**Ecosystem Type: LAKES AND PONDS**

**Category: Clean and Plentiful Waters**

1. **Materials**

***Supplier*** – Lakes and ponds supply materials to support clean and plentiful waters. In fact, lakes supply about 87% of the world’s available surface freshwater (Gleick, 1996). These ecosystems have reservoirs that retain water by intercepting rainfall and runoff (Ludwig, Tongway, and Marsden, 1994; Bonnet et al., 2008). They also have floodplains that absorb river flooding (Bonnet et al., 2008).

***Driver*** – The quality of water and habitat that lakes provide to supply clean and plentiful waters is influenced by changes with chemical and physical inputs (i.e., runoff, precipitation). For example, impervious surfaces can have a negative impact on the lake’s overall water quality. One study found that the nutrient flux in Lake Tahoe increased greatly over the last 50 years since the surrounding community urbanized and converted land (Schuster and Grismer, 2004). This has increased algal production in the lake, affecting the quality of the available water.

***Demander*** – Many users depend on the availability of clean and plentiful waters supplied by lakes and ponds including those within agricultural, domestic, and industrial sectors (Bronmark and Hansson, 2002). In fact, lakes supply about 87% of the world’s surface freshwater (Gleick, 1996). Of these sectors, agriculture has the largest use of freshwater resources for food production (Calzadilla, Rehdanz, and Tol, 2010). In addition, a study in 2005 indicated that thermoelectric-power generation had the second highest use of water—about 201 billion gallons per day (Kenny et al, 2009).

1. **Nutrition**

***Supplier*** – not applicable

***Driver*** -not applicable

***Demander*** - not applicable

1. **Energy**

***Supplier*** – not applicable

***Driver*** – not applicable

***Demander*** – There is a demand for plentiful waters to supply energy, particularly for thermoelectric power generation. In 2005, thermoelectric power accounted for almost 41 percent of all freshwater withdrawals (Kenny et al, 2009). Further, the Great Lakes region identified in 2007 that 75 percent of water used for thermoelectric production came from the surface waters of the Great Lakes (Tidwell and Moreland, 2011). This equates to a withdrawal of 25.8 billion gallons per day from these major freshwater resources, which also accounted for 81 percent of total withdrawals from the Great Lakes (Tidwell and Moreland, 2011).

1. **Mediation of Waste, Toxics, and Other Nuisances**

***Supplier*** – Lakes can help maintain connected downstream waterways because they have the ability to intercept and trap sediment wastes (Cereghino et al., 2008). These sediments may carry with them toxics like chemicals (Arain et al., 2008), by-products of manufacturing wastes (Czuczwa, Niessen, and Hies, 1985), or bacteria (Gachter, Meyer, and Mares, 1988). One study found that by-products from combustion was a major source of pollutants trapped on lake sediments (Czuczwa, Niessen, and Hies, 1985).

***Driver*** – The ability for lakes and ponds to retain water to mediate wastes from entering downstream waterways is affected by changes in water use and adjacent land cover. For example, impervious surfaces can intensify the effects of greater storm events, such as increasing runoff rates. Higher discharge into lakes can lead to a decrease in the overall residence time for sediments flowing into the reservoir (Verstraeten and Poesen, 2000). A shorter residence time limits the lake or pond’s ability to capture and trap these wastes from flowing into adjacent waterways. On the other hand, a decrease in water supply within these reservoirs--due to excessive human consumption or droughts--can lead to minimal flushing of bacteria and wastes out of these ecosystems (Paerl, Hall, and Calandrino, 2011), impacting the cleanliness of these waters.

***Demander*** – not applicable

1. **Mediation of Flows**

***Supplier*** – Lakes and ponds support clean and plentiful waters because they help to mediate the flow of water, sediments, and wastes. Lakes supply about 87% of the world’s surface freshwater available for use (Gleick, 1996). One reason these ecosystems account for this large supply is because of their ability to intercept and retain rainfall and runoff. Further, lakes can trap sediments that are produced in these runoff events (Kling, Kipphut, and Miller, 1991), which helps regulate downstream water quality.

***Driver*** – The ability for lakes and ponds to retain water and mitigate the flow of sediment into downstream waterways is affected by changes in water use and adjacent land cover. For example, impervious surfaces can have a negative impact on the lake’s overall water quality. Higher discharge into lakes reduces the effectiveness these ecosystems have for capturing wastes. One study found that intensified discharge may lead to a decrease in the overall residence time for sediments flowing into the reservoir (Verstraeten and Poesen, 2000).

***Demander*** – not applicable

1. **Maintenance of Physical, Chemical, and Biological Indicators**

***Supplier*** – Lakes help to maintain the water quality of downstream waterways because they are able to maintain the physical, chemical, and biological habitat due to their ability to adsorb nutrients by sediments and aquatic species. In other words, these ecosystems act as a sink for nutrient interception (Cereghino et al., 2008). Common nutrients that lakes retain are carbon, nitrogen, and phosphorous (Gachter, Meyer, and Mares, 1988; Kling, Kipphut, and Miller, 1991). This occurs because microorganisms that settle on lake sediments will fix and transform these nutrients.

***Driver*** – Excess fertilizer and manure use can negatively impact the ability of lakes and ponds to maintain the physical, chemical, and biological structure of water supplies to support clean and plentiful waters. These fertilizers can cause toxic algal blooms, which leads to a loss of oxygen resulting in the death of fish and other aquatic species (Carpenter et al., 1998).

***Demander*** – not applicable

1. **Spiritual, Symbolic, Religious, and Social Experiences**

***Supplier*** – Lakes and ponds supply clean and plentiful waters that support spiritual and social experiences (Klessig, 2001). For example, lakes are often enjoyed by tourists (Cooper, 2006) because they supply a reservoir for boating and swimming activities.

***Driver*** – Excess fertilizer and manure use can negatively impact the ability of lakes and ponds to maintain the physical structure of the water to support social and spiritual activities. These fertilizers can cause toxic algal blooms (Carpenter et al., 1998), making the reservoir unusable for social activities like swimming, fishing, and boating or extracted for spiritual activities.

***Demander*** – not applicable

1. **Physical and Intellectual Interactions w/ Biota, Ecosystems, and Land/Seascapes**

***Supplier*** – When the water supplied by the lakes are clean, people can use this resource for activities like swimming and boating (Lindeberg and Albercook, 2000). They can also be enjoyed along hiking trails or near properties (Gonzalez-Abraham et al., 2007).

***Driver*** – The ability for lakes and ponds to retain water in order for physical interactions to occur can be affected by changes in water use and adjacent land cover. For example, a decrease in water supply within these reservoirs--due to excessive human consumption or droughts--can lead to higher concentrations of bacterial counts and wastes (Paerl, Hall, and Calandrino, 2011), impacting the cleanliness of these waters. This can prevent users from entering the reservoir out of concern for public health.

***Demander*** - not applicable

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