A Corporate Water Footprint

Deckers Outdoor Corporation

A Group Project submitted in partial satisfaction of the requirements for the degree of Master's in Environmental Science and Management for the Bren School of Environmental Science and Management

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The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) Program. It is a three-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Final Group Project Report is authored by MESM students and has been reviewed and approved by:

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Abstract

Quantifying the water footprint of a corporation's global supply chain is a new and challenging undertaking. Water footprinting is a concept that has mainly been applied to individual products, such as one t-shirt, or entire countries. Instead, this project considers water consumption across Deckers Outdoor Corporation's (Deckers) global supply chain, including cows and sheep raised for leather, product assembly factories in Asia, retail stores, and offices. Headquartered in Santa Barbara, Deckers is a footwear and apparel company with several prominent brands including UGG and Teva. Deckers requested that our team calculate the corporation's annual water consumption, the associated environmental impacts of that water consumption, and how they might reduce their water footprint. Since corporate water foot printing is so new, accepted approaches, system boundaries, and definitions are still being developed. DeckersWater designed an approach that is accurate and easy to use for corporations seeking to establish a baseline water footprint and identify key areas for improvement. A key methodological innovation is our inclusion of water consumed directly in the generation of electricity used throughout Deckers' supply chain. We use the Water Stress Index to examine the impact of Deckers' activities in countries experiencing water-stress, as well as forecasted business risks due to projected future water stress. Recommendations for Deckers to reduce both their total amount of water consumption and their impact on water-stressed countries are framed within the context of Deckers' relative control over their supply chain vendors.

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“Leave footprints, the good kind.”

deckers

OUTDOOR CORPORATION

Executive Summary

Deckers Outdoor Corporation (Deckers), the parent company to several prominent footwear brands including UGG and Teva, requested that our team (DeckersWater) calculate the corporation's 2010 water consumption, the associated environmental impacts of that water consumption, and how they might reduce their water footprint. Because corporate water footprinting is a relatively new practice, accepted approaches, system boundaries, and definitions are still being developed. Thus, DeckersWater designed an approach that is accurate and easy to use for corporations seeking to establish a baseline water footprint and identify key areas for improvement. We used this methodology to assess Deckers' 2010 water consumption.

Water footprinting is a relatively new concept, first appearing in the academic literature in 2002. The concept has mainly been used to examine water consumption of individual products, such as a t-shirt or a single beverage, or entire countries. Recently, a number of corporations have performed more exhaustive company-wide water footprints, but system boundaries, levels of disclosure, term definitions, and methodologies have varied widely. Our methods and system boundaries are clearly delineated, and justifications are decidedly transparent in order to enable replication or modification of our methods by other corporations.

A water footprint includes an inventory or accounting of evaporative water consumption, an assessment of the environmental impacts associated with that water consumption, and recommendations. Our approach focuses specifically on evaporative blue water consumption, or water consumed through evaporation throughout Deckers' supply chain from freshwater sources such as rivers, lakes and reservoirs.

DeckersWater aims to make a contribution to the water footprinting community through our novel system boundary approach. We differ from most of the water footprinting community in that we include water consumed in the direct generation of electricity, and exclude measures of gray and green water. Electricity generation can be very water intensive; thus, we believe that an accurate water footprint must attribute the water consumption to the corporation for which that electricity is generated. Green water is a measure of rainwater, which we exclude because rain will fall and be evapo-transpired irrespective of whether "natural" or farmed vegetation is present. Green water reflects natural water cycle activity; it does not reflect human activity, which is the purpose of conducting a footprint of any kind. Gray water is a measure of the water required to dilute pollutants to "ambient standards." We exclude gray water from our study for a number of reasons. The most important reason being that the majority of biologically and chemically based waste water treatments do not use dilution and therefore the gray water measure can artificially inflate a water footprint.

We examined blue water evaporative consumption (direct water) and the water consumed in direct generation of electricity (electricity water) in each stage of Deckers' supply chain. In the first supply chain stage, material production, our water consumption estimate includes water consumed for feed production, animal processing and slaughter, as well as material processing and tanning. Material production is followed by product assembly in industrial factories in China and Vietnam and offices, stores and distribution centers (Deckers facilities) in North America, Europe and Asia.

Deckers' estimated water footprint for 2010 was approximately 4.3 million cubic meters. 55 percent of that footprint is attributable to material production, 41 percent to product assembly, and 4 percent to Deckers facilities. Additionally, the breakdown by direct water and electricity water is 53 and 47 percent, respectively. A more tangible way of representing these data is the water consumed per pair of shoes. Based on the style of shoe provided by the client as representative of the brand, we estimate a pair of UGG boots consumes approximately 230 liters of water whereas a pair of Teva shoes consumes approximately 380 liters of water. This disparity is due in large part to the high water consumption on average per ton of cowhide in comparison to sheepskin during the material production stage.

One of the challenges with water footprinting, in general, is quantifying the environmental impacts of water consumption as they relate to the entity for which the water footprint is being calculated. This challenge is a consequence of the end product of a water footprint – water footprinting studies yield one global number but water consumption impacts are generally localized. Nevertheless, we were able to provide some insights on impacts by using the Water Stress Index to illustrate how much of Deckers' supply chain activities are impacting countries already experiencing water stress (water use to water availability). Approximately 83 percent of Deckers' estimated consumption occurs in countries experiencing 'medium' water-stress (mainly China). Future projections based on hydrological, climate change and population growth models suggest that all of Deckers' estimated material sourcing countries will be water-stressed by 2025. Water stress may also become a more serious business risk in the future as regulatory pressures, water demands, and investor concern surrounding water related business risks escalate.

Recommendations for Deckers to reduce both their total amount of water consumption and their impact on water-stressed countries are framed within the context of Deckers' relative control over their supply chain vendors. Supply chain scenario analyses are a useful tool with which to target areas for improvement. For example, reducing electricity by 10 percent in the product assembly stage would reduce the total footprint by approximately 4 percent, whereas the same reduction at Deckers facilities would only reduce the total footprint by approximately 0.4 percent. This difference reflects the variance in water consumption at the supply chain stages. Further, changing which countries Deckers sources their raw materials from is another way to reduce their water footprint. However, our model suggests that in certain scenarios, there could be an inadvertent tradeoff between reducing the total water footprint number and shifting material sourcing or company operations to countries with low water stress.

Reducing electricity and direct water consumption at early supply chain stages will have a higher overall impact on Deckers' water footprint. With this in mind, we have provided Deckers with a data collection survey that can be used at any level of the supply chain, and provided a number of key recommendations. Key recommendations include continuing to build relationships with suppliers directly and through industry groups, investing in energy efficiency, conducting business in low to medium water stress regions with clear energy and water efficiency goals, and continuing to monitor water consumption.

Glossary

Key Definitions

Blue Water - Fresh water withdrawn from fresh water bodies (ground & surface)

Cowhide Leather - Varied grades of cow derived leather

Deckers - Deckers Outdoor Corporation

Deckers Facilities - Offices, stores and distribution centers used for company operations

DeckersWater - The Bren School team that conducted this study

Direct Water - Evaporative blue water consumption resulting from supply chain activities

Electricity Water - Direct evaporative blue water consumption resulting from electricity generation

Evaporative Consumption - Water that is withdrawn from a water body and then evaporated by human activity, including direct heating, irrigation that leads to evaporation, thermal power generation, and increases in evaporative rates

Gray Water - Water used to dilute pollutants to "ambient standards"

Green Water - Rainwater

Natural Materials (for Deckers) - Cowhide leather, sheepskin leather and natural rubber

Sheepskin Leather - Twinface Grade A sheepskin

Synthetic Materials (for Deckers) - Ethylene vinyl acetate (EVA) and synthetic rubber

Water Availability - Total available liquid fresh water generated by the natural environment

Water Use - Water withdrawn for agricultural, industrial and domestic/municipal purposes

Water Footprint - An accounting or inventory of evaporative blue water consumption in a corporate supply chain followed by an assessment of the environmental impacts of that inventory and recommendations for inventory reduction.

Water Stress - Lack of blue water availability where and when it is needed

Water Stress Index - A measure of water stress; Water use / water availability

Acronyms Guide

ArcGIS - Geographic Information Systems Software

BOD - biological oxygen demand

CDP - Carbon Disclosure Project

COD - chemical oxygen demand

DOE - United States Department of Energy

DWI - direct Water Inventory

EVA - ethylene vinyl acetate

EWI - electricity water inventory

FAO - United Nations Food and Agriculture Organization

kg - kilogram

LCA - Life-cycle Assessment

m - meter

TWI - total water inventory

WEF - World Economic Forum

WF - water footprint

WFN - Water Footprint Network

WSI - water stress index

Objectives

DeckersWater set out to answer the following questions:

- How much water does Deckers consume in one year?
- What can be gained by reducing that water consumption?
- How can water consumption be reduced?

To address these questions, we identified the following objectives:

- Design a company-wide water footprint assessment methodology that is rigorous and useful.
- Implement the water footprint assessment methodology to provide Deckers with a 2010 baseline measure of water consumption.
- Assess the environmental impacts of Deckers consumptive water use.
- Recommend practical and measurable water consumption reduction methods.

Project Significance

Fresh water is a critical resource. Only 3 percent of the earth's water is fresh water, and just 30 percent of that fresh water is potentially available for human use (figure 1). While fresh water is a renewable resource, communities and companies around the world have faced shortages of clean fresh water when and where they need it in recent years due to growing population, economic development and climate change (CDP 2010; Orr et al 2009). According to recent estimates, 1 billion people in developing nations lack access to safe drinking water, and over 2 billion people lack sufficient water for sanitation purposes (Bartram, 2008).

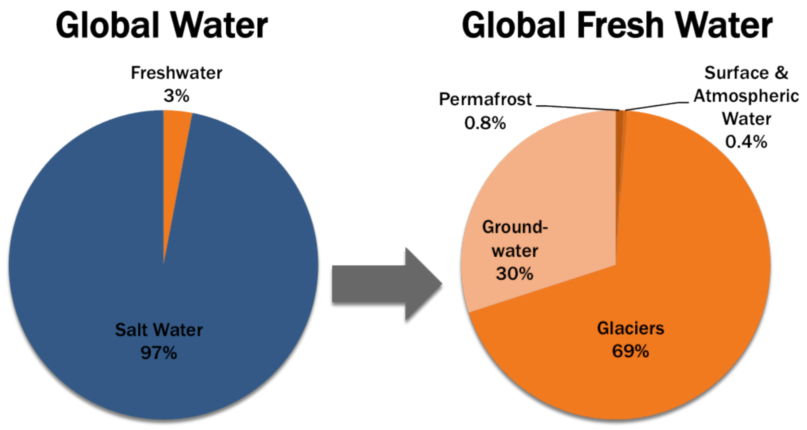

Figure 1: Approximately 3 percent of the earth's water is fresh water. Of that fresh water, only 30 percent is potentially available for human use in the form of ground or surface water.

Global fresh water demand is projected to increase due to population and industrial growth, while groundwater supplies are being depleted at an unsustainable rate (Barton et al 2010). Furthermore, rain patterns are predicted to change with global warming; in general, wet places will get wetter while dry places will get drier (Barton et al 2010). Due to these changes, global fresh water availability is projected to be 40 percent less than fresh water demand by 2030 (Barton et al 2010).

While water footprinting is a relatively new approach, it is a useful tool that a corporation can use to understand their water consumption, water-related environmental impacts, and related business risks (Barton et al 2010). Businesses depend on water for everything from material production (e.g.. growing cotton for use in material), to landscaping at facilities, to electricity generation. Companies like Deckers can become industry leaders by designing and utilizing clear and accurate water footprinting approaches.

Water footprinting techniques have been changing since the concept was first introduced in the literature in 2002 (Hoekstra 2008), and are becoming an increasingly popular way for organizations to better understand and quantify their impacts on freshwater quantity (Morikawa et al 2007). However, streamlined methods and approaches are still being developed, and system boundaries vary widely (Ridoutt et al 2009; Morikawa et al 2007; Barton et al 2010).

The Pacific Institute's review of corporate water reporting across 11 industries found that water reporting in corporate social responsibility reports is inconsistent across industrial sectors. Even within the same sector, reporting methods vary substantially. Several definitions and scoping boundaries are used to report both blue water consumption and wastewater information, resulting in inadequate benchmarking and difficulty in making comparisons across companies. Additionally, even though regional vulnerabilities are acknowledged in the reports, site-specific information is left out of site or facility water performance. This information appears to be consistent with our findings – the tools and infrastructure required to adequately and accurately report water information is not in place. Facilities may have a general if not precise measure of water withdraw through utility bills, but do not measure outflow in order to determine consumption. (Morikawa et al 2007)

In the five years since the release of the study by the Pacific institute, few advances have been made in the industry to standardize water reporting, which poses challenges for companies in the early stages of the process, especially when attempting to examine the entire corporate supply chain. The aim of this study is to provide one informed attempt to address these gaps by clearly defining terms and justifying system boundary choices in a way that can be easily emulated by other companies.

As part of this defining process, DeckersWater has adopted three key approaches that are unique within the water footprinting community. This is the first published water footprint of which we are aware that includes water used directly in the generation of electricity. This study is also on the cutting edge in that we examine the entire supply chain of a corporation, instead of that of one product or one country. Finally, we exclude both green (rainwater) and gray water (water used to dilute pollutants to "ambient standards") from our study, which we believe artificially inflate a footprint.

Background

Deckers Outdoor Corporation

Deckers Outdoor Corporation (Deckers) was started in 1973 by Doug Otto. He began making and selling sandals when he was a student at University of California, Santa Barbara (Deckers Outdoor Corporation 2012). Since then, Deckers has become the parent company to several shoe brands; current brands include UGG, Teva, Sanuk, Mozo, Ahnu, and Tsubo (Deckers Outdoor Corporation 2012)[1]. In 2010, the year of our study, Deckers net sales were over $1 billion, which demonstrates an almost 20 percent growth over the previous year and over 50 percent growth over 2007 (Deckers Outdoor Corporation 2012). By comparison, Nike's 2010 net sales were approximately $19 billion (Nike 2010) and Puma's were approximately $3 billion (Puma 2010). While Deckers is the parent company to several brands, in 2010 UGG represented 87 percent of net sales and Teva represented 10 percent (Deckers 2010). Like many footwear companies, Deckers brands are branching out into apparel and other accessories, but their product base is still dominated by footwear (Deckers Outdoor Corporation 2012).

