (i.e., recharge areas)	***5. Symbolic/contextual values***
(5) important because they limit damage from climate change/ weather events (e.g., flood damage)	(21) important because they have historical and cultural heritage significance
(6) important because they protect other Jordanian water bodies (i.e., Zarqa River, Dead Sea)	(22) important because they had spiritual or religious significance
(7) important because they collect surface water	(23) important because they represent the local identity
2. Provisioning Ecosystem Services	***6. Bequest, others-oriented and moral values***
(8) important because they provide fresh water	(24) important for future generations to enjoy
3. Socio-cultural Ecosystem Services	(25) important for tourists to enjoy
(9) important because they contribute to relaxation, tranquility and/or cognitive wellbeing	(26) important for other residents of Amman to enjoy
(10) important because they inspire art and culture	(27) important as it's our moral duty to protect the environment
(11) important because they supply recreation space	***7. Ecosystem Disservices***
(12) important because they are naturally beautify or ascetically pleasing	(28) NOT important because they provide habitats for pests
(13) important because they allow people to experience nature	(29) NOT important because they have poor water quality
(14) important because they allow people to learn from nature	(30) NOT important because they are unsafe for human health (e.g., disease & pollution)
(15) important because they supply social gathering spaces	(31) NOT important because they are unsafe for human safety (i.e., drowning)
(16) important because they provide an economic benefit to urban tourism	(32) NOT important because they often need maintenance
(17) important because they increase property values (i.e., improve economic development)	(33) NOT important because they limit valuable land for development
	(34) NOT important because they divide the city (e.g., transportation networks and social divides)

FACTOR ARRAY FOR PERSPECTIVE #1: 'Recreation and Water Regulation'

Urban water features (streams) in Amman are…

Least how we think	-4	-3	-2	-1	0	+1	+2	+3	+4	Most how we think
	(33)	(16)	(17)	(5)	(3)	(2)	(1)	(4)	(11)	
	(34)	(29)	(28)	(8)	(9)	(10)	(7)	(6)	(24)	
		(31)	(30)	(22)	(12)	(19)	(13)	(15)		
			(32)	(23)	(14)	(21)	(20)			
				(25)	(18)	(27)				
					(26)					

PERSPECTIVE #1 Demographics

50% Male & 50% Female

Focus Groups B, D & E

3 of 12 (25%) socio-political experts
0 of 12 (0%) water resource experts
7 of 12 (58%) 'infrastructure and built environment experts
2 of 12 (17%) 'conservation and natural environment' experts

FACTOR ARRAY FOR PERSPECTIVE #2: 'Health and Safety Concerns'

Urban water features (streams) in Amman are…

Least how we think	-4	-3	-2	-1	0	+1	+2	+3	+4	Most how we think
	(8)	(16)	(14)	(3)	(2)	(7)	(1)	(20)	(6)	
	(11)	(17)	(15)	(4)	(10)	(26)	(13)	(21)	(24)	
		(22)	(18)	(5)	(12)	(28)	(29)	(27)		
			(34)	(9)	(19)	(30)	(31)			
				(23)	(25)	(32)				
					(33)					

PERSPECTIVE #2 Demographics

38% Male & 63% Female

Focus Groups A & C

3 of 8 (38%) socio-political experts
2 of 8 (25%) water resource experts
2 of 8 (25%) 'infrastructure and built environment experts
1 of 8 (13%) 'conservation and natural environment' experts

Figure 12. The Q-set: Factor configurations and factor demographics

assigned to urban water features' collection of surface water (7: +2), management of rainwater runoff (1: +2), groundwater infiltration (4: +3), and microclimate regulation (2: +1). Additionally, perspective one values urban water features' for protecting other Jordanian water bodies (e.g., Zarqa River and Dead Sea) (6: +3); hence, regional water management and watershed sustainability is also important to this perspective. Yet interestingly, this perspective assigns a slightly negative and neutral value salience to urban water features' climate change adaptation (e.g., lessening the damage of climate induced pluvial flooding) (5: -1), and mitigation services (e.g., carbon sequestration) (3: 0), respectively. This is because participants believe that Amman's urban water features lack the ability to realize these services. Be that as it may, participants discussed their desire for an alternate (future) scenario, whereby water features are capacitated to fulfill this adaptive role in downtown Amman. One focus group suggested that under such conditions, this ecosystem service would warrant the highest possible value ranking (+4).

This perspective assigns all ecosystem disservice statements negative value rankings (100%). Ecosystem disservices include water features': poor water quality (29: -3), habitation of urban pests (28: -2), dividing the city (socially or physically) (34: -4), ongoing maintenance requirements (32: -2), limitation of developable land (33: -4), and health and safety concerns (30: -2; 31: -3). Deliberative comments reveal that these participants believe that ecosystem disservices can be mitigated through innovative planning, design and technology solutions.

Lastly, the results reveal for whom participants' value urban water features. Perspective one assigns a slightly positive value ranking to the concept that Amman's urban water features are important in their own right (19: +1) and that people are morally obligated to protect the environment (27: +1). Furthermore, this perspective values Amman's urban water features for

their use and enjoyment by other residents' (26: 0) over that of tourists (25: -1). Yet, quantitative rankings suggest that this perspective has a strong bequest value of nature, valuing urban water features for their rarity (20: +2) and chiefly for their contributions to future generations (24: +4).

2.5.2 Perspective two: 'Health and safety concerns'

The second perspective has an eigenvalue of 1.14 and explains 23% of the study variance. Two focus groups (A and C), with a total of eight participants, loaded significantly onto this factor (See Appendix G, H & I).

The results reveal that perspective two strongly devalues Amman's urban water features for their supply of clean water (8: -4), in other words, they are considered highly polluted. Correspondingly, this perspective assigned positive or neutral value rankings to six of the seven (86%) ecosystem disservice statements, suggesting that Amman's urban water features are pest-inhabited spaces (28: +1), unsafe for human health (e.g., contamination and disease) and safety (e.g., drowning) (30: +1; 31: +2), and unjustly require ongoing maintenance (32: +1). Deliberative comments reveal that participants are supportive of Seil Amman's original covering motives (i.e., to reduce human toxicity and disease), partly due to water features' negative portrayal in Amman's media, whereby stories of pollution and drowning are disseminated. However, the two disservice statements assigned neutral and negative salience values include water feature's occupation of developable land (33: 0) and their division of the city (i.e., socially and, or physically) (34: -2) respectively. Deliberative comments suggest that these environmental disservices are not considered pertinent in Amman, as they are also manifested by human-made entities (e.g., roadways also limit developable land and divide the city).

When evaluating this perspective's trade-off preferences, the results reveal a strong devaluation of urban water features' supply of recreation (11: -4) and social gathering spaces (15: -2). Correspondingly, this perspective assigns neutral or negative salience rankings to the majority (78%) of sociocultural ecosystem services. These services include: beautification benefits, (12: 0), inspiration to art and culture (10: 0), educational value (i.e., learning from nature) (14: -2), human relaxation and cognitive development (9: -1), as well as socioeconomic services, such as urban tourism (16: -3), and property value development (17: -3). Deliberative comments suggest that these perspectives result from the limited scale of Amman's urban water features and concerns over their poor health and safety, making them ill fit for human use and contact.

Yet, perspective two positively values urban water features' experiential services (e.g., sounds of water) (13: +2). Deliberative comments suggest this is because natural experiences can be supplied by even the smallest water entities, and does not necessitate human contact.

Additionally, the results reveal that perspective two only slightly values Amman's urban water features for their regulatory ecosystem services, as four of these seven statements (56%) received negative or neutral salience rankings. Regulating ecosystem services that were assigned positive value rankings include: local surface water collection (7: +1) and the local management of rainwater runoff (1: +2). Deliberative comments suggest that participants prefer the collection of urban water for non-consumptive purposes (e.g., agriculture irrigation), fearing that water features will overflow during periods of intense rainfall (i.e., flash floods) - a major safety concern. However, this perspective also assigns neutral or negative salience values to other local regulating services, including microclimate regulation (2: 0), groundwater regeneration (4: -1), and climate change adaptation (i.e., limiting the damage of climate-induced flooding) (5: -1). Notably, deliberative comments reveal that participants prefer the application of grey

infrastructure (i.e., culverts and stormwater sewers) to adapt to local flooding brought on by climate change. Additionally, participants believe, based on their local ecological knowledge, that the extensive depth and salinity of the underlying aquifer (Amman-Zarqa Basin) limits groundwater quality and percolation. Moreover, perspective two does not value Amman's urban water features for their contribution to national (or global) climate change mitigation (i.e., carbon sequestration) (3: -1), since they are lacking in the city, which restricts this capacity. Yet, this perspective strongly values urban water features for their regulatory benefit at the watershed scale, specifically, the protection of other Jordanian water bodies (e.g., Zarqa River and Dead Sea) (6: +4).