Deckers is a global company, with headquarters in Santa Barbara, California. The company uses product assembly factories in China and Vietnam, and sources materials from around the world. Deckers' operates offices, stores and distribution centers (Deckers facilities) in China, Japan, Russia, North America and Europe. See Appendix 1 for a detailed list of locations and map of Deckers Facilities. (Deckers 2010) (Figure 2)

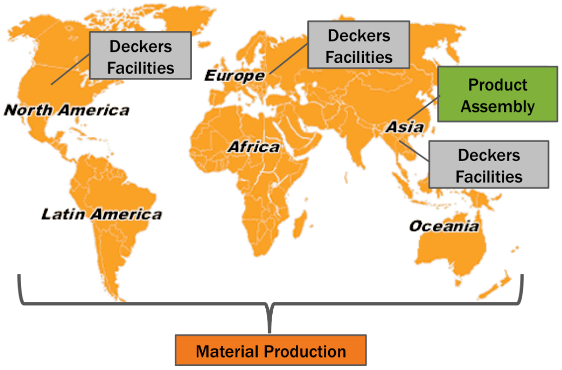

Figure 2: *This map demonstrates Deckers' worldwide scope*

Deckers is committed to the environment and lowering their environmental impact, but because they have grown so quickly, they don't yet have a comprehensive quantified understanding of their environmental impact. Thus, Deckers is gathering baseline data on their carbon, water and other environmental impacts in order to set clear and reasonable environmental goals. They requested this water footprint as a part of that effort. (Deckers pers comm 2011)

Deckers' Chairman and CEO, Angel Martinez states:

> *We provide our employees with the tools and resources they need to understand our impact on the environment and how we can reduce our impact over time. The result of [this] is a deep commitment to the environment, to human rights and to corporate responsibility that are at the core of our values. Our progress is not over; our work does not end. We continue to seek still better ways to promote environmental*

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[1] Image from Deckers.com

> *responsibility, to encourage environmentally friendly technologies and to respect internationally recognized human rights.* (Deckers Outdoor Corporation 2012)

Business Risk

Water-related business risks fall into four categories: physical, allocation, public perception and direct financial. The physical water risk companies face is the potential for too little water when and where it is needed (Barton et al 2010). Allocation risk is similar, but the access to water is restricted by regulations rather than the whims of nature (Barton et al 2010). Public perception of how a corporation addresses water scarcity has potential reputational repercussions in the future as scarcity increases (Barton et al 2010). While physical, allocation, and public perception risks have potential to affect a corporation's bottom line, direct financial risks stemming from water unavailability have upfront costs. Potential financial risks include higher energy prices, higher insurance and credit costs, and higher material costs (Orr et al 2009).

China has already faced a number of water-related business challenges. Widespread droughts have hurt agricultural sectors (CDP 2010). For example, in spring of 2011, cotton futures prices in New York doubled within one year as a result of droughts in China, causing Gap, Inc. to cut its full-year profit forecast by 22 percent. These cotton costs were also a major driver of a 36 percent decline in that quarter's net income for Polo Ralph Lauren Corporation (Roy 2011).

Water availability risk has not historically been measured by businesses, but has become a more serious part of the corporate risk assessment in the past few years. Leading business publications such as Harvard Business Review (Lubber 2009) and Bloomberg (Winston & Wales 2012) advocate the inclusion of water consumption impacts and related risks in corporate strategic planning, particularly in the face of climate change. In 2010, Ceres, a national coalition of investors and environmental groups, partnered with an investment Research firm (UBS) and Bloomberg to examine water related business risk among 100 companies (Barton et al 2010). In the same year, the Carbon Disclosure Project conducted a similar study with signatories representing 137 financial institutions with assets over $16 trillion (CDP 2010). These studies indicate growing interest of investors in water related business risk, especially amongst the Socially Responsible Investing community.

The Carbon Disclosure Project surveyed 150 international companies. The study revealed that 39 percent of respondents had "already experienced negative water-related impacts," including higher treatment costs to meet water quality regulatory standards, increased competition for water resources, and increased raw material costs. 89 percent of responding companies have developed specific water policies, strategies, and plans, while 60 percent have set water related environmental performance goals. (CDP 2010)

Water stress and the related business risks are projected to worsen in top raw material producing and manufacturing regions (Barton et al 2010; WEF 2009; Orr et al 2009). Thus, access to fresh water when and where it is needed will be a growing challenge businesses face in coming years (Barton et al 2010; WEF 2009; Orr et al 2009).

Water Footprint Approaches

Water Footprint Overview

Water footprinting is a relatively new discipline; the concept was first introduced in academic literature in 2002 as an outgrowth from other ecological footprinting (Hoekstra 2008). The earliest publications focused on the footprints of countries, and defining the concept of *virtual* *water*, or the water used abroad to create all of the products a given country uses (Hoekstra & Hung 2002). As water footprinting researchers continued to examine regional water consumption (for example, Hoekstra & Hung 2002, Mekonnen & Hoekstra 2011), they also branched out to the footprints of individual products. A sampling of individual product water footprints include Spanish tomatoes (Chapagain & Orr 2009), soda (Ercin et al 2010), peanut m&m's® (Ridoutt et al 2009) and a Patagonia cotton t-shirt (Patagonia 2012).

Water Footprint Network

The Water Footprint Network (WFN) has been a leader in the defining concepts behind water footprinting, and their methods are consistently referenced in the water footprint literature, even when methods stray from the guidelines (for example, SABMiller 2009, Hampton et al 2011). Members of this group wrote the first publications on water footprinting, and to this day its members publish a significant volume of the water footprint literature (Hoekstra 2008; WFN 2012). Thus, it is valuable to briefly examine WFN's approach.

The *Water Footprint Manual* was published by WFN in 2011 as a guide to the practice of water footprinting. A water footprint is defined by this publication as a "volumetric measure of the severity of water consumption and pollution"—volume of water per unit of time for processes, volume of water per product unit for products, and volume of water per monetary unit for businesses. (Hoekstra et al 2011)

Water use is divided into two categories: consumptive and non-consumptive. According to *The Water Footprint Manual*, consumptive use of blue water (fresh water taken from surface our ground water) includes all water incorporated into the product, evaporated, returned to the catchment area during a different time period from which it was withdrawn (i.e., withdrawing water in the dry season and returning it in the rainy season), and/or returning the water to a different catchment area from which it was withdrawn or to the ocean. Simply put, consumptive use of blue water removes water from the environment and does not return it efficiently to the environment, whereas non-consumptive use of blue water removes water from the environment and then efficiently returns it to the environment having not significantly changed the quality of the water. Only consumptive water use is included in a water footprint. (Hoekstra et al 2011)

While exact definitions of *consumptive* vary among water footprint practitioners, all water footprints measure only consumptive water use. WFN consumptive water measurements do not include the direct water attributable to electricity generation.

Fresh water consumption then falls into three categories: green, blue and gray. Green water is composed of rainwater that does not become runoff. Blue water is water taken from surface or groundwater. Gray water is the volume of water used to "assimilate" pollutants to background concentrations and existing water quality standard levels. (Hoekstra et al 2011)

A water footprint assessment is a process that consists of four distinct, but interdependent phases: (i) goal and scope section (ii) accounting (iii) sustainability assessment, and (iv) response formation (Figure 3).

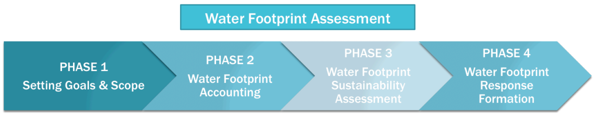


Figure 3: *The full WFN water footprint assessment is comprised of four consecutive phases.*

The accounting phase is where data are collected and accounting takes place, and the sustainability assessment is how the environmental impacts of the footprint are measured. (Hoekstra et al 2011)

Corporate Water Footprints

Water footprints focusing on the entire corporation supply chain have only begun to be published in the past few years, fueled by a need to assess water consumption in the context of business risk (Barton et al 2011).

For example, recent water footprint publications focusing on entire corporations include SABMiller in 2009 (SABMiller 2009), Puma in 2010 (PPR 2010), Nestle in 2011 (Nestle Waters 2011), and Del Monte Foods (Del Monte 2012). These footprints are not published in peer reviewed publications, but instead are published on corporate websites. This is an excellent step in the right direction in increasing transparency of corporate operations to the public, but the lack of water reporting standards in the industry poses challenges in comparing corporate performance as well as assessing methodology accuracy. Reports share varying levels of detail and use widely varied methods and system boundaries (Morikawa et al 2007). For example, Del Monte Foods only publishes final results without outlining methodology (Del Monte 2012), whereas Nestle has published a detailed report (Nestle Waters 2011). This variance in reporting makes it difficult for environmentally minded investors or the public to make informed decisions.

It is useful to examine the practices of Deckers' closest competitors. A number of shoe manufacturers have not addressed the issue of water consumption, or are not reporting their studies publicly. However, two key competitors, Nike and Puma, have published their water consumption research.

Nike's water program was created in 2001 to address localized water quality impact primarily in the textile industry (Nike Inc. 2012). Nike recently expanded this program to include volumetric measures of water use across the entire supply chain (including footwear) and now collects specific production and water use data. Nike is beginning to develop metrics to critically evaluate water use and improve water management focusing on "borrowing water responsibly and returning it clean to communities" (Nike Inc. 2012). As Nike continues to improve their water measurement tools, the company plans to share these tools with the industry and encourage their use across all applicable industries (NIKE Inc. 2009). While Nike appears to be making great strides in developing tools for corporate water reporting, it is still unclear how the company defines water *consumption* and where they have drawn their system boundaries. For example, it is unclear whether water consumption due to electricity generation was included in their study.

PUMA has also been collecting key environmental performance data, including water usage since 2005, and is currently in the process of improving the accuracy of their company-wide water footprint. However, their definition of consumption is also unclear and while system boundaries reportedly include material production, statements within the same report claim that water consumed in the growth of natural materials is excluded. As far as we can tell, water consumption directly attributable to electricity generation is excluded from PUMA's company-wide water footprint. (PUMA 2010)

Though both Nike and PUMA have taken steps towards measuring and reporting water data, their approaches are representative of the inconsistencies in the broader practice of company-wide water footprinting. Specific methodologies for water measurements are not reported and blue, green, and gray water terms are not used. Furthermore, when terms such as *consumption* are used, they are either not defined, or defined unclearly. As these companies begin to analyze and collect more data, company-wide water footprinting methodologies will need to become more standardized with clear key performance indicators if the goal is to compare the performance of corporations.

Since corporate water footprinting is a relatively new concept, several corporations have not physically measured their water footprints, but are still taking steps towards reducing fresh water impacts. Timberland and Target, for example, are working to reduce their fresh water impacts by upgrading machinery and appliances, installing water-recycling systems, planting more water efficient landscaping, and reducing electricity use. However, without first determining a baseline of water consumption and water quality impacts, the success of these efforts cannot effectively be measured. Continued water stewardship by leading corporations such as Deckers, Nike, and Puma will provide preliminary models to be improved upon as more corporations begin to incorporate water consumption in to Corporate Sustainability Planning.

Pollution and Water Footprinting

Supply Chain Pollution

Corporations impact water resources in two key ways: withdrawal (consumption and diversion) and pollution. Both actions have negative ecological impacts, but those impacts are quite different (Chapagain et al 2006). While the DeckersWater footprint is solely focused on measuring water consumption, Deckers and similar organizations often aim to reduce their pollution loads (WEF 2009). For footwear and apparel, most water quality impacts discussed below occur during material production, whereas impacts from water consumption can be found across all stages of the corporate supply chain (Morrison et al 2009; Bass et al 2010).

At the agricultural phase of material production, water pollution generally occurs as applied fertilizers and pesticides are leeched into water runoff. For example, high concentrations of nitrogen and phosphorus that often run off of agricultural lands into fresh water bodies lead to algal blooms. These blooms change the chemistry of fresh water, which often alters food webs, negatively affects wild fish populations, and increases the cost and energy requirements of water purification (Smith et al 1999; Chapagain et al 2006; Paerl 2009; Howarth et al 2011).

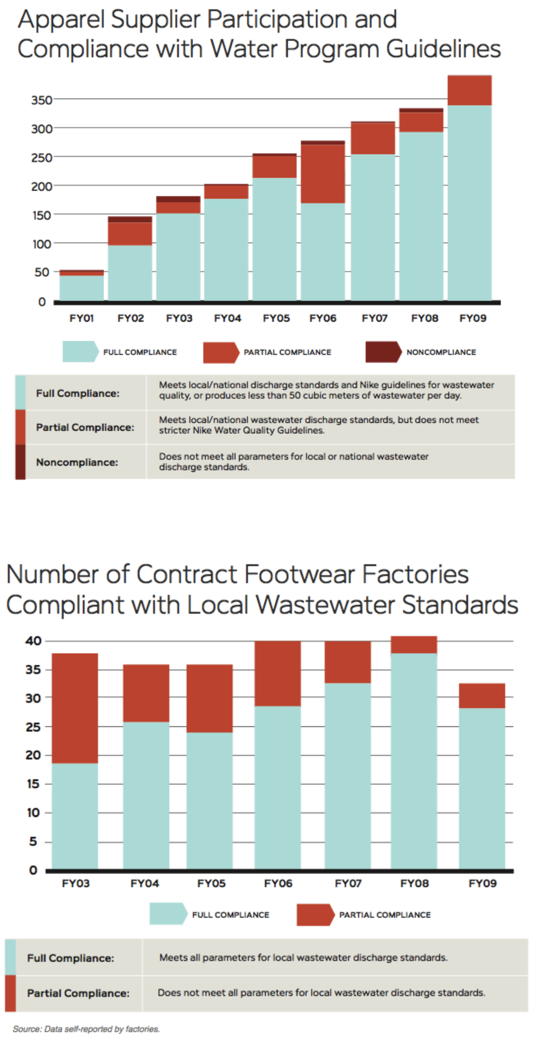
Similarly, the tanning and industrial phases of material production may result in waste flows that contain high nutrient loads and toxic pollutants, if the industrial discharges are not treated (Chapagain et al 2006).

Competitors' Approach to Pollution

While many water footprinting guides suggest companies should measure gray water, a review of current Corporate Sustainability and water footprint reports by DeckersWater revealed that few companies are addressing pollution in terms of volume of gray water. This is not to say that corporations are necessarily ignoring pollution, but that they are taking a different approach.

Again, while a number of Deckers' competitors are not addressing their pollution loads or not reporting their findings, Nike and Puma are addressing pollution in ways that may be useful to Deckers.