The deliberative comments reveal that participants value the protection of other Jordanian water bodies in part because they represent Jordan's national identity. Similarly, perspective two strongly values Amman's urban water features for their historic and cultural heritage significance (21: +3), specifically as it pertains to Amman's Seil. Deliberative comments reveal participants' desire to improve the cultural expression of Amman's Seil, as its current embodiment misrepresents the local identity (23: -1). Yet interestingly, this perspective does not value Amman's urban water features for their spiritual or religious significance (22: -3).

Lastly, the results reveal for whom participants' value urban water features. The trade-offs made by perspective two suggest that participants prefer urban water features for their use and enjoyment by other residents' (26: +1), over that of tourists (25: 0). This perspective adopts an anthropogenic perspective, indifferent to the concept that urban water features are important in their own right (19: 0) and in disagreement with the concept that they are inherently important for other creatures (18: -2). Moreover, participants value Amman's urban water features for their rarity (20: +3), and strongly consider it their moral duty to protect the environment (27: +3). Yet

this perspective believes that Amman's urban water features are mostly important for their contributions to future generations (24: +4); values which stem from fear and uncertainly in an era of rapid climate change, and concerns about Amman's future vitality.

2.6 Competing water management paradigms in Amman

The results reveal two competing perspectives regarding the value of Amman's urban water features and their ecosystem services, which inform the city's contemporary conception and treatment of urban surface waters (Hespanhol, 2008). We discuss these paradigms in greater detail and explain how the derived perspectives exemplify them. This is followed by recommendations for future water management solutions in Amman.

2.6.1 'Engineered' water management paradigm

The so-called 'engineered' water management paradigm stems from 19th century Europe, in response to the challenges set forth by the industrial revolution. These challenges included water pollution and spread of water-born disease, resulting from limited knowledge of sanitary care and disease theory (Deligne, 2016; Hespanhol, 2008). In light of the public health movement, and in the name of modernity and hygiene, many urban waterways were covered and transformed into combined sewer systems (e.g., London's Fleet River and Paris' Bièvre) (Deligne, 2016). Engineered stream channelling and culverting became the predominate treatment of urban surface waters, paving the way, both idiomatically and physically, for urbanization. Following the coverage of urban water resources, cities turned to extensive watershed transposition, whereby water is imported from progressively distant external sources, as local supplies became polluted or exhausted (Hespanhol, 2008).

Amman's adoption of the 'engineered' water management paradigm was influenced by British planning approaches, popularized during the British mandate of Transjordan (1922-1946). In fact, Jordan's land use planning system is largely based on the British model, with Amman's earliest city plans (1955 and 1968) developed by British planners or European-trained experts (Abu-Dayyeh & Ziadat, 2005; Meaton & Alnsour, 2012). Amman's expression of the 'engineered' water management paradigm is exemplified in its canalizing and subsequent two-phase covering of the Amman Seil, first in 1968 due to sanitation and disease concerns, and again in 1997 (Farhan & Al-Shawamreh, 2019; Hacker, 1960, p. 27). However, Amman has realized the full expression of this paradigm by applying successively technocratic and remote solutions to bridge the gap between water demand and supply. This includes importing groundwater from regional wells of the Amman-Zarqa Basin, which, following depletion, was superseded by costly or non-renewable mega projects that transport significant volumes of distant-sourced water (i.e., the Disi Water Conveyance Project, and the Red-Dead Sea Canal) (Al-Bakri et al., 2013; Schyns et al., 2015).

2.6.2 'Sustainable' water management paradigm

The technological advancements of the twentieth century have enhanced communication networks and knowledge integration, globally improving urban health conditions. Simultaneously, academics and environmentalists began to recognize humans' dependency on nature and the growing need for sustainable resource management in the face of rapid climate change (Lele et al., 2013). As a result, a different water management paradigm emerged, recognizing the value of natural systems and their services. Under this model, urban water bodies are considered integral parts of a city's service network, whereby grey, blue and green infrastructures blend together to produce innovative and multidisciplinary water management

solutions. This so-called 'sustainable' paradigm is rooted within restoration ecology, supported by the application of nature-based solutions, which protect, sustainably manage and restore natural ecosystems to improve people-environment relations while simultaneously enhancing human well-being (IUCN, 2019; Hespanhol, 2008). Hence, this water management paradigm favours local water solutions over water transportation.

Stream daylighting is perhaps the most radical expression of this paradigm shift, which involves transforming the urban landscape by deliberately exposing some or all of a previously covered river, creek, or stormwater drainage (Pinkham, 2000, p. iv). Stream daylighting can provide environmental, economic, and sociocultural benefits, notably: 1) improved ecosystem functions; 2) cost efficient infrastructure management; and 3) improved social amenities (See: Conradin & Buchli, 2004, p. 277-288; Pinkham, 2000, p. iv-vi; Wild, Bernet, Westling, & Lerner, 2011). Stream daylighting provides a flexible adaptation strategy that enhances urban resilience and enables cities to better cope with the impacts of climate change. For example, the Cheonggyecheon Stream project in Seoul, South Korea, demolished an urban expressway to daylight 10.9 km of buried stream, naturalizing public space for recreation and simultaneously enabling cultural and socio-ecological resilience by: 1) highlighting the stream's cultural heritage significance; and 2) accommodating a 100-year flood event (Figure 13.) (Lee & Anderson, 2014).

2.6.3 Exemplifications of the 'engineered' and 'sustainable' paradigms

Contention between two perspectives occurs when ecosystem services are positively salient to one and negatively salient to the other, or when deliberative comments indicate a difference in the logic or reasoning behind the construction of each viewpoint (i.e., statement configurations)

(Armatas et al., 2014). These contentions represent distinguished perspectives, hence, their topics are likely politically charged.

Figure 13. The Cheonggyecheon Stream: The right image depicts its naturalized stream design and the left image displays its stormwater overflow conduits (Green, 2014; Anzola, 2007)

The distinguished values of the two perspectives exemplify the competing and water management paradigms in Amman (i.e., 'engineered' and 'sustainable' paradigms). Accordingly, we believe the values of perspective one ('Recreation and water regulation') support the 'sustainable' water management paradigm, whereas the values of perspective two ('Health and safety concerns') are typological of the 'engineered' water management paradigm. The following discussion highlights the trade-offs between each perspective, and their respective paradigm portrayal.

Perspective one and two assign neutral or positive value saliences to 78% and 33% of the sociocultural ecosystem services respectively. Accordingly, perspective one was more likely to trade-off all other statements in favour of sociocultural ecosystem services, compared to

perspective two, as it pertains to urban water feature's supply of recreation and social gathering spaces. Contrastingly, based on participants' local ecological knowledge, perspective two believes Amman's urban water features are hazardous to human health and safety, and therefore, are unfit for recreation or social gathering. This perspective considers Amman's urban water features as highly polluted, pest-inhabited spaces that unjustifiably require ongoing maintenance; an opinion that supports the 'engineered' water management paradigm's concern over poor water quality. Hence, when making trade-off decisions across ecosystem services, perspective two favours the importance of urban water features' ecosystem disservices, as 86% of these statements were assigned a positive or neutral salience ranking. This perspective perpetuates negative perceptions of urban water features (e.g., hazards to human health and safety, habitation of urban pests, need for maintenance) and supports Seil Amman's original covering motives, that is, to safeguard human health and safety. Comparatively, perspective one does not support these trade-offs, as these participants value Amman's urban water features despite of their disservices, as all of their ecosystem disservice statements (100%) were assigned negative salience rankings. Alternatively, this perspective considers innovative planning, design and technology as ways to overcome urban challenges, therefore embodying the 'sustainable' water management paradigm, by recognizing the potential value of urban water features' adaptive capacity. That is, their ability to adjust to climate change by moderating or avoiding harm (e.g., prevent flooding) and exploiting beneficial opportunities (e.g., collection of intensified rainfall precipitation) (IPCC, 2014).

Furthermore, the 'sustainable' water management paradigm is supported by perspective one's trade-off selections, which favour regulating ecosystem services, particularly those that deliver local water management solutions, including water features' contribution to groundwater

recharge and the regeneration of the Amman-Zarqa Basin. Perspective one and two assign neutral or positive salience rankings to 86% and 57% of the regulating ecosystem services respectively, with perspective two notably devaluing urban water features' contribution to local groundwater regeneration. Accordingly, compared to perspective one, perspective two does not value Amman's urban water features' for their local water supply and regulatory services, maintaining the status quo of the 'engineered' water management paradigm by supporting the transposition of distant-sourced water.

In consensus, both perspectives assign positive value saliences to urban water features' rainwater management services, and negative salience values to their climate change adaptation services, specifically flood mitigation. Yet, the deliberative comments indicate a difference in logic between the two perspectives. Distinctively, perspective two's deliberative comments indicate that this perspective prefers flood mitigation strategies that rely on technical solutions involving grey infrastructure (i.e., culverts and stormwater sewers), as they fear natural systems will overflow, posing a safety risk. This perspective is in line with the 'engineered' water management paradigm, whereby natural systems are entities in need of human control. Alternatively, perspective one expressed preference for nature-based solutions, which adapt to climate change by enhancing and working with nature - a manifestation of the 'sustainable' water management paradigm.

2.6.4 Future water management recommendations

More recently, the Greater Amman Municipality (GAM) is beginning to recognize the need for sustainable water management plans. This is supported by the fact that, as of 2018, the city has

partnered with the European Bank for Reconstruction and Development (EBRD)[8] as part of their 'Green City Framework', helping to develop a Green City Action Plan for Amman by funding projects that address the city's need for sustainable growth (The Jordan Times, 2019). This framework's actions are aimed at tackling the city's environmental challenges, with objectives such as pollution reduction, improved resource efficiency and implementing climate change adaptation strategies, to name a few (The Jordan Times, 2019).

It is critical that Amman capitalizes on this partnership, in order to develop programs and policy measures that manifest the 'sustainable' water management paradigm, whereby nature-based solutions can ameliorate urban water shortages and simultaneously improve human-nature relations, a perspective which the majority of the sampled experts support.

Specifically, we suggest that Amman operationalize the EBRD partnership to investigate the viability of daylighting Amman's Seil, which, similar to many accomplished daylighting projects (Cheonggyecheon Stream, Seoul, South Korea; Arcadia Creek, Michigan, USA; and Maneggback Brook, Zurich, Switzerland, to name a few), can provide a cost-effective and flexible adaptation strategy that targets local flood reduction (Delibas & Tezer, 2017; ERZ Entsorgung, 2003). For example, the city of Athens, Greece is considering trading-off a costly culvert replacement project in favour of stream daylighting. This proposal suggests daylighting the Ilisos River to recoup its natural stormwater management services to mitigate the city's reoccurring flash floods, which are the result of culverted streams (Baboulias, 2019).

Moreover, the sustainable water management paradigm supports water reuse, and planning interventions that bolster local water resources - employing tactics such as potable rainwater

[8] EBRD is an international development investment bank

collection, stormwater treatment and reuse (e.g., for non-potable urban uses, such as irrigation of green spaces or civil construction), and recuperating groundwater levels with artificial aquifer recharge (Hespanhol, 2008). These localized methods gain autonomy from external water supplies and exploit the benefits of climate change, under circumstances of increased precipitation.

However, the results reveal that Amman is amid a paradigm shift, meaning some experts remain preoccupied with the 'engineered' water management paradigm. Masoud et al. (2011) supports this statement by arguing that Amman's water management plans are too often mega projects, distracted by political undertones and neglectful of long-term sustainability. Therefore, to prevent the overuse of the 'engineered' paradigm, in favour of more sustainable solutions, it is critical that Amman implements programs and policies that addresses this paradigm's primary concerns, importantly the health and safety of urban streams; integrating these concerns into the application of nature-based solutions.

One such approach is stream daylighting, which, for over a decade, has been used in Zürich, Switzerland as a water quality improvement strategy, used to separate combined sewer systems. Positive impacts of this approach include economic, ecological and sociocultural benefits such as reduced wastewater treatment costs, reintroduction of rare keystone species, and enriched urban spaces with linear parks (Conradin & Buchli, 2004; ERZ Entsorgung, 2003). Notably, sewer separation reduces the likelihood of sewage overflows, minimizing human contact with sanitary pathogens during heavy rainfall events (ERZ Entsorgung, 2003). Additionally, daylighting implementations that divert or collect stormwater runoff can intercept untreated domestic, industrial and commercial pollutants from entering receiving water bodies, and once treated, this water can be used for non-domestic purposes or discharged into the regional water basin, diluting

its effluent concentrations and improving the water quality of the entire watershed (ERZ Entsorgung, 2003).

Moreover, to improve the support and uptake of sustainable water management solutions, initiatives should incorporate ecosystem services that are considered valuable to both perspectives (i.e., consensus or near-consensus statements). For instance, intercepting polluted stormwater runoff from receiving streams protects other Jordanian water bodies, such as the Zarqa River and the Dead Sea – a service strongly valued by both perspectives. Additionally, both perspectives strongly value urban water features for their cultural and historic significance; hence, decision-makers should implement resource management plans that enhance this ecosystem service, for improved policy support. For example, daylighting Amman's Seil also provides an opportunity to better express the city's cultural identity, which strengthens the city's cultural resilience. Contrarily, both perspectives do not recognize the economic value of urban streams, hence, pitching and hoping to get expert support for a project with primarily economic objectives centred around tourism is likely fruitless. Whereas, policies or nature-based solutions emphasizing the bequest value of nature have a higher likelihood of implementation success, as these values are of the upmost importance to both perspectives.

Additionally, in order to expedite Amman's shift towards the sustainable water management paradigm – to improve both ecological and human well-being - we suggest further international partnerships that facilitate knowledge exchange and disseminate the benefits of nature-based solutions, specifically stream daylighting.

2.7 Future applications of 'Deliberative Q-method'

The ecosystem service literature is dominated by valuation studies that singularly ascribe to either a constructionist or positivist worldview; hence, they are incapable of reflecting the full breadth of human values. Therefore, a pragmatic valuation framework is suggested, to improve the validity and creditability of sociocultural valuation studies. A mixed-methods approach is advantageous as it can incorporate deliberation, local ecological knowledge and explicit trade-off mechanisms - conditions that are not simultaneously achieved by any other method.

To operationalize this study's theoretical framework Deliberative Q-method is suggested, whereby quantitative statistical procedures cross-validate qualitative focus group results to improve the rigor of valuation studies - informing both *how* attributes are valued, and *why* they are important. This methodological combination recognizes value plurality by deciphering multiple social perspectives. Hence, it is well attuned to the study of complex urban realities, specifically in the realm of urban planning, where constituents' values are increasingly heterogeneous, and climate change makes the future uncertain (Zabala et al., 2018).
The conceptual framework was tested in Amman, Jordan, amid the city's water scarcity crisis, aimed at understanding how experts' value urban water features' ecosystem services. The values uncovered by the methodology are critical for policymaking as they prevent superficial management solutions and ensure that decision-making impetuses are contextually relevant, discernible and actionable. Hence, Deliberative Q-method reduces management inefficiencies and stakeholder conflict, improving the likelihood of policy success (Chee, 2004; Galafassi et al., 2017; King et al., 2015). Additionally, in the researchers' experience Deliberative Q-method is successful at fostering dynamic group discussions within the public participation process, as pre-formed sorting statements shape the focus group agenda. Furthermore, Deliberative Q-method

can be easily adapted and used to study values or preferences under a variety of research topics, within and beyond ecosystem service research (e.g., human health research, marketing and advertising research).

Within the ecosystem service literature we suggest further applications of the method. Specifically, the integration of multiple ecosystem types (i.e., street trees, lawns and parks, urban forests or cultivated lands) into the value framing process, so the comparative value of their services can be assessed to better prioritize the application of nature-based solutions. Additionally, due to the temporal variability of people's values, it is suggested that future studies examine value transformation before and after management interventions. In this sense Deliberative Q-method can also be applied to assess a policy's perceived success.

Applying Deliberative Q-method in Amman revealed two competing water management perspectives. Although most experts favour sustainable water management solutions, support for, engineered and technical applications still endure. Therefore, Amman is amid an ecological paradigm shift, and in order to expedite the transition towards sustainability we suggest bolstering international partnerships and knowledge exchange, specifically as it relates to stream daylighting. Furthermore, Deliberative Q-method provides a heuristic planning tool that can facilitate knowledge construction and disseminate the importance of urban ecosystems – an application that is transferrable to all urban centres looking to ameliorate human-environment relations in the face of rapid climate change.