Nike is working transparently with others in the industry to establish a program that encourages suppliers' adherence to high water quality standards for all of their production. This program includes the most water-intensive facilities, including textile mills, dyeing and finishing facilities, and vertically integrated factories. The Nike Water Program guidelines for standard water quality indicators such as pH, BOD, COD, total suspended solids, and color, were developed with Business for Social Responsibility's Sustainable Water Group. Rather than moving production elsewhere, Nike's strategy is to work with suppliers to achieve continuous improvements. Therefore, partially compliant suppliers are encouraged to take steps to improve wastewater quality beyond what's required by local regulations. In 2009, the Water Program introduced a web-based reporting system to make enrollment and participation more convenient for suppliers. This system collects production, water use, discharge, and wastewater quality data for evaluation against the NIKE Water Program guidelines and the locally regulated environmental standards. Supplier engagement has grown, but there is still a significant level of noncompliance. Water quality standards exist, but still serve more as a goal than as a minimum requirement (Figure 4). (Nike Inc. 2009)



Full Compliance:	Meets local/national discharge standards and Nike guidelines for wastewater quality, or produces less than 50 cubic meters of wastewater per day.
Partial Compliance:	Meets local/national wastewater discharge standards, but does not meet stricter Nike Water Quality Guidelines.
Noncompliance:	Does not meet all parameters for local or national wastewater discharge standards.

Full Compliance:	Meets all parameters for local wastewater discharge standards.
Partial Compliance:	Does not meet all parameters for local wastewater discharge standards.

Source: Data self-reported by factories.

Figure 4: *Compliance with water quality standards by Nike's contracted footwear factories (Nike Inc. 2009)*

Puma thus far has taken a less quantitative approach; they reward subsidiaries for outstanding environmental performance. Each year the PUMA subsidiary with the best environmental performance is given the PUMA Safe Award. This program is a quite preliminary step toward encouraging and supporting good environmental practices. Puma's future water reduction goals target supplier factories and logistics partners. They currently work with several "data collection models" to ensure that "accurate data are collected" from external factories and service partners, but detailed information on which models or how they are used are not publicly available. Much of the work Puma has done is reported in general terms. (PUMA 2010)

In recent years, leather products have increasingly become the focus of environmental impact studies. Tannery effluents rank among the highest pollutants of industrial wastes, in part due to high chromium concentrations (Belay 2010, Altaf et al 2008). See Appendix 2 for detailed examination of leather tanning processes and the types of pollution these processes introduce to the aquatic environment).

Water Stress

Volumes of water consumed may or may not have significant environmental impacts depending on where that water is consumed. For example, 1,000 m^3 of water consumed in the tropics may have little to no environmental impact while that same volume of water could be harmful to plant and animal life when consumed in the desert. Thus, a tool to examine the impacts of water consumption on a regional scale is useful. In this project, we use the concept of *water stress*, formally introduced by Vorosmarty (2000) and expanded upon by Pfister and colleagues (2009). Water stress is a measure of water use to water availability; that is, the higher the amount of freshwater use relative to freshwater availability, the more stressed water resources in a region will be (Vorosmarty 2000). Ridoutt and Pfister (2010) expand this model by introducing modeling of future water stress. In relation to corporate water footprinting, this tool may prove to be especially useful in assessing business risks of changing water supplies now and in the future. The resolution of this approach ranges from regional to continent levels.

Images from Jessica Heyman

Image from Deckers

DeckersWater Scope & System Boundaries

Approach

Deckers requested a company-wide water footprint, but with no clearly successful and transparent company-wide footprints to emulate, and little access to prior records from the client, we faced the challenge of designing a water footprint methodology for Deckers that is feasible, accurate, and comprehensive.

Our water footprint is an accounting or inventory of water consumption combined with an assessment of the environmental impacts of that water consumption and suggestions for improvement. Thus, DeckersWater is in line with similar corporate water footprints, as well as academic studies of water footprinting. However, this study focuses specifically on blue water evaporative consumption, excluding green and gray water measurements for reasons discussed below. Blue water, or fresh water, is considered diverted when it is returned to the same watershed, and consumed when it is drained into a different watershed, drained into the ocean, incorporated into the product, or evaporated. This study focuses only on the blue water consumption over which we perceive Deckers has influence: blue water that is evaporatively consumed in processes throughout Deckers' supply chain. (Figure 5)

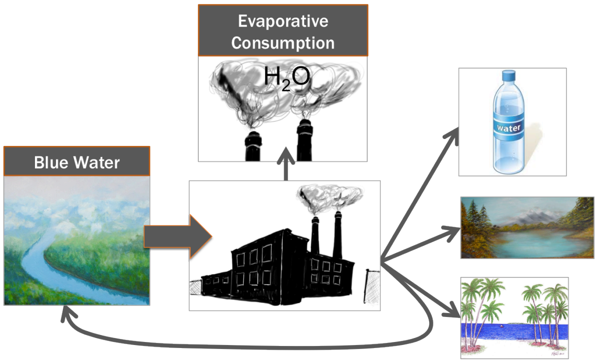


Figure 5: *While blue water that is withdrawn from a watershed can be consumed in a number of ways, this study focuses in the consumption over which Deckers has direct influence: evaporative consumption.*

Blue water evaporative consumption occurs in the following ways:

- Direct Water
    - Direct heating of water
    - Evaporation through irrigated plants
- Electricity Water
    - Water directly evaporated in thermal power generation
    - Increased water evaporation from reservoirs

We focus on three out of the four key stages of Deckers' supply chain: material production, product assembly and Deckers facilities (offices, stores and distribution centers). Direct water and electricity water are measured at each of these levels. Consumer use, the final stage of their supply chain, is excluded because our estimation is that direct water and electricity water related to consumer use of footwear is negligible. Transportation between supply chain levels and packaging are also excluded, as they likely do not make a material contribution to Deckers' water consumption.

Department stores and other retail stores not managed by Deckers also fall outside the system boundaries (Figure 6).

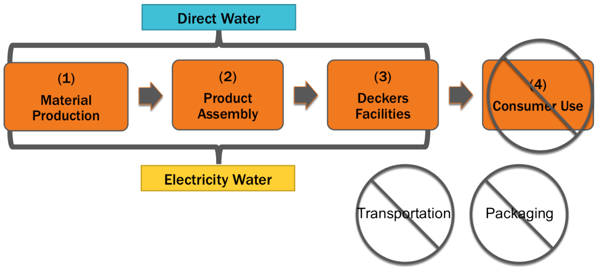


Figure 6: *Map of DeckersWater system boundaries*.

System Boundary Justification

The aim of this footprint is to provide Deckers with the tools to discover areas of high consumption, develop a baseline against which they can compare future improvements, and to help Deckers make strategic and informed decisions as to where they can best use their resources to reduce their overall environmental impacts. While the approach is generally accurate and successfully fills Deckers' needs, the series of assumptions necessary to meet these goals means there is some level of uncertainty associate with our model output.

After review and assessment of arguably the most common water footprint guide published by WFN, we determined that their approach is not sufficiently set up for a company in the beginning stages of collecting water data from outsourced operations for two reasons: 1) generally, water data are not being collected or monitored, so the necessary tools are not already in place; and 2) the categories of green, blue, and gray water do not address the needs of a company that wishes to report the volume of consumptive water or waste water data, and are not useful measures in a corporate context. This second point will be discussed in detail below.

No other approach that we have found sufficiently fills Deckers needs. Thus, DeckersWater developed a modified approach that is useful for Deckers and that other corporations can build upon.

Blue Water Evaporative Consumption-Included

While both the consumption and diversion of blue water have environmental impacts, we focus only on consumption in this study. Water footprints universally focus on water consumption, so our methodology will allow for relative comparability of numbers across other companies. Furthermore, consumption lends itself to accounting, while impacts of diversion are not inherently volumetric.

The two consumptive uses of water not measured by this study are blue water drained into salt water bodies and blue water incorporated into the product.

Blue water drained into salt water can effectively be considered consumption, as the water is no longer available for human or ecosystem use. This type of water consumption was not measured by this study because these measurements require metered data and access to detailed water management reports of all districts in which the client operates, which we do not have. This issue of limited data is true for most corporations, but as water footprinting methods improve, these data may be valuable to incorporate into future footprints.

Water incorporated into a product is considered consumption as well, but is not included in this study because the amount of water incorporated into shoes is negligible or immaterial.

Electricity Water-Included

Electricity and water use are interdependent. It takes significant amounts of electricity to extract convey, store, treat, and otherwise process water. While data vary regionally, in California water processing, transport, use, and disposal consume 19 percent of the total electricity used in the state. (Wilkinson et al 2006; WEF 2009)
Additionally, thermoelectric power production utilizes extensive amounts of water. Power production withdrawals accounted for 49 percent of total US water use in 2005, with 23 gallons of water being used on average to create one kilowatt-hour of electricity. Of the water used for electricity production in 2005, 99 percent of the water was surface water, with 28 percent of that water being saline. (US Department of Commerce 2005)

Water is directly evaporated in power generation through two processes: water heating in thermal power generation and increased evaporation rates due to dams. Thermal power generation, including coal, oil, nuclear, biofuel, etc., work by heating water to make steam that spins turbines. Water can be re-cycled or pass through the facility once (Figure 7). With both technologies, the consumptive water measure is that of evaporation. (Averyt et al 2011; WEF 2009)

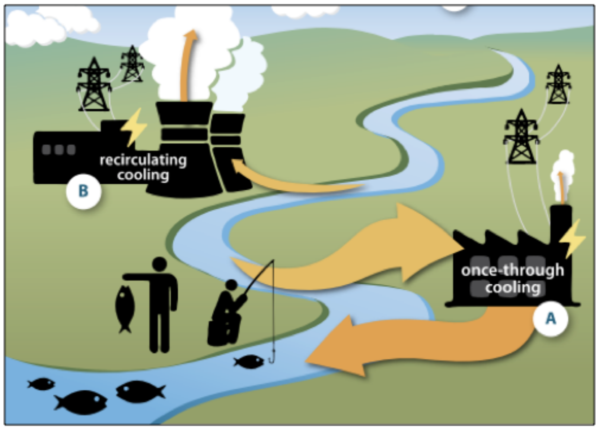


Figure 7: *Both recirculating cooling and once-through cooling thermal power generation plants evaporate blue water (Averyt et al 2011).*

Hydropower is produced by building dams, which creates reservoirs. The increase in surface area from creating the reservoir increases evaporation rates above that which would naturally occur in an unaltered freshwater system (Mekonnen & Hoekstra 2012; WEF 2009)

Typical water footprints do not include water consumed in electricity generation. However, there are significant impacts of electricity use on freshwater resources, and thus inclusion of this measure in our methodology provides a more accurate measure of water consumption throughout Deckers' supply chain. As more organizations are realizing that water and electricity are interdependent (CDP 2010), there has been a push for businesses to quantify water consumption due to direct electricity generation by leading organizations such as the World Economic Forum (WEF 2009), World Wildlife Fund (Orr et al 2009), and the Pacific Institute (Cooley et al 2011). Our decision to include electricity water is positioning Deckers ahead of other companies in the industry that are not including this measure.

Green Water - Excluded

If the goal of calculating a water footprint is to determine the impact on water availability, we argue that only components that deplete or alter natural water cycles should be included in a water footprint. Because rainwater will be consumed by vegetation growth and evaporated from the soil surface irrespective of the final form and disposition in manufacturing, there is no direct negative environmental impact; rainwater is supplied by a natural process and is present no matter how the property is operated. We do recognize that evaporative consumption of water used to irrigate crops does have negative environmental impacts, such as impeding competing uses of the water (i.e. in situ ecological uses or domestic uses) and depletion from the system. However, since

irrigation water is withdrawn from surface or groundwater, it is classified as blue water, and therefore is not part of the green water measure. (Ridoutt et al 2009)
Our argument for excluding green water from a water footprint is supported by Peters et al. (2010). In performing a life cycle analysis of Australian red meat, the authors argue that including rain water does not make sense from an environmental impact perspective. In fact, rain-fed crops often use less water than native vegetation. They argue that if the goal of a footprint is to assess water use in conjunction with the environmental damage associated with that water use, it is not appropriate to include green water. Instead, they suggest it may be more important to look at water use from a sustainability perspective where focus is placed on the practices used to obtain the water and the quality of the water when it is returned (Peters et al 2010).

In determining sustainable water use, the following are used to characterize the source:

- Is it renewable?
- Does water extraction exceed renewal rate
- Is the water returned to its original watercourse in full (Peters et al 2010; Owens 2002)

Because rain water is renewable, extraction does not exceed renewal rate (it cannot be used any faster than it falls), and it is not removed from its original water course, “in situ” rain water should be excluded from water use calculations (Peters et al 2010).

Gray Water - Excluded

Gray water is the volume of water used to “assimilate” pollutants to background concentrations that meet existing water quality standard levels (Hoekstra et al 2011). As stated above, if the goal of calculating a water footprint is to assess one’s impact on water resources, the quality of the water being returned to the system must be considered, but not volumetrically.

First, waste water treatment processes that are primarily chemically or biologically based generally do not involve water dilution. Using a volumetric measure of the amount of water needed to assimilate pollutants doesn’t provide practical information that can be used to inform company sustainability practices. Further, since wastewater treatment processes don’t typically involve water dilution, calculating grey water as the amount of water needed to dilute to an ambient standard artificially inflates the company’s volumetric baseline (Morrison & Schulte 2010).

Second, collecting the appropriate data to calculate gray water is often not feasible in practice. Most corporations simply do not measure or monitor effluent flow or pollutant concentrations, unless required by law (Morrison & Schulte 2010).

Methods & Findings

DeckersWater calculated an estimation of direct water and electricity water at each of the three stages of the supply chain examined (Figure8). Where data were available from the company, those data were used. When data were unavailable, we designed methods to best estimate Deckers' water consumption (see Appendix 3 for raw data and their sources). DeckersWater collected data for 2010, and literature values are in most cases from the same year. When 2010 literature values were unavailable, we obtained literature values from dates as close to 2010 as possible. For all three levels of the supply chain, we applied an electrical transmission loss of 6 percent (average US transmission loss) (US EPA 2007) to the electricity water measurements. As is inherent in any model, a number of assumptions were made in order to develop this model, and are delineated in figures 13, 16 and 17.

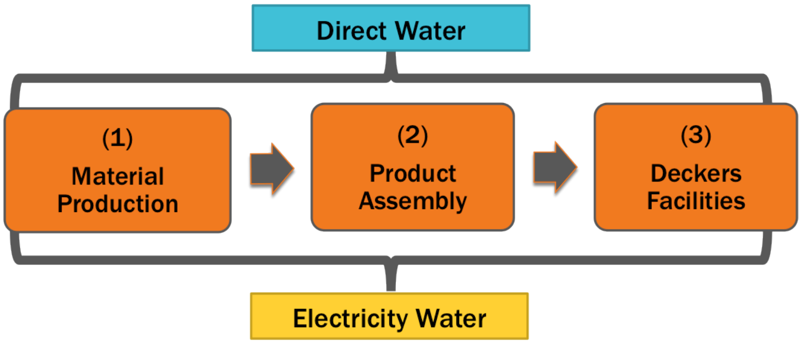


Figure 8: *Direct water and electricity water are measured at each of these three levels of Deckers' supply chain.*

Electricity Conversion

For each step of the supply chain we obtained a measure of electricity. It was then necessary to convert electricity use to water consumption. To do so, we designed a simple methodology (Figure 9).