Chapter 3.0: Conclusion

3.1 Limitations

The case study analysis presented in this thesis aims to better understand the sociocultural values Amman's experts assign to the ecosystem services of urban water features. However, in choosing to focus on this underrepresented value type we have not captured the full expression of monetary or ecological values. Although this is considered beyond the study scope, recent literature has recommended a move towards an '*operational integrated valuation*' framework, whereby simultaneous and explicit trades-offs are made across monetary, ecological and sociocultural value domains (Gómez-Baggethun et al., 2014). Analyzing society's sociocultural value preferences alongside monetary and ecological constraints is important since these considerations affect the formation of value itself. For example, if there is a cost-effective, man-made alternative to a particular ecosystem service, then the value of the original (i.e., natural) ecosystem services may be lessened (Ibid.). An ecological example relates to an ecosystem's functional capacity or ecological threshold. Individuals may not value an ecosystem service if the ecosystem itself is incapacitated to fulfill this service role. For example, Amman's experts did not value urban water feature's climate mitigation services, since these ecosystems are lacking in the city, hindering their ability to "make a difference". In many respects, the method's open-ended dialogue and interdisciplinary nature allows for the integration of monetary and ecological values, since experts from these respective fields are free to incorporate relevant information and facts into the (deliberative value) framing exercise. However, this method lacks explicit reference to monetary and ecological value domains. Despite this, it is of the authors' opinion that this method is flexible and has potential to be adapted for this purpose. For example, since the size of the Q-grid can be expanded to accommodate additional sorting statements

(Coogan & Herrington, 2011; Webler et al., 2009, p. 19), researchers can choose to explicitly include statements from monetary and ecological value domains. Alternatively, future researchers could combine Deliberative Q-method's procedures with other valuation techniques, such as citizen juries, whereby participants are presented evidence or information on scientific issues related to monetary and ecological values prior to sorting the statements (Kallis et al., 2007, p. 22).

One of the primary limitations of this study is that it's static; the analysis takes place at only a single point in time and space (Vihervaara et al., 2017, p. 93). Again, although addressing this limitation is beyond the scope of this study, multi-temporal analyses are advantageous for spatial planning as value changes can signify critical changes in the ecosystem itself (Ibid.). Additionally, analyzing representative values from different geographical areas (e.g., different districts within the Greater Amman Municipality) provides spatially explicit results, which can be used by researchers to interpret the conditions of different benefiting areas (i.e., places where ecosystem service use or demand is redundant or conversely, is needed) (Ibid.). Similarly, Deliberative Q-method could be further adapted to inform on the supply side of ecosystem services by asking participants to refer to, or mark on a map, areas that exemplify their statement rankings or deliberative comments (i.e., incorporating elements of participatory mapping studies) (Santos-Martín et al., 2017, p. 103).

In choosing to elicit values from professional experts in Amman, the generalizability of our research results are also limited; restricted to this subset of the population. Therefore, future applications of Deliberative Q-method should include laypeople in search of a more diverse and representative sample, which enables a broader generalizability across the City's diverse population. However, because human values are socially-derived and contextually significant

(Irvine et al., 2016) researchers are cautioned when generalizing results derived from this method, and therefore, generalization should be limited to regions with similar size, urban contexts, and cultural underpinnings. Furthermore, including laypeople in the value framing process can increase social equity and justice, enabling people to take control of the social processes that govern their welfare, which in turn, improves the governance of the planning system itself (Hudson et al., 1979; Kallis et al., 2007, p. 12; Wilson & Howarth, 2002).

During data collection, focus group facilitators attempted to mediate power dynamics by encouraging an equal input from all contributors, yet power imbalances inevitably remain (e.g., based on attributes such as gender, class, education, participants' job title or organization affiliations). Furthermore, "there may be significant differences between individuals in their perceptions of power, both their own and held by others", differences which are often "unfathomable to the cultural 'outsiders' in the collaborative effort" (Mason & Boutilier, 1996, p. 148). Therefore, future researchers applying Deliberative Q-method should attempt to better understand and mitigate these power imbalances. One such approach could be grouping participants with similar characteristics or demographics in the same focus groups, to inform a single Q-sort, which is then aggregated to inform the larger social perspective. However, the author acknowledges that such an approach could stifle dynamic group discussions, community cohesion, and social learning. At the very least, future studies should be aimed at understanding and communicating hidden power dynamics (Ibid.), for example, by interviewing each participant after the focus group and asking them to reflect on their individual experiences.

Although measures were taken to ensure study accuracy and validity (i.e., embedded mixed methods research design[9], internal and external member-checking of study attributes and results) all forms of research are susceptible to some form of researcher bias (Creswell, 2014, p. 98). Therefore, as the author, I recognize my positionality as a researcher and the positionality of additional contributors who assisted during the study's attribute development and data collection stages (i.e., focus group note takers and facilitators). The majorities of this study's research assistants have no lived experience in Amman and do not speak the native language of Arabic. Prior to visiting Jordan, researchers gained familiarity with the research context through peer-reviewed journal articles, grey literature and the narratives of current and former residents.

3.2 Contributions to scholarship and practice

The objective of ecosystem service valuation is primarily practical, aimed at operationalizing the ES concept within real-world problems. Therefore, valuations should render easily digestible and useful information for stakeholders, decision-makers, and planners, while being sensitive to the value plurality, risk and uncertainty facing today's complex and diverse cities. Accordingly, Deliberative Q-method bridges the quintessential gap between theory and practice, and builds upon robust theoretical and empirical frameworks believed to be valuable to planners, policymakers and scholars alike. This research highlights two important considerations: (1) a valuation approach's epistemology should be fit for the purpose of the process; and (2) practitioners should question the status quo by applying nature-based solutions that go beyond individual government sectors to reconcile competing policy goals. Results from the Amman case study suggest moving away from the 'engineered' water management paradigm towards

[9] "An embedded mixed methods design involves… either a convergent or sequential use of data, but the core idea is that either quantitative or qualitative data is embedded within a larger design… and the data sources play a supporting role in the overall design" (Creswell, 2014, p. 44)

locally sustainable nature-based solutions. For instance, stream daylighting, has the capacity to mitigate water scarcity while ameliorating human well-being by improving urban conditions such as recreation opportunities, sense of place, and critically, climate change adaptation and resilience.

This research responds to the lack of real-world examples that operationalize sociocultural valuation, specifically in the context of urban planning, to mainstream the consideration of social and cultural values in environmental management and policy decisions. Moreover, Deliberative Q-method's pragmatic framework is advantageous as it can be used to suit to a variety of different research topics, within urban planning and beyond (e.g., health research, consumer marketing).

Deliberative Q-method is preferable to conventional sociocultural valuation methods as it integrates multiple tools (e.g., preference assessments, narratives, deliberative valuation) into a single method, and in doing so, captures a range of value types (See Figure 3.). In fact, this method could be further adapted to incorporate elements of photo-elicitation surveys (by replacing the sorting statements with images) or scenario planning (by carrying out two focus groups using the same participants and sorting statements under different scenario options). Hence, Deliberative Q-method is advantageous due to its propensity for adaptation. For example, Deliberative Q-method can be further adapted to incorporate additional planning theories and/or epistemologies such as, incremental planning or advocacy planning, which supports a transformative worldview[10]. Incremental planning theorists believe that in order for a decision or policy to be proven mistaken, one must argue that another policy is preferred rather than offer

[10] A transformative worldview believes that research questions should be intertwined with politics and a political change agenda to confront social oppression (Mertens, 2010)

abstract and subjective comments about a pre-determined, unreached objective (Lindblom, 1965, p. 79-88). In this respect, Deliberative Q-method can be used to sort (make trade-offs) across different policies themselves, which is preferable in scenarios where decision-makers cannot agree on a set of guiding values or objectives, but agree on a specific policy itself (for different underlying reasons) (Ibid.). Researchers or practitioners could alternatively choose to take an advocacy planning approach, or satisfy a transformative worldview, by recruiting participants that are considered marginalized in society and by prioritizing the results gleaned from this population (Creswell, 2014, p. 38). Additionally, researchers or practitioners can empower and represent marginalized populations by enabling their involvement in Deliberative Q-method's attribute development, data collection, and data interpretation stages.

Effective solutions require diverse perspectives and multiple levels of action, extending beyond the scope of any single planning theory or research epistemology. Hence, this thesis contributes findings that explicate *why* and *how* pragmatism can mainstream the valuation of sociocultural values within urban planning, removing implementation barriers and acknowledging the idiosyncrasies of real-world problems such as value heterogeneity and value plurality.

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Appendices

APPENDIX A: Focus group information letter

UNIVERSITY OF WATERLOO

FACULTY OF ENVIRONMENT | School of Planning
519-888-4567, ext. 36564 | fax 519-725-2827
uwaterloo.ca/planning

ORE # 22861

Date: _____ April 2018

Title of Project: The Potential of Daylighting (Deculverting) Urban Streams for Climate Change Adaptation and Mitigation and for Place-Making: Amman's Seil and Seoul's Cheonggyecheon

Organizer*:* Dr. Luna Khirfan
University of Waterloo, Faculty of Environment, School of Planning
Ontario, Canada
1-519-888-4567 Ext. 33906

Dear Sir / Madam,

This letter is an invitation to participate in the research project entitled: The Potential of Daylighting (Deculverting) Urban Streams for Climate Change Adaptation and Mitigation and for Place-Making: Amman's Seil and Seoul's Cheonggyecheon. This study is being conducted by Dr. Luna Khirfan of the Faculty of Environment, School of Planning, at the University of Waterloo, Canada and is apart of a five-year research program funded by the Social Sciences and Humanities Research Council (SSHRC). I would like to provide you with more information about this research project and what your involvement would entail if you decide to take part.

The purpose of this study, therefore, is to establish links between urban stream daylighting at three interrelated levels (at the macro eco-system regeneration level, at the meso urban morphological level, and at the micro place-making level), while eliciting participatory planning and design approaches to inform the creation of design proposals and policy recommendations for future action on Amman's Seil (Jordan) and Seoul's Cheonggyecheon (South Korea). Therefore, I would like to include you as a study participant as I believe your professional and local expertise are best suited to speak to the various project levels as described below.

Participation in this study is voluntary. It will involve partaking in a two-hour long focus group exercise, to take place at Columbia Global Center, Amman at 5 Moh'd Al Sa'd Al-Batayneh Street, King Hussein Park, Amman 11814 – Jordan, from 9:30am until 11:30am on ***10 April 2018***. For the purposes of this study a focus group is defined as a small group discussion that utilizes visual and interactive tools. The focus group will be led by the organizer (Dr. Luna Khirfan) and will be facilitated by a group of well-trained students from the University of Waterloo, who are partaking in a special research-based course taught and directed by the organizer.

During the focus group exercise local experts and students will form small groups to discuss ideas and collectively formulate a vision for the daylighting of Amman's Seil, Jordan. Each focus group team will comprise of 5 participants and two to three student facilitators. Each team will seek to identify how the daylighting of their city's urban stream may serve climate change adaptation and mitigation, and place-making, using post-it notes and flip charts (textually) and by adding layers over a base map (visually and spatially). This information will then be shared with the rest of the participants at the end of the exercise.

The focus group's discussions and raw materials such as its colour coded post-it notes, flipchart notes and sketches will be textually transcribed. The output of this research, including the focus group's

discussions and raw materials, will be used in the creation of textual and visual analyses, design proposals and policy recommendations for future action on Amman's Seil (Jordan) and Seoul's Cheonggyecheon (South Korea). In addition, the output of this research will be used for further analyses published in peer-reviewed journals and in students' graduate theses conducted under the umbrella of this research project. Following the focus group, written feedback will be provided to all study participants along with the organizer's contact information. This feedback will include a statement of appreciation, details about the purpose of the study, restatement of the outline for anonymity and the security of data, an approximation of when study findings will be available for public viewing, and how participants can gain a copy.

In order to respect your privacy and rights the following study measures will be taken: 1) all information gathered during the data collection phase, including the focus group, will be anonymously grouped with responses from other study participants; 2) your name will not be identified with, nor linked to the input you provide during the focus group session; 3) you will not be identified by name in any publication or dissemination of results/findings that ensues from this study; 4) all information letters and consent forms provided to participants will specifically request that they respect the confidence of fellow focus group participants; 5) the information collected during the data collection sessions will securely be kept for a period of at least 7 years at the University of Waterloo in the Faculty of Environment, School of Planning and discreetly disposed of after this time.

Your participation in the focus group is completely voluntary, and there will be no remuneration (financial, in-kind, or otherwise) provided. There are no known benefits and/or risks associated with your participation, beyond what you may encounter in your everyday life. Given the group format of this session, we will ask you to keep in confidence information that identifies or could potentially identify a participant and/or his/her comments. As discussed above, your identity will be kept confidential and the resulting dataset and/or manuscript(s) will not contain any information that may identify you. Due to the group nature of the activity the researcher cannot guarantee that other participants will keep group activities, discussions and/or fellow participant information confidential. You will have the right to withdraw your involvement at any time before or during the focus group. However, please be aware that due to the collaborative nature of the focus group, your drawings and/or specific contributions will be unextractable from collective materials and discussion, and therefore will remain usable by the researcher regardless of participation withdrawal during the activity.

For all other questions, or if you wish to withdraw your involvement in this study please contact the focus group organizer ***Dr. Luna Khirfan***, you may reach her at ***lkhirfan@uwaterloo.ca*** or 1-519-888-4567 ext. 33906.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #22860). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I look forward to seeing you at the focus group and thank you for your assistance with this project.

Yours sincerely,

Luna Khirfan, PhD, MA, MA, BSc
Associate Professor
The University of Waterloo, School of Planning
Ontario, Canada
URL: https://uwaterloo.ca/planning/people-profiles/luna-khirfan

APPENDIX B: Focus group consent form

UNIVERSITY OF WATERLOO

FACULTY OF ENVIRONMENT | School of Planning
519-888-4567, ext. 36564 | fax 519-725-2827
uwaterloo.ca/planning

ORE # 22861

Date: _____ April 2018

Title of Project: The Potential of Daylighting (Deculverting) Urban Streams for Climate Change Adaptation and Mitigation and for Place-Making: Amman's Seil and Seoul's Cheonggyecheon

Organizer*:* Dr. Luna Khirfan
University of Waterloo, Faculty of Environment, School of Planning
Ontario, Canada
1-519-888-4567 Ext. 33906

CONSENT OF PARTICIPANT

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read, and consent to the information presented in the "Focus Group Information Letter" regarding the study entitled: The Potential of Daylighting (Deculverting) Urban Streams for Climate Change Adaptation and Mitigation and for Place-Making: Amman's Seil and Seoul's Cheonggyecheon. For the purposes of this study a focus group is defined as: a small group discussion that utilizes visual and interactive tools. The study's principle investigator is Dr. Luna Khirfan of the Faculty of the Environment, School of Planning at the University of Waterloo, Canada. The focus group will be led by the organizer (Dr. Luna Khirfan) and will be facilitated by a group of well-trained students from the University of Waterloo, who are partaking in a special research-based course taught and directed by the organizer.

I have had the opportunity to ask a focus group facilitator and/or the organizer any questions related to this session. I have received satisfactory answers to my questions, and I have been provided with any additional details that I may have requested. I am aware there are no direct benefits or risks beyond what I may encounter in my everyday life associated with my participation. Additionally, during the focus group I may decline from answering any questions that I feel I do not wish to answer, and I can withdraw from contributing to the session in other ways if I wish to do so. I understand that I may withdraw from the study without penalty at any time by advising the researchers of this decision. I understand that the researcher cannot guarantee that other participants will keep group activities, discussions and/or fellow participant information confidential. Additionally, I understand due to the collaborative nature of the focus group, my drawings and/or specific contributions will be unextractable from collective materials and discussion, and therefore will remain usable by the researcher regardless of participation withdrawal during the activity.

Given the group format of this session, we will ask you to keep in confidence information that identifies or could potentially identify a participant and/or his/her comments.

For all other questions please contact the focus group organizer ***Dr. Luna Khirfan***, you may reach her at ***lkhirfan@uwaterloo.ca*** or 1-519-888-4567 ext. 33906.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #22860). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this focus group and to keep in confidence information that could identify specific participants and/or the information they provided in this session.