Figure 9: *Method used to convert electricity requirements to water consumption.*

(a) **Electricity Requirement of Activity:**
We determined the electricity requirements for each activity, such as leather production, running a factory, etc. We found data for material production electricity use in LCA studies for sheepskin

(Barber & Pellow 2006) and cowhide (Bruno et al). The sheepskin LCA does not cover twinface sheepskin which is the skin with wool still attached; it covers only the hide and therefore future studies including twinface sheepskin may be useful for Deckers. We found average electricity use for synthetic and natural rubber and EVA in Eco Invent (Eco Invent Database 2012). Material electricity requirements are outlined in figure 10. We obtained factory electricity data from surveys delivered to six factories (see Appendix 4 for the sample survey and Appendix 5 for survey results). Finally, electricity use at the facility level was obtained through electricity bills (detailed results in Appendix 6).

	Sheepskin (1000kg)	Cowhide (200kg)	EVA (1 kg)	Rubber - Natural (1000kg)	Rubber - Synthetic (1000kg)*
Global Water (m3)	212	679	0.04	361	1.8
cooling	-	-	*0.02*	-	-
process	-	-	*0.01*	-	-
Electricity (kWh)	3,436	386	0.33	271	271
farm	*480*	*96*	*N/A*	-	*N/A*
processing	*2,956*	*289.5*	*0.33*	*271*	*271*
FAO Classification	995	919	N/A	836	N/A

**numbers are for polybutadiene*

Figure 10: *Electricity and direct water requirements based on literature values (see Appendix 3 for literature sources) of sheepskin, cowhide leather, EVA, Natural rubber and synthetic rubber.*

(b) Electricity Fuel Mix:
We used fuel mix country-level and global average data for from the International Energy Agency website. Detailed fuel mix data can be found in Appendix 7.

(c) Blue Water Consumption / Fuel:
Blue water evaporative consumption per fuel type was taken from a study completed by the National Renewable Energy Laboratory. Macknick et al's (2011) study is robust, taking into account power plant mix, the way in which power plants use water, from where water is withdrawn, and the difference between water withdrawal and water consumed. This study provides a US national average of blue water consumption for several fuel types and generation technologies. We chose to focus on those fuel types and generation technologies that had the most extensive supporting data and comprise the majority of fuel types and generation technologies employed throughout the world: coal, oil, gas, biomass nuclear, hydro, solar PV, and wind. Other electricity generation technologies such as solar thermal and waste, which may consume water, are not included in this report because of lack of supporting data. (Figure 11)

Energy Type	Water Consumption (m3/mWh)*
coal	2
Oil	4
Gas	1
Biomass	2.1
Nuclear	2.5
Hydro	68
Solar	0.0001
Wind	0.0001

**Macknick et al, 2011*

Figure 11: *Water consumption directly attributable to use of different fuel types in the generation of electricity.*

Material Production

Material Production Approach

While Deckers is the parent company to six brands, UGG and Teva combined make up 97 percent of the company's net sales. Thus, the materials DeckersWater focused on are the top materials for each of these shoes. Representative shoes provided by the client were the UGG Classic Short and the Teva Riva (Figure 12). The UGG boot is made up of predominantly Twinface Grade A Sheepskin. For this material, the skin and the wool of the sheep are removed and treated together. The UGG boot sole is made of EVA, a synthetic material commonly used as a substitute for rubber, and the label is made of cowhide leather. The two main components of the Teva Riva are cowhide leather and rubber for the sole. Because it is unclear whether Deckers uses natural, synthetic or mixed rubber, we assume a 50/50 mix. Thus, the natural materials studied were cowhide leather, sheepskin leather, and natural rubber; the synthetic materials measured were EVA and synthetic rubber.

Deckers product assembly factories are independent companies that purchase their own materials and sell finished products to Deckers. In some cases, the client works with these contracted facilities to source materials from specified suppliers.

Literature review indicates that the production of cowhide and sheepskin leather materials is water intensive, while synthetic rubber and EVA are much less water intensive. However, because synthetic materials require high electricity use, and DeckersWater is interested in electricity water, these were also important materials to examine.

(Deckers)

(Deckers)

Figure 12: *The UGG Classic Short and the Teva Riva are the representative shoes of their respective brands.*

For each of the materials, DeckersWater measured direct water and electricity water. For sheepskin and cowhide leather, water and electricity used to irrigate feed, raise and slaughter animals, and process raw materials into fabric were all included in the measurement. A 15 percent cutting waste is assumed for leathers based on literature values (Arcenas et al 2010), but not for the other materials. Natural rubber measurements include water and electricity used to irrigate plants, harvest rubber and process rubber into useable material. Synthetic rubber and EVA measurements include the electricity and water necessary to extract raw materials and to process them into usable material.

DeckersWater did not have access to data on the volume or weight of material purchased by the client, or countries from which the client's product assembly factories source materials. Thus, the following calculations yield a best estimate of Deckers water consumption during the material product and product assembly stages. While exact measures of these factors and a reduction in assumptions would greatly improve the precision of the following calculations, the method aims to yield generally accurate measures when data are unavailable.

Material Production
MAJOR ASSUMPTIONS

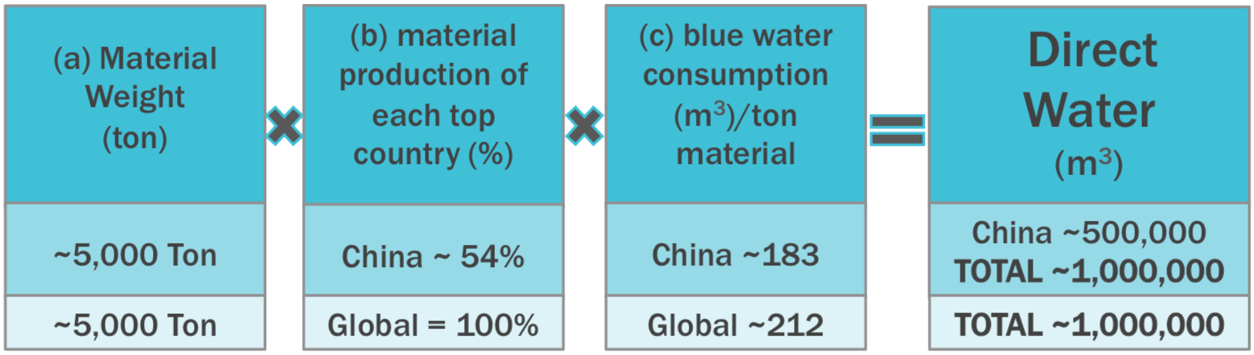
- **Leather grown in a country is also processed and tanned in that same country.**
- **Sheepskin & cowhide leather, rubber and EVA represent the majority of Deckers' materials**
- **Deckers uses materials from the top five producing countries of that material at about the same proportion as they are produced by those countries**
- **The Riva is representative of all Teva and the calf boot is representative of all Ugg products**
- **Water consumption per type of electricity production is relatively uniform around the world**
- **Electricity water is all fresh water**
- **The national makeup of electricity production can be applied at the regional level**

Figure 13: *Major assumptions for material production.*

Material Production Direct Water

Direct Water Methods

The general approach to measuring direct water was the same for all materials studied. DeckersWater multiplied the material weight (tons) by the percent of production allocated to each of the top producing countries and the blue water consumption per ton of material (Figure 14). Detailed calculations for all materials are included in the tool provided to the client and summarized in Appendix 8. The figure below uses the sheepskin used to produce UGGs in 2010 as an example.



(a) Material Weight (ton)	×	(b) material production of each top country (%)	×	(c) blue water consumption (m^3)/ton material	=	Direct Water (m^3)
~5,000 Ton		China ~ 54%		China ~183		China ~500,000 TOTAL ~1,000,000
~5,000 Ton		Global = 100%		Global ~212		TOTAL ~1,000,000

Figure 14: *General approach for measuring the direct water use of producing the following materials: cowhide leather, sheepskin leather, rubber (synthetic & natural), and EVA. Sheepskin for UGGs is included as an example.*

(a) Material Weight:
We determined material weight through a series of assumptions. Deckers sold 18 million pairs of shoes in 2010 and UGG made up 87.2 percent of their sales (Deckers 2010). Thus, by assuming net sales is representative of number of shoes sold, it was determined that they sold 15.7 million pairs of Uggs. The same method was repeated for Teva.

The client provided the weight of each material for each shoe. For example, in a women's size 7 mid-calf UGG boot 0.292 kg of sheepskin leather is used. We used this information to calculate how many metric tons of each of the top materials are used per year per brand, including a 15 percent cutting waste (value provided by the client). Natural materials includes sheepskin, cowhide and natural rubber. Synthetic materials included synthetic rubber and EVA.

(b) Material Production of Each Top Country:
For each material, we assumed that the annual material production (tons) of the top five countries was proportional to the amount of material sourced from each of those countries to produce the total shoes sold by Deckers in 2010.

We found the top five producing countries for natural materials from the UN's FAO statistics database (see Appendix 9 for a detailed listing). For the two leathers, the FAO category *producing animals/ slaughtered* was used, and for natural rubber the FAO category *production (tonnes)* was used (see figure 10 for FAO category codes and Appendix 15 for category descriptions). DeckersWater added up the five countries' total output by mass and then calculated each country's proportion of that total. The UN's FAO database organizes statistics on sheepskin and cowhide leather in several different categories, and we ultimately used the *Producing Animals/Slaughtered* category because it seemed the most accurate based on our methodology and model assumptions. We also used global averages. (FAOSTAT, 2010)

Country level data were not available for synthetic materials, so global averages of blue water consumption and electricity fuel mix (explained below) were used as representative of 100 percent of the amount of sourced material.

(c) Blue Water Consumption / Ton of Material:
We used WFN's database for natural materials to determine the blue water evaporative consumption per ton of material. Hoekstra & Mekonnen's study (2010) takes a comprehensive approach to natural material calculations by focusing heavily on the details of feed production, including variables such as: the breakdown of different plants used for feed, how much feed is required to create each kilogram of animal, how much of the water used to grow feed in a particular country comes from irrigation, the percentage of feed that a country imports (to account for so-called 'virtual water'), the amount of water consumed for tanning and processing in different countries, etc (Hoekstra & Mekonnen, 2010).

We used the Eco Invent Centre database to obtain blue water evaporative consumption numbers for synthetic materials. This database contains over 4000 industrial life cycle inventory datasets, many of which also have corresponding life cycle assessments and/or life cycle management data and services (Eco Invent Center 2012). The life cycle inventory datasets include comprehensive inventory data on electricity supply, resource extraction, material supply, chemical, waste management services, etc. (Eco Invent Center 2012).

Direct Water Findings

Direct water is used for crop irrigation, and for slaughtering and tanning processes for leather and sheepskin. We calculated blue water evaporative consumption for sheepskin to be approximately 1.12 million m^3 using the global average, and approximately 1.03 million m^3 when adding together country specific data (see figure 14). For cowhide leather, the global average generated a total of approximately 640,000 m^3 of water consumed vs. approximately 450,000 m^3 using the top producing countries methodology. For natural rubber, the global average and top five producing countries both generated a total of approximately 160,000 m^3 of water consumed. Synthetic rubber and EVA generated totals of 120,000 and 800 m^3 of water consumed, respectively.

Material Production Electricity Water

Electricity Water Methods

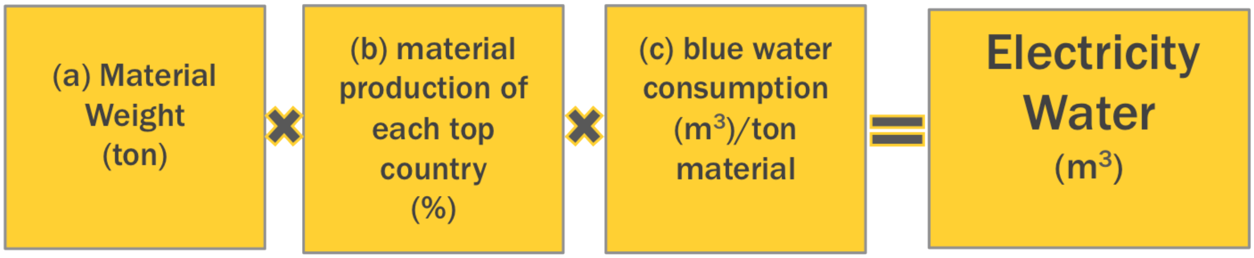


Figure 15: *General methodological approach for measuring electricity water in the material production stage of Deckers' supply chain*

To measure the electricity water of each of the materials, we followed a similar procedure to direct water, detailed in figure 15.

We used literature values to determine the electricity requirement of each material for the conversion equation (figure 15). Electricity requirements for sheepskin and cowhide were taken from life cycle analysis studies (Barber et al 2006; Bruno et al). Because we could not find LCA data on the amount of electricity used on cattle farms, we applied the sheep farm number. These numbers are likely comparable or an underestimate, as electricity on cattle farms is mostly used to run irrigation systems where sheep farms include electricity to shear wool throughout the sheep's live. Natural rubber, synthetic rubber, and EVA electricity requirements were taken from the Eco Invent Center database described in the direct water measure. Because we could not locate a reliable measure of electricity needed to process synthetic leather, we applied the natural rubber processing electricity requirement, as the numbers should be comparable (Department of Alternative Energy Development and Efficiency 2007). Detailed calculations are provided to the client in the water footprint tool, and a summary of calculations can be found in Appendix 8.

Electricity Water Findings

We calculated the water consumption for electricity generation for sheepskin to be approximately 246,000 m^3 and 407,000 m^3, using the global average and top five producing countries respectively. The latter number is higher than the global average due to fuel mixes for the top five producing countries. Specifically, all five countries use hydropower which has the highest water consumption factor of the fuel types and electricity generation technologies included in this report. For example, New Zealand, a top sheepskin producer, generates 56 percent of the country's electricity through hydropower; Sudan, a top cowhide producer, generates 48 percent through hydropower. The world average is 17 percent.

For cowhide leather, the global average generated a combined total for UGG and Teva of approximately 24,800 m^3, where the top five countries generated a combined total of approximately 40,600 m^3. As with sheepskin, the later number is much higher than the global average due to fuel mixes for the top five countries. In this case, Brazil generates 84 percent of the country's electricity through hydropower and is the third highest producer of cows in the world.

Natural rubber and synthetic rubber generated totals of approximately 1,700 m^3. Since we assumed a 50/50 mix of natural and synthetic rubber, the amount of material estimated was the same for both materials and therefore the electricity water is the same. EVA generated a total of approximately 16,300 m^3.

Product Assembly

Product Assembly Approach

Deckers shoes are assembled in factories in China and Vietnam. Deckers contracts with these factories but does not own them. Some factories assemble shoes solely for Deckers, while others assemble products for several brands. Similar to our methodology for material production, we measured both direct water and electricity water. However, upstream consumption associated with the manufacturing of machinery and capital equipment used in the factories was excluded from our system boundaries. For more information on general workings of assembly factories, see Appendix 10.

DeckersWater developed a survey (see Appendix 4) that was distributed among a number of Deckers' assembly factories to obtain direct raw data on direct water and electricity usage. Of the twenty-one factories that Deckers contracts with, we submitted the surveys to six factories chosen by Deckers and received responses from six factories of varying production quantities. We were told that these factories were chosen at random. See Appendix 5 for survey results.

Product Assembly
MAJOR ASSUMPTIONS

- **Factories in Vietnam operate similarly to factories in China**
- **The factories surveyed are representative of all Deckers factories**
- **15 percent of factory withdrawal is consumptive (World Economic Forum 2009)**

Figure 16: *Major assumption for product assembly.*

Product Assembly Direct Water

Direct Water Methods

DeckersWater used a survey to obtain electricity and direct water data for 6 of the 21 factories Deckers uses. Because data were only obtained for 6 of 21 factories, DeckersWater extrapolated the sample of 6 factories to represent the 21 factories while maintaining the proportion of factories with low, medium and high direct water use levels. We based attributional allocation on the percent of shoes produced for Deckers as reported by those factories. Thus, anywhere from 13-100 percent of the factories' direct water was allocated to Deckers. Because we were only able to obtain reliable withdrawal numbers from these factories, we multiplied Deckers' withdraw by 15 percent, which is the average conversion factor for water consumption to withdraw for factories worldwide, according to WEF's *Energy Vision Update* (2009).

Direct Water Findings

Using these methods, direct water at Deckers' product assembly stage is estimated to be approximately 440,000 m^3.

Product Assembly Electricity Water

Electricity Water Methods

Data collected on surveys were extrapolated for electricity using the same method applied to direct water. Factories were re-ranked as high, medium and low according to their electricity use. We then converted electricity to m^3 of water using the conversion equation delineated in figure 15.

Electricity Water Findings

Using these methods, electricity water at the product assembly stage is estimated to be 1,318,000 m^3. The electricity water number is noteworthy because it is almost triple the direct water measure, and represents over a quarter of Deckers' worldwide water inventory. This is reflection of two factors. First, the factories use an enormous amount of electricity (approximately 95 million kWh), which is similar to the annual electricity used by the entire UC-Santa Barbara campus (UCSB Energy Report 2009-10). Second, China receives a significant portion of their electricity from hydropower, which has a much larger blue water consumptive intensity than any other fuel source.

Deckers Facilities

Deckers Facilities Approach

The client does not own any facilities, but rents its offices stores and distribution centers. These facilities consume direct water in two ways: landscaping irrigation and HVAC heating/cooling systems. While *water consumption* used colloquially raises images of low flow toilets, sinks, and showers, these water fixtures do not consume water; water used in these devices is diverted. Thus, these uses are outside of the system boundaries of this study.

The majority of Deckers facilities are in malls or industrial parks, and no direct water or electricity data were available to the DeckersWater team. Thus, our methods utilize a number of publicly available tools to approximate the client's direct and electricity water. Each location was examined individually using Google Maps. We examined all 42 Deckers facilities, including 25 in the United States and 17 abroad. For a complete list, see Appendix 1.

Deckers Facilities
MAJOR ASSUMPTIONS

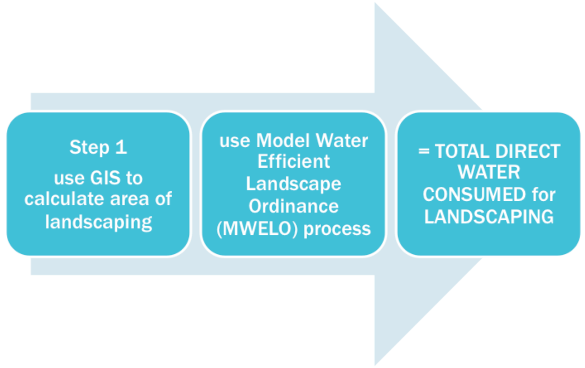
- **Direct & electricity water use at US facilities is representative of water consumption at these facilities abroad**
- **All grasses at Deckers' Facilities are cool season turf and sprinkler systems are medium efficiency**
- **Each commercial facility has standard refrigeration requirements regardless of climate, construction type and building design**
- **Evaporative losses only occur during refrigeration operation of HVAC system**

Figure 17*: Major assumptions for Deckers facilities.*

Deckers Facilities Direct Water

Direct Water Methods

Landscaping: To determine the amount of direct water at all landscaped areas of Deckers' facilities, our method utilized two tools: ArcGIS mapping and basic evapo-transpiration methodology (see Appendix 11 for detailed methods). We used these tools to determine the amount of evapo-transpiration at the facility as a whole, and the proportion attributable to Deckers (Figure 18) (DOE, Guidelines for Estimating Unmetered Landscaping Water Use, 2010).



For step 1, we mapped all Deckers facilities using ArcGIS mapping tools, and determined the percent of landscaped area for Deckers based on square footage. (see Appendix 11 for an example map).

Figure 18: *This method is used to determine the amount of water consumed by landscaping for an entire facility, and then the proportion attributable to Deckers.*

For step 2 (figure 18) we calculated the evapo-transpiration using the following steps:

1. Determine the representative climate of each facility based on the climate of the nearest city. See map in Appendix 11. (DOE, Guidelines for Estimating Unmetered Landscaping Water Use 2010)

2. Find the irrigation needs over and above rainfall for landscape types for each of the chosen locations using the Department of Energy classification system. (DOE, Guidelines for Estimating Unmetered Landscaping Water Use 2010)

3. Convert irrigation to consumption using an irrigation factor for cool season turf grasses, which are the representative turf for this process as they are the most common landscape turf type (DOE, Guidelines for Estimating Unmetered Landscaping Water Use 2010).

4. Multiply annual irrigation factor by irrigated area to get total water evapo-transpired from landscape turf and divide by average irrigation system efficiency of 65% to account for water losses in irrigation systems. This provides the total annual landscape water consumption. (DOE, Guidelines for Estimating Unmetered Landscaping Water Use 2010)

HVAC: Heating Ventilation and Cooling (HVAC) systems also consume water. We assumed that all facilities are cooled by 1 degree Fahrenheit, 8 hours a day for 4 months straight. This methodology utilizes industry measures of air conditioning from the Facilities Engineering Journal. Determining direct water due to HVAC systems involved the following steps:

1. Use Manual N Commercial Load Calculation conversion to determine the tonnage of refrigerant per square foot. 700 square feet of commercial space requires 1 ton of refrigerant per degree of cooling (Manual N Commercial Load Calculation 1998)

2. Multiply the number from step 1 by the Facilities Engineering Journal's conversion factor for total gallons per workday of evaporation per tonnage of refrigeration (per day = eight hours) (Weimar & Browning 2010).

Deckers Facilities direct water data are listed in Appendix 6

Direct Water Findings

Using the methods outlined above, we determined that Deckers facilities consume approximately 22,000 m^3 of direct water for landscape irrigation and 50,000 m^3 of direct water with their HVAC systems.

Deckers Facilities Electricity Water

Electricity Water Methods

We had electricity bills from 12 facilities (11 in the United States and one in Tokyo). These facilities used an average of 493,632 kWh per facility in 2010, with a range of 35,000 kWh to 7,000,000 kWh. We extrapolated this average out to all 42 Deckers facilities.

Electricity Water Findings

Based on the above methodology, we determined that Deckers facilities worldwide consume approximately 120,000 m^3 of water.

Image from Deckers

Overall Footprint

Adding together electricity and direct water for each supply chain stage yielded Deckers overall water footprint. We estimate that Deckers consumes from 4.2 to 4.3 million m^3 annually, dependent upon use of global averages or top five material producing countries (Figure 19).

Of that total, approximately 55 percent comes from material production, 41 percent comes from product assembly, and 4 percent comes from Deckers facilities (Figure 20). For a detailed summary of findings, see appendix 12.

4.3 million m^3

Figure 19: *Deckers total water consumption is approximately equivalent to 25% of Santa Barbara's annual water usage.*

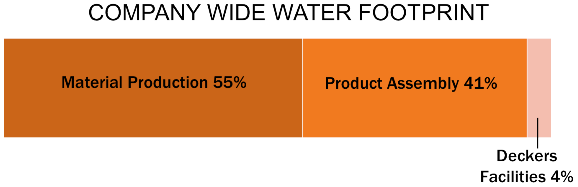


Figure 20: *Inventory breakdown by supply chain stage inclusive of both direct water and electricity water.*

Looking specifically at the categories of direct water and electricity water throughout the supply chain, approximately 53 percent comes from direct water and 47 percent comes from electricity water. A detailed breakdown of direct water and electricity water is visualized in figure 21. Notably, 49 percent of the total company direct water comes from production of sheepskin leather, both because producing this material is water intensive, and because large amounts of this material is used. Also, 69 percent of the total company electricity water comes from the product assembly stage. This makes sense because significant amounts of electricity are used in product assembly, while use in the material production is mostly for tanning and irrigation systems, and at facilities is mostly for lighting, electronic devices and cooling.

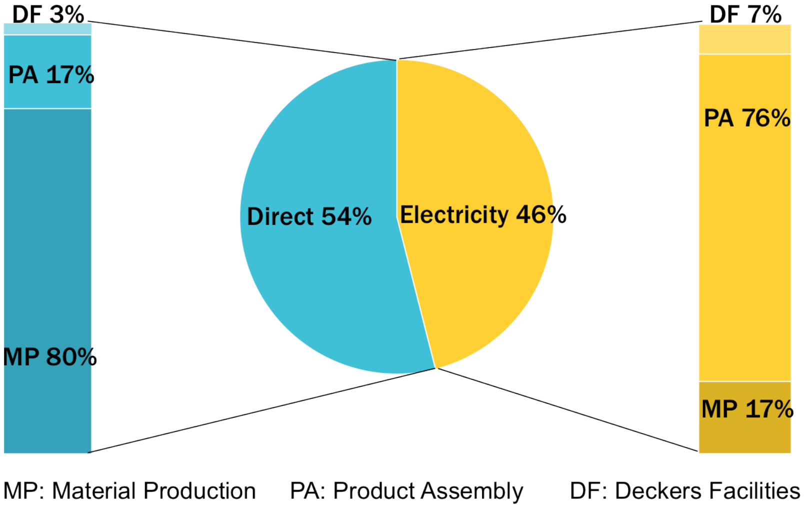


Figure 21: *Direct water comprises 53 percent of the total water inventory; electricity water comprises 47 percent. Inventory breakdown of direct water and electricity water are shown to the left and right of the pie chart respectively. The bar graphs represent each component as a percentage of either the total direct water or total electricity water, not of the total company inventory.*

Interestingly, the material production stage alone comprises between 42 to 48 percent of the total company direct water and product assembly alone comprises approximately 31 percent of the total company electricity water. Additionally, we suspected water consumption at Deckers' facilities would be a very small percentage of the total water inventory; our findings reflect less than five percent.

Figure 21 also illustrates the inventory breakdown for direct water and electricity water by supply chain stage as a percent of the company total for that category across the supply chain. For example, direct water at the material production stage comprises 80 percent of the total company direct water; electricity water at the material production stage comprises 17 percent of the total company electricity water. Appendix 13 contains a detailed breakdown of direct water and electricity water at each supply chain stage as a percentage of the total company water inventory and the total company water inventory for that category across the supply chain stage.

A comparison of water inventory by brand reveals 83 percent of the estimated total water inventory comes from the manufacture and sale of UGG products; 17 percent comes from Teva products (Figure 22). We expected to see rough proportionality between brand water inventory and market share and our findings support this assumption.

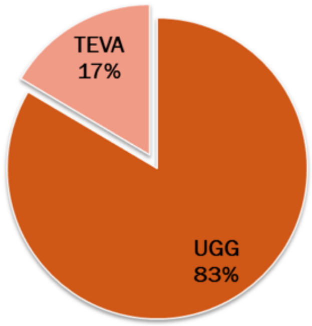


Figure 22: *Total brand water inventory as a percentage of total company water inventory.*

The overall trend between the share of direct water and electricity water is consistent across brands with material production being composed of mostly direct water and product assembly, and Deckers facilities being composed mostly of electricity water. The breakdown of direct water and electricity water at each supply chain stage is visualized for UGG and Teva in figure 23. Detailed inventories for both brands are found in Appendix 14.

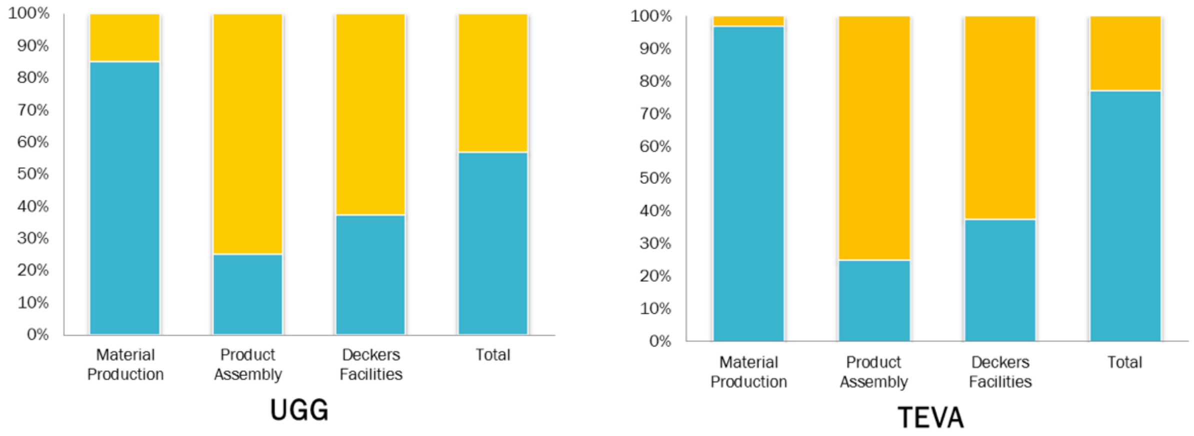


Figure 23: *The inventory breakdown for the UGG & Teva brands by direct water (blue) and electricity water (yellow) categories at each stage in the supply chain*

One surprising finding is that on a per pair basis, our model estimates the Teva Riva has a higher total water inventory than the UGG boot: 380 liters versus 230 liters, respectively (Figure 24). This increase is likely due to the higher blue water consumption per ton of cowhide leather produced than sheepskin (global average 679 m^3/ton and 212 m^3/ton, respectively) combined with the difference in material composition of the two shoes. Cowhide leather composes 34 percent of the Teva Riva but only five percent of the UGG boot (see Appendix 15).