_____
Print Name

_____
Signature

_____
Date

_____
Witness

APPENDIX C: Focus group feedback letter

UNIVERSITY OF WATERLOO

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ORE # 22861

Date: _____ April 2018

Title of Project: The Potential of Daylighting (Deculverting) Urban Streams for Climate Change Adaptation and Mitigation and for Place-Making: Amman's Seil and Seoul's Cheonggyecheon

Organizer*:* Dr. Luna Khirfan
University of Waterloo, Faculty of Environment, School of Planning
Ontario, Canada
1-519-888-4567 Ext. 33906

Dear Sir / Madam,

I would like to thank you for your participation in the study entitled: The Potential of Daylighting (Deculverting) Urban Streams for Climate Change Adaptation and Mitigation and for Place-Making: Amman's Seil and Seoul's Cheonggyecheon. This research project is a part of a five-year research program, funded by the Social Sciences and Humanities Research Council (SSHRC) and conducted by Dr. Luna Khirfan of the Faculty of Environment, School of Planning, at the University of Waterloo, Canada. As a reminder, the purpose of this study is to establish links between urban stream daylighting and: urban morphology, climate change adaptation and mitigation, and place-making, while eliciting participatory planning and design approaches.

The focus group data will be compared and compiled with information gained through local citizen interviews and interviews with local experts to generate inductive themes and inform the creation of design proposals and policy recommendations for future action on Amman's Seil (Jordan) and Seoul's Cheonggyecheon (South Korea). Specifically, the views of local experts and policy makers will be compared to those of ordinary citizens, especially with regards to the perceptions of values of the urban streams as ecosystems, namely: use and experience values; existence values; symbolic values; bequest and moral values; and negative values of the streams. Resulting design proposals will go through an iterative design process, ensuring that all design proposals are continuously revised based on critique provided through discussions among the researchers and students through stakeholder feedback. Stakeholder feedback will be documented and incorporated into the design proposals. The final design proposals and policy recommendations will be shared with the public through an online portal. In addition, the output of this research will be used for further analyses published in peer-reviewed journals and in students' graduate theses conducted under the umbrella of this research project.

Data collected during the focus group exercise will help the researchers gain insight into the range and scope of daylighting practice around the world, including a better understanding of the design, monitoring and evaluation strategies for daylighting projects.

As an approximation, the findings of this study will be available for public viewing towards the end of 2018. Moreover, study participants can visit the research project's website where you can find up-to-date summaries on data collection and study findings as they develop. There is also the potential for a public exhibition to premier in Amman to debut the study's findings to all participants and interested public, organized by the project's principle investigator, Dr. Luna Khirfan. If you would like to be contacted in the event that the public exhibit becomes a reality, please notify the principle investigator

Dr. Luna Khirfan at the contact information provided below.

Given the group format of this session, we remind you to keep in confidence information that identifies or could potentially identify a participant and/or his/her comments.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #22860). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I hope you will find that I have been faithful to the information you provided and to the general circumstances of the daylighting of Amman's Seil as you described them. If you have any further questions or concerns please contact the interview organizer ***Dr. Luna Khirfan***, you may reach her at ***lkhirfan@uwaterloo.ca*** or 1-519-888-4567 ext. 33906.

We greatly appreciate your participation, and hope that this has been an enjoyable and interesting experience for you.

Yours sincerely,

Luna Khirfan, PhD, MA, MA, BSc
Associate Professor
School of Planning
The University of Waterloo
Ontario, Canada

URL: https://uwaterloo.ca/planning/people-profiles/luna-khirfan

EV3, 200 UNIVERSITY AVENUE WEST, WATERLOO, ON, CANADA N2L 3G1

APPENDIX D: Factor one demographics

Q SORT B - 1 Male & 3 Females	
[redacted] (F) [B]	Professor at Jordan University of Science and Technology, Department of Urban Planning and Design
[redacted] (M) [B]	Professor at the German Jordan University, School of Architecture & Built Environment
[redacted] (F) [B]	Architect
[redacted] (F) [S]	Social Geographer with interest in public policies on regional and urban development in Jordan and Syria.
Q SORT D - 4 Females	
[redacted] (F) [B]	Practicing urban designer/ urban planner at Dar Al-Handasah
[redacted] (F) [B]	Engineer, working on the Green Infrastructure and International Cooperation project (GIZ)
[redacted] (F) [S]	Professor at the University of Jordan, Department of Architecture. Research interests include spatial justice and tactical urbanism
[redacted] (F) [B]	Civil Engineer at the Greater Amman Municipality (GAM), Local Plans Division
Q SORT E - 3 Males & 1 Female	
[redacted] (M) [S]	Communication director at the Greater Amman Municipality (GAM)
[redacted] (M) [S]	Program director at the Arab Forum for Environmental Development
[redacted] (M) [N]	Project facilitator for the Sustainable Use of Ecosystem Services in Jordan project (GIZ)
[redacted] (F) [B]	Architect

12 of 20 total Participants: 4 Male (50%) and 8 Female (50%)

N = Conservation and Natural Environment Expert (i.e., landscape architects, conservationists)
B = Infrastructure and Built Environment Experts (i.e., civil engineers, architects, urban designers)
W = Water Resource Management Experts (i.e., water resource managers and engineers)
S = Socio-political Experts (i.e., social geographers, heritage conservation, environmental policy experts)

APPENDIX E: Factor one crib sheet with participant comments

Distinguishing statements for factor 1 indicated in Bold (P<.05) Asterisk (*) indicates significance at P< .01)
Red comments = Q sort B
Green comments = Q sort D
Blue comments = Q sort E

Items Ranked at +4

***(11) IMPORTANT BECAUSE THEY SUPPLY RECREATIONAL SPACES_____+4**
- Amman is in desperate need of 'blue' recreation spaces as there are currently not many.

(23) IMPORTANT FOR FUTURE GENERATIONS TO ENJOY_____+4
- Participants generally agreed, although they feared that Amman's water quality is too polluted to actually make a difference for future generations.
- Participants said they worry extensively about their children; strongly worrying about the future over the present.

Items Ranked Higher in Factor 1's Array than in Factor 2's Array

(2) IMPORTANT BECAUSE THEY PROVIDE COOL AREAS IN THE CITY_____+1
- Participants believed that urban streams do provide cool areas in the city.

(3) IMPORTANT BECAUSE THEY UPTAKE GLOBAL CARBON AND PROTECT AGAINST CLIMATE CHANGE_____0
- Participants agreed that this is an important role of streams, but in their current state there are too few of them to uptake carbon in Amman. In the future, if the number of urban streams increases they could better fill this role.
- Small bodies of water call not moderate climate change.

***(4) IMPORTANT BECAUSE THEY REPLENISH GROUNDWATER SUPPLIES (I.E., RECHARGE AREAS)_____+3**
- Professionals knew that streams are a major source of groundwater replenishment, but the extent of this ecosystem service is limited presently. Older participants felt like this was more important when they were young (prior to stream covering).

(8) IMPORTANT BECAUSE THEY PROVIDE FRESH WATER_____-1
- Disagree, streams in Amman do not have freshwater.
- In Jordan in general perhaps, but not in Amman. There is no separation between fresh water and polluted sewage. King Tala Damn is where the fresh water comes from.
- Streams only contribute fresh water through rainfall and groundwater replenishment, but due to Amman's development (area of surface coverage) this contribution is largely insignificant. In Amman streams do not provide fresh water. Fresh water comes from water supply trucks and pumped water from aquifers.

(9) IMPORTANT BECAUSE THEY CONTRIBUTE TO RELAXATION, TRANQUILITY AND/OR COGNITIVE DEVELOPMENT_____0
- They provide tranquility and relaxation, but to a limited extent since there are so few.

(10) IMPORTANT BECAUSE THEY SUPPLY ART AND CULTURE_____+1
- Inspiration for art and culture is a future opportunity but it does not currently apply.
- Planners and architects find inspiration in everything, especially water.

(14) IMPORTANT BECAUSE THEY ALLOW INDIVIDUALS TO LEARN FROM NATURE_____0
- Currently, you cannot learn from streams because they do not exist.
- Agree, we can learn from nature.
- Amman only has ponds and fountains, which do not provide learning opportunities.

(17) IMPORTANT BECAUSE THEIR PROXIMITY INCREASES PROPERTY VALUES_____-2
- Since water streams in Amman are so rare there is no precedence for this - development is not related to water here. Property values are more dependent on location, but participants agree that water features attract people.
- Water features in Amman do not increase property values because the beautiful examples are not in the city.

(7) IMPORTANT BECAUSE THEY ARE SURFACE WATER COLLECTION AREAS_____+2
- Participants highly agreed that surface water collection is an important ecosystem service, but "water collection does not work in Amman given the current climate and city conditions".
- There are few green spaces where surface water collects due to how compact Amman is, surface collection requires large surface areas.
- Amman has a poor stormwater drainage network. They need a better stormwater drainage network but this is difficult to accomplish because experts do not know the location of all the old infrastructure and sewer routes.

***(15) IMPORTANT BECAUSE THEY SUPPLY SOCIAL GATHERING PLACES_____+3**
- Participants believed this to be true for all of Amman's water features, no matter how small (including fountains)
- Water attracts people to an areas, allows people to sit and enjoy, and have an inexpensive family fun.
- Areas with water features are popular areas for families to gather, especially kids. Children like to go to public water features, such as fountains, to play and hang out.

(18) IMPORTANT BECAUSE THEY SUPPLY HABITATS FOR CREATURES_____0
- This ecosystem service is important but, in their present state, water features do not contribute much.

(19) IMPORTANT BECAUSE STREAMS ARE IMPORTANT IN THEIR OWN RIGHT_____+1
- Humans do not have the right to kill a river, but it was suggested by a participant that this is a North American imposed value rather than a local one.
- There are important in their own right, needed for a broader ecosystem network (ecological outside of human use).

***(22) IMPORTANT BECAUSE THEY HAVE SPIRITUAL OR RELIGIOUS SIGNIFICANCE_____-1**
- Participants believed water features held more religious significance to people of the past compared to now (e.g., Roman Nymphaeum).
- Some water bodies/streams are Baptism sites, but this only applies to small, very specific places.

Items Ranked Lower in Factor 1's Array than in Factor 2's Arrays

(6) IMPORTANT FOR THE PROTECTION OF JORDANIAN WATER BODIES (E.G., ZARQA RIVER, DEAD SEA)_____+3
- Water is the most important resource, because there is a scarcity in Jordan.
- Urban streams are importance since they protect the Dead Sea, which has been shrinking rapidly.

(20) IMPORTANT BECAUSE THEY ARE RARE IN THE CITY_____+2
- Streams are very rare in Amman and therefore important.
- Participants agree that streams are rare in Amman, but more of them wouldn't lessen their importance.

(21) IMPORTANT BECAUSE THEY HAVE HISTORIC AND CULTURAL HERITAGE SIGNIFICANCE_____+1
- Participants agree that urban water features are historically and culturally significant. This is where "the story of the city began", settlement occurred around the Seil. There are many places named after the Seil and the head of the stream, but they are lost in context now after the stream was covered.
- Historically significant.
- Religious significance no not really, but cultural or heritage significance yes.

(25) IMPORTANT FOR TOURISTS TO ENJOY)_____-1
- All focus groups agreed but were indifferent.

(26) IMPORTANT FOR OTHER RESIDENTS TO ENJOY_____-0
- All focus groups agree but were indifferent.

***(27) IMPORTANT AS IT IS OUR MORAL DUTY TO PROTECT THE ENVIRONMENT___+1**
- Planners and environmental agents agreed that it was their moral duty to protect the natural environment.

***(28) NOT IMPORTANT BECAUSE THEY PROVIDE HABITATS FOR PESTS_____-2**
- Important regardless of pests.
- Pests do not determine the importance of water features, they are important despite their presence.

***(29) NOT IMPORTANT BECAUSE THEY HAVE POOR WATER QUALITY_____-3**
- Poor water quality is not necessary the biggest concern.
- Streams can be fed by rainwater and springs, which do not have poor water quality. Participants have never seen water features toxic enough to harm human health, but they all agree that they can be polluted in Amman. Streams are still very important despite potential pollution due to all their other service they provide.
- Even if Amman's water features are polluted they are still important. Water can be filtered or improved, polluted water features are not a lost cause. Poor water quality is not enough to devalue these ecosystems.

***(30) NOT IMPORTANT BECAUSE THEY ARE UNSAFE FOR HUMAN HEALTH (E.G., DISEASE + POLLUTION)_____-2**
- There are no health issues associated with Amman's local water bodies (participants reference the non-existence of malaria in Amman). Participants do not believe that all of Amman's water features are heavily contaminated, and those that are can be cleaned. Moving bodies of water are preferred over stagnant ones, since they have better water quality.

***(31) NOT IMPORTANT BECAUSE THEY ARE UNSAFE FOR HUMAN SAFETY (E.G., DROWNING)_____-3**

- One participant believes that streams in Amman can be unsafe. A few years ago there was a project for "limitless towers" where a huge hole was dug. The hole was filled with rainwater and a young 10 year old boy drowned. However, this is a rare case and all participants agree it is not highly relevant.
- The only unsafe water is behind the dams outside Amman. In Amman this is not a problem due to water features' scarcity. We shouldn't remove streams because of this factor.
- Yes, participants slightly agree. There was a pond near the Pepsi factory where a lot of people drowned (Farah Park).

***(32) NOT IMPORTANT BECAUSE THEY OFTEN NEED MAINTENANCE_____-2**

- Even if urban water features need maintenance they are still important, they do not need continual maintenance if naturalized.
- Not a good reason to remove water features.

Items Ranked at -4

***(33) NOT IMPORTANT BECAUSE THEY LIMIT VALUABLE LAND FOR DEVELOPMENT_____-4**

- There is a lot of other land in Amman that can be developed.
- Development happens wherever there is water, and more regulations should be in place to protect streams from urbanization.

(34) NOT IMPORTANT BECAUSE THEY DIVIDE THE CITY (E.G., LIMIT TRANSPORTATION NETWORKS)_____-4

- Urban water features do not divide the city. It is the role of urban designers and planners to find solutions that bridge these potential divides.
- They do not divide the city currently - not applicable.

APPENDIX G: Factor two demographics

Q SORT A - 1 Male & 3 Female	
[redacted] (M) [W]	Engineer working on integrated water resources management
[redacted] (F) [B]	Professor at the German Jordan University, School of Architecture & Built Environment
[redacted] (F) [S]	Professor at the Hashemite University, Department of Architecture Engineering with a PhD. in cultural heritage
[redacted] (F) [B]	Urban planner at the Greater Amman Municipality (GAM)
Q SORT C - 2 Male & 2 Female	
[redacted] (M) [W]	Coordinator at the Friends of the Earth Middle East, Department of Water Management & Environment
[redacted] (F) [S]	Science policy and programme development advisor at the Royal Scientific Society, Jordan
[redacted] (F) [S]	Professor at the German Jordan University, School of Architecture & Built Environment. Research interests include urban regeneration and heritage conservation
[redacted] (M) [N]	Landscape architect for the Watershed and Development Initiative (WADI)

8 of 20 total participants - 3 Male (37.5%) and 5 Female (62.5%)

N = Conservation and Natural Environment Expert (i.e., landscape architects, conservationists)
B = Infrastructure and Built Environment Experts (i.e., civil engineers, architects, urban designers)
W = Water Resource Management Experts (i.e., water resource managers and engineers)
S = Socio-political Experts (i.e., social geographers, heritage conservation, environmental policy experts)

APPENDIX H: Factor two crib sheet

Distinguishing statements for factor 1 indicated in Bold (P<.05) Asterisk (*) indicates significance at P< .01)
Pink Comments = Q sort A
Hello Comments = Q sort C

Items Ranked at + 4

(6) IMPORTANT FOR THE PROTECTION OF JORDANIAN WATER BODIES (E.G., ZARQA RIVER, DEAD SEA.)_____+4
- Protecting Jordan's water bodies is important, especially the Zarqa River.
- The protection of watersheds are important. Participants acknowledged that Amman's Seil is a major drainage path to the Zarqa River, which eventually drains in to the Dead Sea. The Dead Sea needs protection due to its recent shrinking.

(24) IMPORTANT FOR FUTURE GENERATIONS TO ENJOY_____+4
- Water features in Amman are important for the prosperity of future generations, we must protect them.
- Amman's water features are important for the health of future generations. Therefore, we need to conserve these areas, particularly since Amman's climatic future remains uncertain.

Items Ranked Higher in Factor 2's Array than in Factor 1's Array

(20) IMPORTANT BECAUSE THEY ARE RARE IN THE CITY_____+3
- Streams in Amman are rare and therefore important.

(21) IMPORTANT BECAUSE THEY HAVE HISTORIC AND CULTURAL HERITAGE SIGNIFICANCE_____+3
- Amman's Seil has cultural heritage significance. The tile design at the Hashemite Plaza shows were the Seil once flowed.
- The present conditions do not recognize stream's heritage value, but they should.

(25) IMPORTANT FOR TOURISTS TO ENJOY_____0
- Streams are not important for tourists to enjoy, they are more important for residents.

(26) IMPORTANT FOR OTHER RESIDENTS TO ENJOY_____+1
- Yes, participants agree that streams are important for other residents to enjoy.

***(27) IMPORTANT AS IT IS OUR MORAL DUTY TO PROTECT THE ENVIRONMENT___+3**
- Of course it is our moral duty to protect the environment (no participant in this group thought twice about this).