Shoe Images: Deckers

Figure 24: *Comparison of water consumption per pair of shoes. One liter is approximately one Nalgene water bottle.*

Sensitivity Analysis

Many of our model inputs are based on assumptions, estimation and literature values. Thus, there is uncertainty associated with our final model output. To address this uncertainty, we conducted a simple sensitivity analysis in Excel with key input variables. We identified these key variables using the following criteria: 1) variables with high values relative to others in the same category; 2) variables with high uncertainty in our estimations; 3) variables based on assumptions; and 4) variables with large literature value ranges. Table 1 lists key variables, the baseline values, as well as the corresponding ranges that were tested. Appendix 16 contains detailed results for each sensitivity analysis treatment for each key variable.

Table 1: *Sensitivity analysis key variables tested with baseline values and corresponding ranges.*

Variable	Baseline	Range
Pairs of shoes sold (in millions)	18	[15.3, 22.5]
Market share (changed simultaneously)		
UGG (%)	87.2	[.785, .959]
Teva (%)	10.1	[.138, .188]
Cutting waste % (sheepskin & cowhide)	15	[.035, .3225]
Electricity transmission loss	6.156	[.01244, .06417]
Sheepskin to cowhide % composition UGG (change		
Sheepskin (g)	292	[248.2, 318.28]
Cowhide (g)	26	[0,69.8]
Cowhide % composition TEVA (g)	228	[193.8, 262.2]
Natural to synthetic rubber allocation (changed		
Natural (g)	50	[0,494]
Synthetic (g)	50	[0,494]
Sheepskin sourcing (changed simlultaneously)		
China (%)	54	[0,1]
India (%)	15	[0,1]
Australia (%)	10	[0,1]
New Zealand (%)	10	[0,1]
Sudan (%)	10	[0,1]
Cowhide sourcing (changed simlultaneously)		
China (%)	31	[0,1]
USA (%)	25	[0,1]
Brazil (%)	20	[0,1]
India (%)	16	[0,1]
Argentina (%)	8	[0,1]
Natural rubber sourcing (changed simlultaneously)		
Thailand (%)	37	[0,1]
Indonesia (%)	34	[0,1]
Malaysia (%)	10	[0,1]
India (%)	10	[0,1]
Vietnam (%)	9	[0,1]
Material water consumption: global average (m3)		
sheepskin	212	[159, 307.4]
cowhide	679	[509.25, 307.4]
natural rubber	316	[108.3, 613.7]
synthetic rubber	1.8	[1.98, 2.7]
EVA	36	[18, 54]
Material electricity requirement (kWh)		
sheepskin	3436	[2577.15, 4295.25]
cowhide	1927.7	[1447.75, 2409.625]
rubber	271	[203.25, 338.75]
EVA	333	[249.75, 416.25]
Industrial direct water conversion factor (%)	15	[.0975, 0.2025]
Product assembly direct water exptrapolation		
low, medium, high users (#)	7/11/3	see data tables
production allocated to Deckers (%)	100,51,14	see data tables
Product assembly electricity exptrapolation		
low, medium, high users (#)	7/11/3	see data tables
production allocated to Deckers (%)	100,81,13	see data tables
Deckers facililties: working days	270	[310,365]
Deckers facilities: electricity	-	no range, collected raw data

Our sensitivity analysis resulted in a range for the total footprint or total water inventory (TWI) from approximately 3.9 to 4.5 million m^3. We found that the TWI is greatly influenced by changes to country sourcing allocation and variables that are correlated with the weight of material inputs. For example, a 10 percent increase in cutting waste resulted in a five percent increase in the TWI.

The two main components that impact country sourcing allocation are country specific electricity fuel mixes and direct water estimates per unit of material input. The latter can vary widely across the top producing countries for natural materials. Therefore, the percentage of material sourced from each country directly influences the total. We tested country sourcing assumptions for natural materials and found that changes to 1) sheepskin sourcing resulted in a TWI range of a seven percent decrease to an eleven percent increase; 2) cowhide sourcing resulted in a TWI range of a six percent decrease to a seven percent increase; and 3) rubber sourcing resulted in a TWI range of a four percent decrease to a five percent increase. Details of these scenarios are found in the Material Sourcing Scenarios section of this report.

Not surprisingly, even large changes to variables that comprise a minor portion of the TWI either due to small market share or low input value, only influence TWI slightly. For example, changes to the direct water variable for synthetic rubber processing yields virtually no change in TWI. Additionally, changes made to inputs that influence water consumption at Deckers' facilities had very little effect on TWI – increasing the work week from five to seven days only increased the total footprint by 0.4 percent.

Unpredictably, though, changes to electricity requirements for sheepskin processing also had virtually no effect on TWI. We expected this variable to have a higher degree of influence over TWI because the baseline value was the highest value of all material processing electricity requirements and sheepskin comprises a majority of the material input by weight in this model. However, a combination of higher electricity requirements and a change to source location may have a substantial impact on TWI, particularly if that country relies on hydropower as an electricity source. The client can use our model to further assess changes to TWI based on combination of changes.

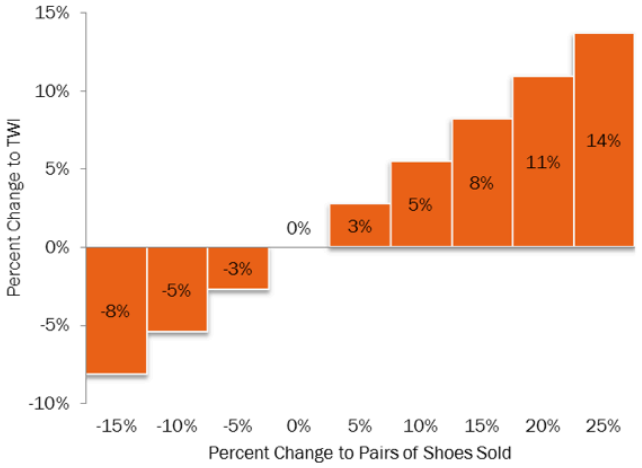


Figure 25: *The percent change in total water inventory (represented on the y axis) is roughly half the magnitude of change in sales revenue (represented on the x axis). Pairs of shoes sold were used as a proxy for sales revenue in this model.*

Another interesting finding is that across the range of sales tested, the percent change in TWI is roughly half the magnitude of the percent change in sales (represented as pairs of shoes sold). For example, a 10 percent increase in sales yields a 5 percent increase in total water inventory; a 20 percent increase in sales yields an 11 percent increase in TWI (Figure 25). Since the number of pairs sold is one of the first inputs in our model and directly affects the amount of material upon which subsequent calculations are based, we expected a change to the number of pairs sold to have a substantial effect on TWI relative to changes in other variables. This assumption is supported by the results of our sensitivity analysis.

Product Assembly – Extrapolation and Attribution Allocation Testing

We tested our extrapolation and attribution allocation assumptions at the product assembly stage by creating several scenarios. These tests posed challenges because there was so much uncertainty as to whether the sample of six factories that we surveyed was actually representative of the 21 factories we know Deckers' uses. We found that Deckers' water footprint can vary widely by changing the number of factories in each user level (low, medium and high) and the allocation of product to Deckers. The electricity scenarios had the highest variance from a decrease of 20 percent to an increase around 50 percent. The upper range doesn't appear to be very likely as it is based on allocation of 100 percent of the product produced at each of the factories surveyed to Deckers. Since we know from personal communication with the client that a majority of the product assembly factories used also produce for other companies, we know this scenario is not likely. However, we believe there is still value in testing the effect of this scenario. Details from all of the scenarios are found in Appendix 18.

Assessment of Environmental Impact

The inventory portion of a water footprint has little value without an analysis of the environmental impacts of that footprint. However while impact is important, water inventories don't lend themselves readily to impact analysis because an inventory yields one global number whereas water consumption impacts are inherently localized (Ridoutt and Pfister 2010; Vorosmarty et al 2000; Ridoutt et al 2009). In other words, knowledge that Deckers consumes 4.2 to 4.3 million m^3 of water worldwide or even 2.3 million m^3 in China is not easily related to specific environmental harms. However, it is intuitively clear that any corporation's water consumption contributes to consumption related environmental impacts to some degree in the regions and countries in which they operate.

Thus, rather than providing a precise but inaccurate evaluation of the client's environmental impact, we address their impact in two concrete but decidedly broad ways: a general discussion of environmental impacts associated with water withdrawal and water consumption (here and in the background section) and an analysis of water stress.

Environmental Impacts

In general, environmental impacts of water consumption are conflated with impacts of water withdrawal. Indirect ecological impacts of withdrawal include habitat destruction, thermal pollution and altered stream flow. Habitat destruction can result from dam construction, which are built for the direct purposes of water withdrawals, flood control and electricity generation. Water consumption is an indirect consequence of dams and reservoirs. Dams can also alter sediment loads and fish migrations causing interruptions in natural stream conditions, which can lead to extinction of fish species and annihilation of recreational fisheries. (Kondolf et al 2008).

Thermal pollution, in particular, is an impact that has been overlooked in corporate water reporting (Morikawa et al 2007). Thermal pollution can occur when water is diverted from a surface water source such as a river and used as a coolant in a power plant or industrial facility. The temperature of the water that is returned from the plant is generally greater than the ecosystem's ambient water temperature. Water temperature is a critical factor in ecosystem quality since many aquatic organisms are intolerant to changes in temperature (Verones et al 2010; Coutant 1999). For example, thermal pollution can decrease dissolved oxygen levels in water, impairing biological processes in aquatic organisms (Verones et al 2010).

Water Stress as it Relates to Deckers

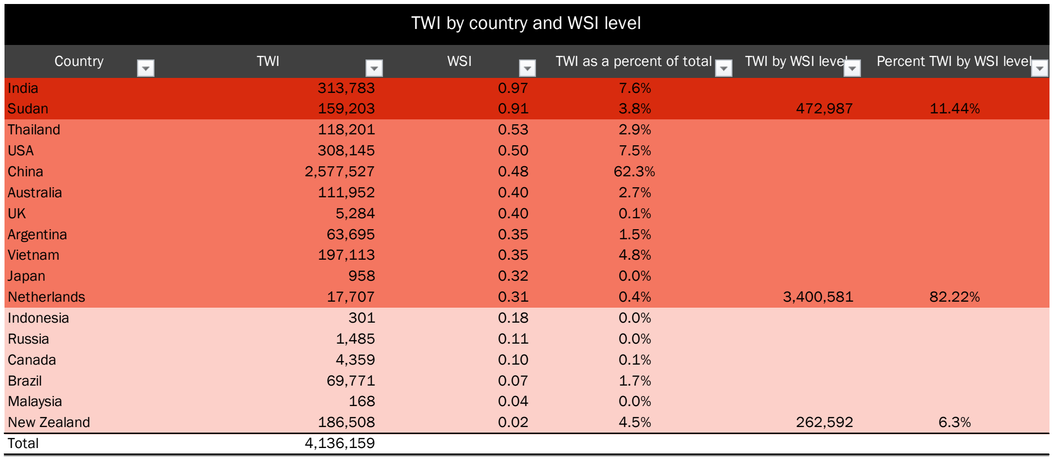
The concept of water scarcity or water stress at the country level first appeared in the academic literature in the 1980s (Fallenmark 1989). In 2000, Vorosmarty and colleagues expanded upon the existing research and forecasted water stress levels around the globe into the future based on climate change, hydrological, and population growth models. We use Vorosmarty and colleagues work later in the section to address the role of future water stress in strategic business planning.

More recently, Pfister et al. (2009) improved upon existing water stress measures with the Water Stress Index (WSI), a spatial tool used in conjunction with Google Earth that illustrates WSI levels across the globe. WSI is measured on a scale from zero to one, with low numbers indicating low stress and high numbers indicating high stress. Where data are available, this tool provides WSI levels at various resolutions from the watershed and regional level to a national average. In the WSI, water stress is defined as the ratio of freshwater use to freshwater availability. Fresh water use refers to the combined measures of agricultural, domestic and industrial water use. Fresh water availability refers to the total available liquid fresh water generated by the natural environment. By this measure, the higher the amount of freshwater use relative to freshwater availability, the more stressed a region will be (Ridoutt & Pfister 2010).

Ridoutt and Pfister (2010) argue that traditional volumetric water footprint measures have no inherent meaning unless mapped against the water availability of the region in which water is being used. Thus, we used the WSI to broadly assess Deckers' estimated water consumption at the country level. There are critics of using national level water stress measures because in many countries there is high regional variability of both water use and water availability. For example, in China, more than 80 percent of the available water originates south of the Yangtze River meaning southern China is much less water stressed than northern China. However, for this study we choose to use national level averages based on data limitations.

Table 2 provides a WSI measure and estimated distribution of the 2010 company footprint to countries in which we know or estimate Deckers' supply chain operates. Figure 26 displays the percentage of Deckers' estimated water consumption within low, medium and high stress levels. We found that 82 percent of Deckers' estimated water consumption takes place in countries with medium level water stress. Of that, approximately 60 percent can be attributed to operations in China.

Table 2: *Deckers' estimated water consumption by country with corresponding country water stress levels (Pfister et al 2009)*



TWI by country and WSI level

Country	TWI	WSI	TWI as a percent of total	TWI by WSI level	Percent TWI by WSI level
India	313,783	0.97	7.6%		
Sudan	159,203	0.91	3.8%	472,987	11.44%
Thailand	118,201	0.53	2.9%		
USA	308,145	0.50	7.5%		
China	2,577,527	0.48	62.3%		
Australia	111,952	0.40	2.7%		
UK	5,284	0.40	0.1%		
Argentina	63,695	0.35	1.5%		
Vietnam	197,113	0.35	4.8%		
Japan	958	0.32	0.0%		
Netherlands	17,707	0.31	0.4%	3,400,581	82.22%
Indonesia	301	0.18	0.0%		
Russia	1,485	0.11	0.0%		
Canada	4,359	0.10	0.1%		
Brazil	69,771	0.07	1.7%		
Malaysia	168	0.04	0.0%		
New Zealand	186,508	0.02	4.5%	262,592	6.3%
Total	4,136,159				

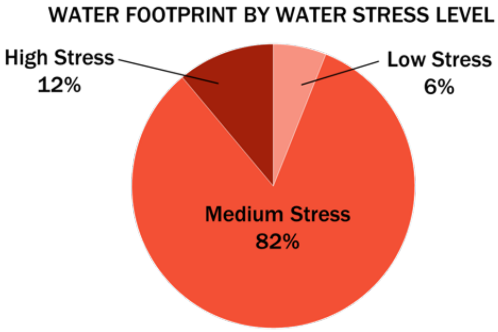


Figure 26: *Distribution of Decker' estimated water consumption within low, medium and high stress levels. (Pfister et al 2009)*

Our findings also indicate sheepskin and cowhide leather are major contributors to Deckers' estimated water consumption. Thus, we have also provided the distribution of estimated water consumption for both sheepskin and cowhide leather by water stress level (Figure 27).

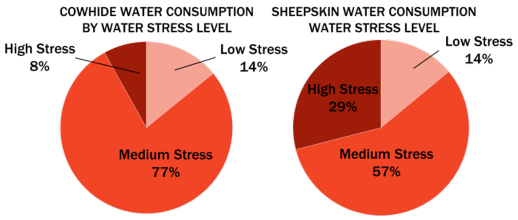


Figure 27: *Distribution of Deckers' estimated water consumption attributable to sheepskin leather (left) and cowhide leather (right) by water stress level. (Pfister et al 2009)*

Using the WSI, we found that the countries from which we estimate Deckers sources sheepskin leather are generally more water stressed than the countries for cowhide leather. This result is partially due to Deckers' use of more sheepskin leather than cowhide leather overall. As a guidance tool, we have provided the WSI levels for all countries in appendix 17.

As mentioned above, Vorosmarty's (2000) work also deals with a measure of water stress but differs from Pfister's WSI measure in that Pfister's tool is representative of evaporative consumption for industrial, domestic, and agricultural water uses; Vorosmarty's work focuses on withdrawals only. However, Vorosmarty's work is useful in our analysis because they make future projections of water stress, which has implications for strategic business planning. These implications are discussed in the business risk section of this report.

According to Vorosmarty's projections, countries estimated to be Deckers' largest suppliers will be considered highly water stressed by 2025 (Vorosmarty et al 2000) (Figure 28). Interestingly, their model suggests that future population growth will exacerbate water stress much more than climate change in 2025 (Vorosmarty et al 2000). Appendix 14 provides the full maps from the Vorosmarty et al (2000) paper.

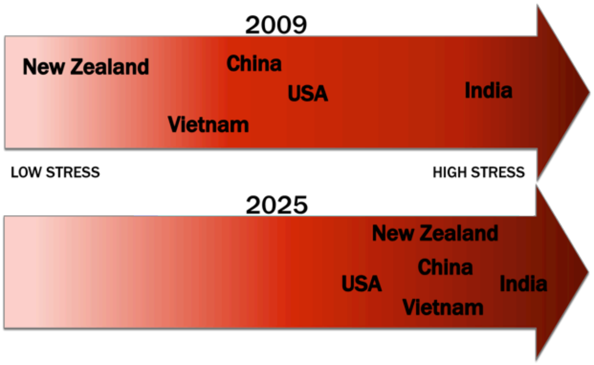


Figure 28: *Deckers' vulnerability from climate change and population growth (Pfister et al 2009; Vorosmarty et al 2000)*

Image from Deckers

Recommendations

Deckers is conducting a comprehensive study of their environmental impacts, of which this water footprint is one element. Thus, given our findings, Deckers may decide that their impacts on water consumption are of lower priority than other environmental impacts. With limited resources to commit, we suggest they prioritize amongst sustainability practices. If they decide that water consumption is one of their priorities, we offer a number of suggestions. Furthermore, many of our recommendations have collateral operational efficiency and environmental benefits.

In developing reduction and material sourcing scenarios we wanted to determine where Deckers can make the biggest change to their water footprint. To do this, we placed each stage of the supply chain (separated by direct and electricity water) on a graph of Deckers' relative control versus relative water consumption at each stage (Figure 29). The circle on figure 29 highlights where Deckers' is will make the largest change to its water footprint. Stages that fall into this area should be the primary focus of reducing water consumption. Based on our estimates of water consumption and perceived level of Deckers' control, no stages currently fall into this area. Still, this is a useful exercise in identifying where Deckers should focus its efforts on reducing water consumption. Additionally, building relationships down the supply chain could help move some of these boxes into the circle on the figure.

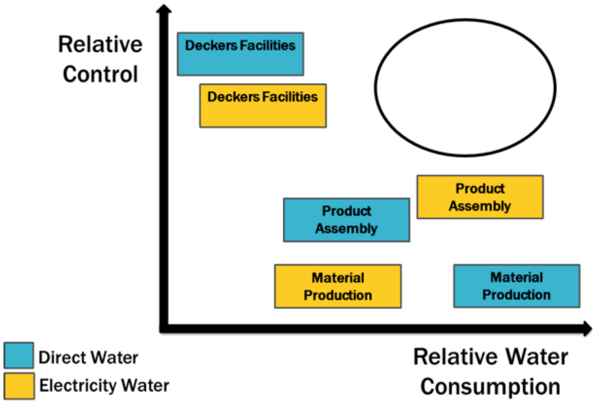


Figure 29: *This figure shows where each of the supply chain stages fall, qualitatively, on a graph of Decker's relative control or influence (y axis) and the relative water consumption at each stage (x-axis). The circle highlights where Deckers' can maximize reductions in water consumption for their efforts.*

Reduction Scenarios

We examine electricity reduction scenarios at Deckers facilities, product assembly stages, and country sourcing at the material production stage. Detailed scenarios are found in Appendix 18.

We chose to focus on electricity reduction scenarios because we see several benefits in reducing the amount of electricity used in footwear manufacturing. Reducing the amount of electricity used will lower costs, water consumption and carbon emissions. While electricity reductions at Deckers facilities doesn't have much effect on the total water inventory, reductions at the product assembly stage have a large impact on the total water inventory. Table 3 shows six scenarios we tested with our model. A 15 to 20 percent reduction in electricity could yield a five to six percent decrease in the total water inventory. We feel this is an attainable goal. In fact, several corporations have set goals of 25 percent electricity reduction over the next five to ten years. We suggest that Deckers refer to the US Green Building Council LEED certification and the Santa Barbara Green Business Certification programs for information on how to achieve these reductions.

Scenario Number	Scenario Description	Percent Change in Total Water Inventory	Reduction Volume (m^3)
1	10% electricity reduction for Deckers facilities	-0.3%	12,012
2	10% electricity reduction at the product assembly stage	-3%	131,751
3	15% electricity reduction at the product assembly stage	-5%	197,626
4	20% electricity reduction at the product assembly stage	-6%	263,501
5	25% electricity reduction at the product assembly stage	-8%	329,376
6	30% electricity reduction at the product assembly stage	-10%	395,252

Table 3: *This table illustrates the effect on Total Water Inventory (TWI) of six electricity reduction scenarios. While reductions at Deckers' facilities do not have much effect on TWI, reductions at the product assembly stage do impact TWI substantially.*

Material Sourcing Scenarios

As mentioned above in the Sensitivity Analysis section, we tested country sourcing assumptions for natural materials by changing the country from where we assume Deckers sources raw materials. We found that Deckers' water footprint can vary widely based on where materials are sourced, with the biggest range related to sheepskin sourcing. When materials are sourced from countries with low water consumption per ton of material input, we see reductions as high as seven percent with sheepskin and six percent with cowhide. Sourcing 100 percent of sheepskin from Australia results in a seven decrease in the water footprint and sourcing 100 percent of cowhide from India results in a six percent decrease in the water footprint.

Interestingly, though Australia and India have low water consumption per ton of material input, both countries are experiencing high levels of water stress. In fact, India has the highest WSI number of all the countries we considered in our sourcing scenarios. This finding encouraged us to test scenarios where material was sourced solely from countries with low water stress, which produced surprising results.

In certain cases, we found there may be an inadvertent tradeoff between reducing the total water footprint number and reducing the amount of materials sourcing from or processed in countries with high water stress. For example, sourcing 100 percent of sheepskin from New Zealand resulted in an eleven percent increase in the total water footprint. Detailed scenarios are listed in Appendix 19.

Final Recommendations

Based on our analysis of Deckers' overall 2010 water consumption and the distribution of that water consumption across the company's supply chain we offer the following final reccommendations:

Build relationships down the supply chain:
Deckers should continue to work on building better relationships with suppliers with the goal of obtaining better understanding of the practices and processes employed at each facility. Where applicable, the client can use industry groups, such as the Leather Working Group, as a proxy for these relationships.

Collect data from suppliers:
Deckers should continue to monitor water and electricity data. More data will help refine Deckers' estimated 2010 water footprint and allow for water stress analysis at finer resolutions. Additionally, more specific data on the final disposition of water used throughout the supply chain can help Deckers refine its understanding of direct and indirect environmental impacts discussed earlier in the report. We have provided an improved survey tool, based on what worked and didn't work with our data collection efforts. The survey has been developed for a product assembly factory but can easily be amended for any step in the supply chain stage.

Measure pollution loads:
To the extent that Deckers can get the right data, the company should measure point source pollution loads.

Prioritize energy efficiency:
We see several benefits to Deckers of prioritizing energy efficiency actions. Reducing electricity will decrease electricity costs, water consumption, and carbon emissions.

Quantify business risk:
Deckers may be intersted in quantifying business risk for internal purposes or for the purpose of attracting socially responsible investors. DeckersWater does not have access to priopriety information necessary to use these tools for the client, but the Ceres tool was provided to the cleint, and is summarized along with a GEMI tool in Appendix 20.

Evaluate tradeoffs associated with sourcing from water stressed regions versus goals of overall reduction:
As illustrated in our material country sourcing scenarios, in certain cases there may be tradeoffs between reducing sourcing from water stressed regions and an goal of reducing the overall company footprint. Ultimately, Deckers should be looking to work with suppliers to increase water efficiency in countries with low water stress.

Exercise care with water footprint terminology:
Water footprinting terminology, system boundaries, and approaches have not yet been clearly defined for corporations. As Deckers works to integrate water measures into the company's corporate sustainability plans, the company should be careful with the terminiology used in published reports. Several corporate sustainability reports that mention water stewardship programs and report on water measures are not clear on what exactly the company is reporting. For example, the term 'water use' can mean the total amount of water withdrawn from freshwater supplies or it can mean the water that is evaporatively consumed. These two definitions carry very different assumptions and impacts; they are not the same thing.

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Appendices

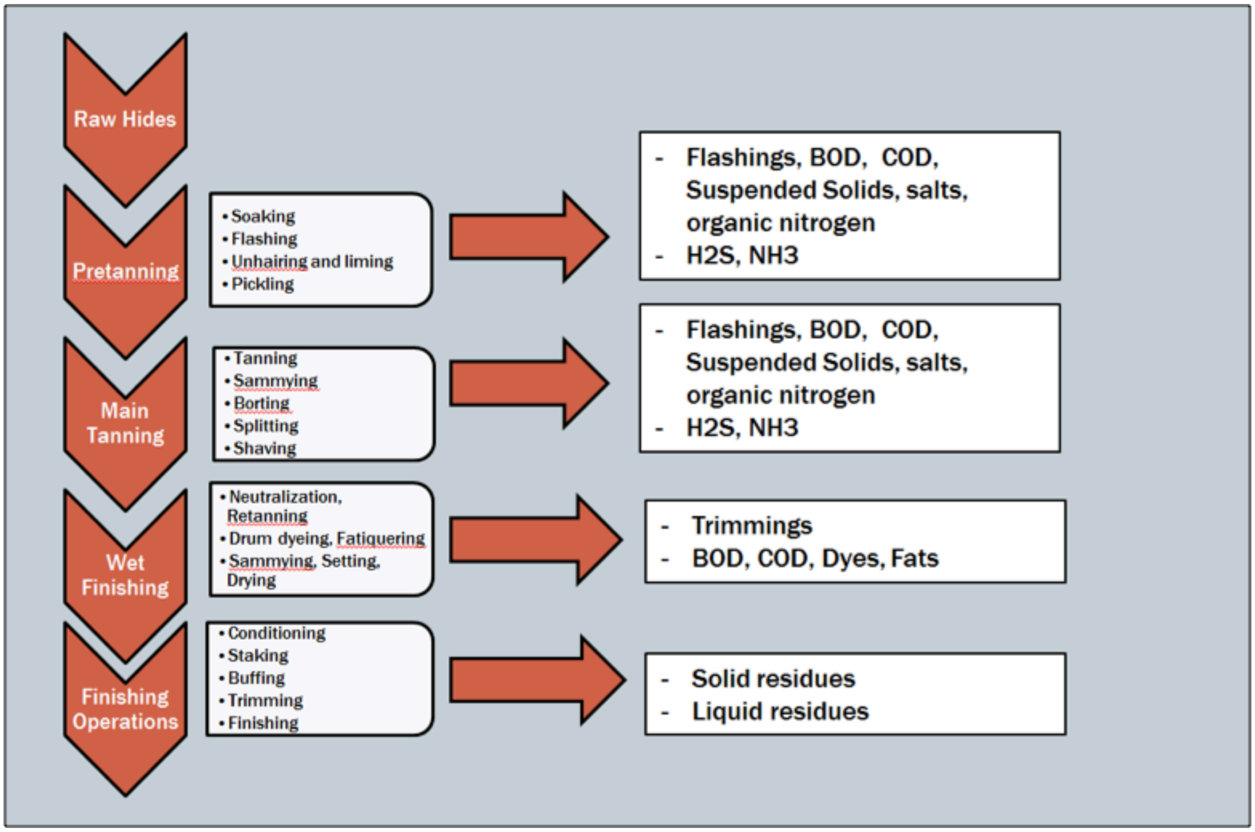
Appendix 1: Detailed list of Deckers facilities