***(28) NOT IMPORTANT BECAUSE THEY PROVIDE HABITATS FOR PESTS_____+1**
- Currently they do provide habitats for pests.
- Historically participants agree, but nowadays the act of covering streams protects us against this.

***(29) NOT IMPORTANT BECAUSE THEY HAVE POOR WATER QUALITY_____+2**
- Water features are still important even if they are polluted; their water can still be used for irrigation and non-consumptive purposes.

***(30) NOT IMPORTANT BECAUSE THEY ARE UNSAFE FOR HUMAN HEALTH (E.G., DISEASE + POLLUTION)_____+1**

- Water features in Amman are heavily polluted, and therefore unsafe for human health.

***(31) NOT IMPORTANT BECAUSE THEY ARE UNSAFE FOR HUMAN SAFETY (E.G., DROWNING)_____+2**

- Water features in Amman are unsafe for people, children could drown or be swept away.
- Some water features are still accessible to humans, but most of these areas are fenced off.

***(32) NOT IMPORTANT BECAUSE THEY OFTEN NEED MAINTENANCE_____+1**

- There is not enough ongoing infrastructure maintenance in Amman. In Amman we construct something or rehabilitate something but do not maintain it. Without maintenance water features inevitably become polluted.

***(33) NOT IMPORTANT BECAUSE THEY LIMIT VALUABLE LAND FOR DEVELOPMENT_____0**

- The presence of water can assist development. Water features do not limit development.

(34) NOT IMPORTANT BECAUSE THEY DIVIDE THE CITY (E.G., LIMIT TRANSPORTATION NETWORKS)_____-3

- Water features do not divide the city. The area where the Seil once flowed was is now occupied by the GAM, and therefore cars still cannot cross over this area.
- Division of the city wasn't the reason for covering the Seil.

Items Ranked Lower in Factor 2's Array than in Factor 1's Array

(2) IMPORTANT BECAUSE THEY PROVIDE COOL AREAS IN THE CITY_____0

- In Amman water features provide cool areas in the City. People used to enjoy the cool air from the Hashemite plaza, when the Seil ran through the area, but the stream is now covered. We are closing water features because people pollute them.

(3) IMPORTANT BECAUSE THEY UPTAKE GLOBAL CARBON AND PROTECT AGAINST CLIMATE CHANGE_____-1

- Currently there is not such uptake in Amman.
- A whole stream could possibly contribute to carbon up-take, but small water features, like those in Amman, can not.

***(4) IMPORTANT BECAUSE THEY REPLENISH GROUNDWATER SUPPLIES (I.E., RECHARGE AREAS_____-1**

- Amman's groundwater table (Zarqa Aquifer) is very deep, so surface waters do not help to replenish groundwater supplies.

(7) IMPORTANT BECAUSE THEY ARE SURFACE WATER COLLECTION AREAS_____+1

- Water features are important surface water collection sites.
- Yes water feature's collect surface water, but once they reach capacity they also flood.

(9) IMPORTANT BECAUSE THEY CONTRIBUTE TO RELAXATION, TRANQUILITY AND/OR COGNITIVE DEVELOPMENT_____-1

- Water features do not currently contribute to tranquility and relaxation. They are polluted and have no flow.

(10) IMPORTANT BECAUSE THEY SUPPLY ART AND CULTURE_____0
- Recent renovations at the Hashemite Plaza have added public art (tile mosaic) to represent the Seil Amman. The City is attempting to conserve the cultural significance of the stream.

(14) IMPORTANT BECAUSE THEY ALLOW INDIVIDUALS TO LEARN FROM NATURE____-2
- The streams in Amman lack nature, so no, you can not learn from them.

***(15) IMPORTANT BECAUSE THEY SUPPLY SOCIAL GATHERING PLACES_____-2**
- Although people generally enjoy gathering around water, this is not true in Amman.
- Streams / water features are fenced off, don't allow access for people to gather together.

(17) IMPORTANT BECAUSE THEIR PROXIMITY INCREASES PROPERTY VALUES_____-3
- Urban water features in Amman do not increase property values, but there are so few so it is hard to know.

(18) IMPORTANT BECAUSE THEY SUPPLY HABITATS FOR CREATURES_____-2
- Other creatures are not as important as humans.

(19) IMPORTANT BECAUSE STREAMS ARE IMPORTANT IN THEIR OWN RIGHT_____0
- Yes, water features and streams are important in their own right.

***(22) IMPORTANT BECAUSE THEY HAVE SPIRITUAL OR RELIGIOUS SIGNIFICANCE_____-3**
- In Amman they should have spiritual significance, but currently they do not.

Items Ranked at -4

(8) IMPORTANT BECAUSE THEY PROVIDE FRESH WATER_____-4
- Water features currently do not provide fresh water, they are polluted, therefore, urban streams are covered.

***(11) IMPORTANT BECAUSE THEY SUPPLY RECREATIONAL SPACES_____-4**
- We don't have streams in Amman, thus they do not provide recreational spaces. In Amman there seems to be a negative attitude towards open streams and their poor safety is commonly discussed in the media. For example, the water in the Zarqa River used to be clean, now it is heavily polluted. Polluted streams cannot be opened for recreational use or space.
- Potential in the future maybe, but not presently. The public sector will not make it happen.

APPENDIX I: Sorting statements with consensus between factors

Red comments = Q sort B
Green comments = Q sort D
Blue comments = Q sort E
Pink Comments = Q sort A
Hello Comments = Q sort C

(1) IMPORTANT BECAUSE THE MANAGE RAINWATER RUNOFF_____+2
- Water features are important for diverting rainwater runoff. Sagf-Seil, acts as a trench.
- Streams indeed manage stormwater runoff, but in Amman there are too few streams. Amman has a terrible stormwater management system. The streets always flood.
- Amman's hilly topography manages stormwater - not streams. However, dips in the roads flood.

(5) IMPORTANT BECAUSE THEY LIMIT DAMAGE FROM CLIMATE CHANGE/WEATHER EVENTS (E.G., FLOOD DAMAGE)_____-1
- Amman needs better solutions to manage rainwater. Amman's current water features have limited capacity to prevent flood damage.
- All participants greatly agree that urban water features should divert water and prevent flooding, but in their current state they do not. In am idealized future scenario this would be ranked +4.
- Flooding happens very quickly and there is not enough water infrastructure to relieve the impacts of flooding.
- Urban water features do not prevent negative impacts of climate change. Culverts help more - they prevent streams from overflowing.
- Streams are not well designed and therefore they do not limit flood damage, not usable for that purpose - stormwater sewers serve that purpose.

(12) IMPORTANT BECAUSE THEY SUPPLY NATURAL BEAUTY_____0
- Water features can supply beauty important for psychological health.
- Water feature's beauty depends on their maintenance. Hard to picture any beautiful streams in Amman; natural beauty is a neglected issue in Amman.
- Water features do provide natural beauty.
- Most of the aesthetic water features are inside residential complexes, not available to the public. Public water features remain empty.

(13) IMPORTANT BECAUSE THEY ALLOW PEOPLE TO EXPERIENCE NATURE (E.G., LISTEN TO BIRD SOUNDS)_____+2
- Water features of all size attract creatures.
- All water features, even fountains simulate nature.

(16) IMPORTANT BECAUSE OF THEIR ECONOMIC BENEFIT TO URBAN TOURISM_____-3
- In Amman water features are not a tourist attraction. They need development before they can be suitable for this purpose.
- Not applicable in Amman, tourists go to archeological sites and urban amenities.
- In Amman streams are not important for tourism - not an attraction. Tourists will not enjoy the streams here. They should be for locals.

(23) IMPORTANT BECAUSE THEY REPRESENT THE LOACL IDENTITY_____-1
- Perhaps sand represents Amman's local identity better than streams.
- Amman's identity is based on water scarcity, not abundance. When people think about Jordan's water features they think outside Amman, like the Dead Sea.
- Streams in Amman do not represent the local identity. The Seil used to be the main water body that people identified with, but now no. Only reminder of the Seil is the mosaic design at the Hashemite Plaza.

(24) IMPORTANT FOR FUTURE GENERATIONS TO ENJOY_____+4

- Participants agreed that water features are important for future generations, but they fear that they are too polluted to make a difference.
- Participants said they worry extensively about their children. They also said that they strongly worry about the future over the present.
- Streams/ water features are important for future generations - we must protect them.
- Participants are uncertain and fearful about the future, especially because of climate change.