Source(s): Deckers Outdoor Corporation personal communications

Facility Name	Facility Type	Facility Location - City	Facility Location - State	Facility Location - Country
Deckers Camarillo	Retail Store	Camarillo	California	USA
Deckers Wrentham	Retail Store	Wrentham	Massachusetts	USA
Deckers Riverhead	Retail Store	Riverhead	New York	USA
Deckers Soho	Retail Store	New York	New York	USA
Deckers Woodbury	Retail Store	Central Valley	New York	USA
Deckers Chicago	Retail Store	Chicago	Illinois	USA
Deckers San Francisco	Retail Store	San Francisco	California	USA
Deckers Lincoln Square	Retail Store	New York	New York	USA
Deckers New Jersey	Retail Store	Tinton Falls	New Jersey	USA
Deckers Cabazon	Retail Store	Cabazon	California	USA
Deckers Honolulu	Retail Store	Honolulu	Hawaii	USA
Deckers Orlando	Retail Store	Orlando	Florida	USA
Deckers Georgetown	Retail Store	Washington DC	Maryland	USA
Deckers Miami	Retail Store	Miami Beach	Florida	USA
Deckers LA Grove	Retail Store	Los Angeles	California	USA
Deckers Las Vegas	Retail Store	Las Vegas	Nevada	USA
Deckers NYC Madison	Retail Store	New York	New York	USA
Deckers Ventura	Retail Store	Ventura	California	USA
Flagstaff Office	Office	Arizona	Arizona	USA
HQ - Goleta Office	Office	Goleta	California	USA
Richmond/Alameda Office	Office	Richmond	California	USA
Camarillo Distribution Center 2	Distribution	Camarillo	California	USA
Ventura Distribution Center 1	Distribution	Ventura	California	USA
New York Showroom	Showroom	New York	New York	USA
Long Acre Concept Store	Retail Store	London		UK
Manchester Concept Store	Retail Store	Manchester		UK
Westfield Concept Store	Retail Store	London		UK
Bicester	Retail Store	Bicester	Oxfordshire	UK
UK Office	Office	Richmond		UK
London Office	Office	London		UK
Moscow	Retail Store	Moscow		Russia
Benelux	Distribution	Netherlands		Netherlands
Tokyo Concept Store	Retail Store	Tokyo		Japan
Japan Office	Office	Tokyo		Japan
Beijing Concept Store	Retail Store	Beijing		China
Guangzhou Office	Office	Guangzhou		China
Hong Kong Office	Office	Hong Kong		China
Macau Office	Office	Macau		China
Beijing Corporate Office	Office	Beijing		China
Shanghai Country Office	Office	Shanghai		China
Montreal	Retail Store	Canada		Canada

Appendix 2: Pollution effects of leather tanning

Source(s): listed in body of writing



(Personal Communication with Deckers Staff-John Grabin)

Chromium is a toxic heavy metal that is carcinogenic, can cause genetic mutations, and has been connected with malformed embryos and fetuses (Leather Working Group 2010; Belay 2010). Roughly 90 percent of global leather production is through chrome-tanning processes. Leather is one of the top materials used in Deckers products and therefore its environmental impacts are particularly important to consider in an impact assessment.

During the tanning process, only a small percentage of the chromium salts react with the skins. Subsequently, the remaining salts stay in the tanning bath and must be treated before being discharged from the facility (Wionczyk et al 2006). Waste water concentrations of chromium range from 500 to 3000 ppm (parts per million), depending on tanning processing technology (Aravindhan et al 2004). Recommended discharge limits range from one to twenty mg/l depending on whether the effluent is discharged directly into a water body or into a public sewer system (the latter allowing for higher concentrations) (Tadesse et al 2006). Based on these recommended levels, treatment systems need to reduce chromium concentrations over 200 fold to meet discharge standards; this is not practical in many cases (Tadesse et al 2006).

Additional pollutants in wastewater from tanning operations include high alkalinity, BOD, TKN, phosphate, chloride and suspended solids (Leather Working Group 2010). These pollutants are often discharged in concentrations higher than the assimilation capacity of the environment (Belay 2010).

Relative to the toxicity of chromium, these pollutants have a lesser impact on the environment, and therefore have received less attention from research scientists.

Multi-stakeholder groups have emerged around the world consisting of brands, suppliers, NGOs, manufacturers and end users of the leather industry to address compliance and environmental performance of tanning operations. One of these groups, The Leather Working Group (LWG), has developed a rating protocol to assess tannery operations and promote sustainable management practices specifically for the leather footwear industry. To date, the LWG has audited 120 leather suppliers and provides a listing of the rated suppliers on its website.

Additionally, the China Leather Industry Association (CLIA), a group dedicated to bridging communications between government and industry, has helped the Ministry of Industry and Information in China identify guidelines for leather tanneries. As one of the world's leading producers of leather products, these efforts in China will be extremely important in setting new standards for tannery operations. Some of the goals outlined in the guidelines include:
by 2010, COD discharge decreased by 10 percent compared to 2007 levels
by 2010, increased efficiency of water use by 10 percent compared to 2007 levels
by the end of 2011, 50 percent of water will be recycled

The ministry also encouraged tanneries to improve the sustainability of operations in order to obtain a green certification called “Eco Leather Mark.” Unfortunately, despite allocating resources to address the environmental impacts of water consumption and water pollution, the Institute for Public and Environmental Affairs (IPE) in China listed 5 of the 40 companies using the Eco Leather Mark as having water pollution infractions in 2010.

Appendix 3: Literature-based data and sources

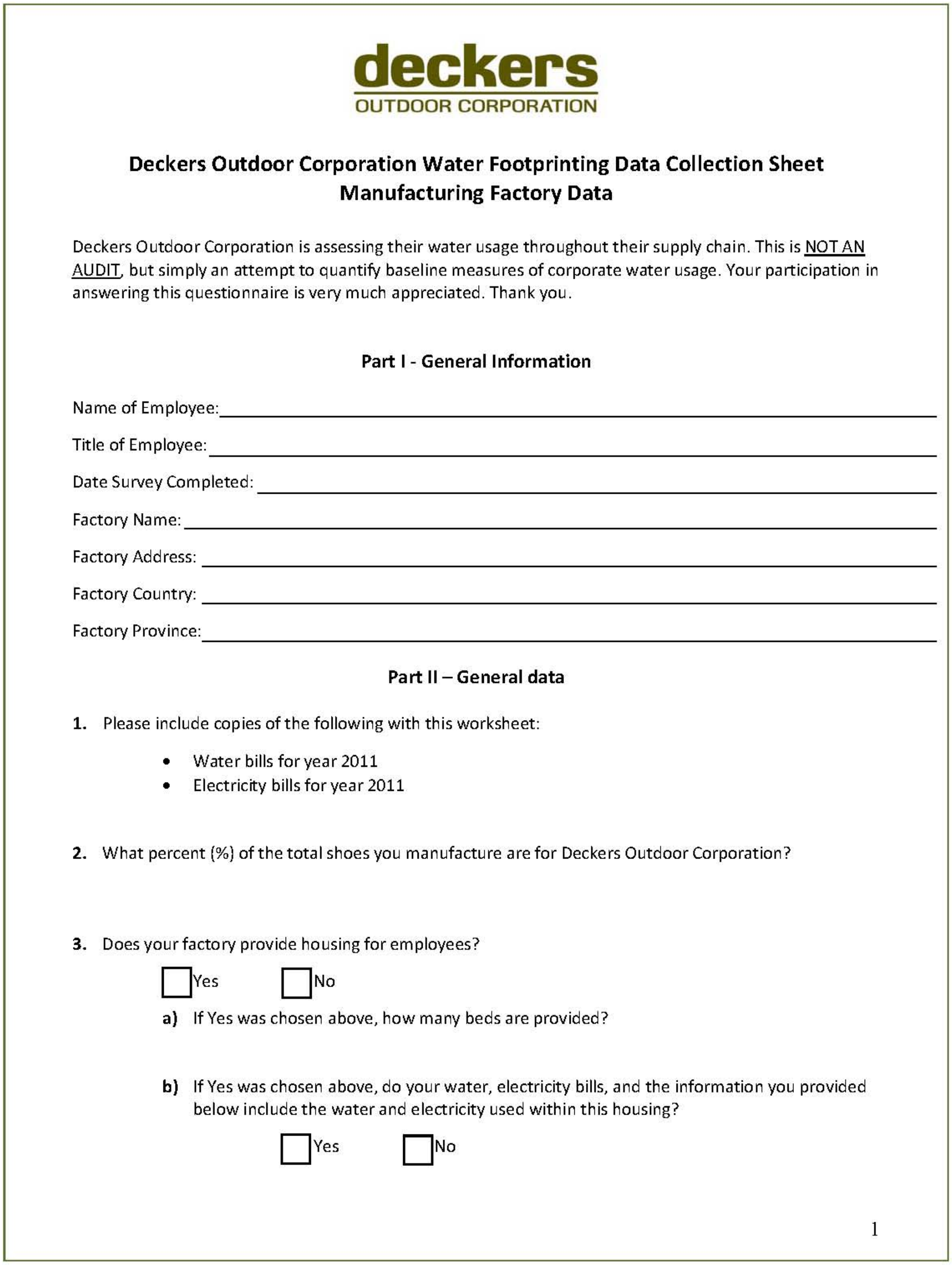
Source(s): listed in body of writing

Parameter	Value	Reference
Total pairs of shoes	18000000	Deckers 2010 Annual Report
Cutting Waste (15%)	1.15	Arcenas et al, 2010
UGG Sheepskin (g/pair)	292	Deckers pers comm 2011
UGG Cowhide (g/pair)	26	Deckers pers comm 2011
UGG EVA Outsole (g/pair)	230	Deckers pers comm 2011
TEVA Cowhide (g/pair)	228	Deckers pers comm 2011
TEVA Rubber (g/pair)	494	Deckers pers comm 2011
UGG Marketshare	87.2%	Deckers 2010 Annual Report
TEVA Marketshare	10.1%	Deckers 2010 Annual Report
Electricity (kWh) / Sheepskin (ton)	3436.2	Barber et al, 2006
Electricity (kWh) / Cowhide (ton)	1927.7	Bruno et al
Global Avg Blue Water (m3) /Sheepskin (ton)	212	Mekonnen & Hoeskstra, 2010
Global Avg Blue Water (m3) /Cowhide (ton)	679	Mekonnen & Hoeskstra, 2010
Electricity (kWh) / EVA (ton)	333	Eco Invent Center
Global Avg Blue Water (m3) / EVA (ton)	36	Eco Invent Center
Electricity (kWh) / Rubber - Natural (ton)	271	Eco Invent Center
Electricity (kWh) / Rubber - Synthetic (ton)	271	Eco Invent Center
Global Avg Blue Water (m3) / Rubber - Natural (ton)	361	Mekonnen & Hoeskstra, 2010
Global Avg Blue Water (m3) / Rubber - Synthetic (ton)	1.8	Eco Invent Center
Industrial Water Consumption Factor	15%	World Economic Forum (USDA reference)
Refrigeration tons/ft^2	700	Weimar & Browning, 2010
GPD (gallons per day)	43.2	Weimar & Browning, 2010
Transmission Loss (6.16%)	1.06	US EPA, eGrid 2007

Appendix 4: Deckers factory survey

Source(s): designed by the DeckersWater team

This data collection sheet, or survey, is modified and expanded from the original survey delivered to the factories in our study.



deckers
OUTDOOR CORPORATION

Deckers Outdoor Corporation Water Footprinting Data Collection Sheet
Manufacturing Factory Data

Deckers Outdoor Corporation is assessing their water usage throughout their supply chain. This is NOT AN AUDIT, but simply an attempt to quantify baseline measures of corporate water usage. Your participation in answering this questionnaire is very much appreciated. Thank you.

Part I - General Information

Name of Employee: ______________________________

Title of Employee: ______________________________

Date Survey Completed: ______________________________

Factory Name: ______________________________

Factory Address: ______________________________

Factory Country: ______________________________

Factory Province: ______________________________

Part II – General data

1. Please include copies of the following with this worksheet:

- Water bills for year 2011
- Electricity bills for year 2011

2. What percent (%) of the total shoes you manufacture are for Deckers Outdoor Corporation?

3. Does your factory provide housing for employees?

☐ Yes ☐ No

a) If Yes was chosen above, how many beds are provided?

b) If Yes was chosen above, do your water, electricity bills, and the information you provided below include the water and electricity used within this housing?

☐ Yes ☐ No

1

Part III – Specific data

1. How much water did your factory INTAKE for year 2011, broken down by month?
(How much water came into the factory?)

Please indicate measurement UNIT here:

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	**Total**
Amount													

2. How much water LEFT your factory for year 2011, broken down by month?
(How much water went out of the factory?)

Please indicate measurement UNIT here:

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	**Total**
Amount													

3. What is your cost per unit volume for water?

Cost:

Unit:

a) Does the cost per unit of water change based on the amount of water you use?

☐ Yes ☐ No

b) If Yes was chosen above, please list the costs per unit of water volume used:

Your Factory

Water Quantity Used	**Price/Unit**

Example

Water Quantity Used	**Price/Unit**
0 – 2000 m^3	0.8 RMB / m^3
2001 – 5000 m^3	1.0 RMB / m^3
>5000 m^3	1.2 RMB / m^3

4. Where does water for your factory come from? Please check all that apply:

☐ Underground Well
☐ Water Supply Company - Please give name:
☐ Government Supplier - Please give name:

2

☐ Other – Please give name:

5. Does your factory intake salt water for any reason?

☐ Yes ☐ No

a) If Yes was chosen above, please indicate what salt water is used for:

b) If Yes was chosen above, please indicate how much salt water is used (please give unit):

6. How much electricity did your factory use for year 2011, broken down by month?
(How much electricity was used within the factory?)

Please indicate measurement UNIT here:

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	**Total**
Amount													

7. What size HVAC system (heating, ventilation, and air conditioning) does your factory have?

Please check months that it is used:

☐ January
☐ February
☐ March
☐ April
☐ May
☐ June
☐ July
☐ August
☐ September
☐ October
☐ November
☐ January

8. Does your factory have waste-water treatment on site?

☐ Yes ☐ No

a) If Yes was chosen above, what kind of treatment is done? Please check all that apply:

☐ Primary
☐ Secondary
☐ Tertiary
☐ Reverse Osmosis
☐ Other

b) What proportion (%) of your electric bill goes towards on-site, waste-water treatment?

9. Is water recycled for other uses throughout your facility?
(for example, do you re-use water for landscaping or toilets)

☐ Yes ☐ No

a) How much water do you recycle throughout your facility? (please give unit)

10. Does your waste-water go to a treatment facility off site or into a body of water?

a) Does your factory measure pollutant loads leaving the facility?

☐ Yes ☐ No

b) If Yes was chosen above, please provide yearly averages and units for all pollutant loads measured (for example, what was the load measured for total dissolved solids, heavy metals, sulfates, salts, nitrogen, phosphorous, etc.):

11. What sources were used to answer this questionnaire?
(for example, meters, water bills, etc...)

12. Please Sign and Date:____

Appendix 5: Factory survey results

Source(s): surveys returned to DeckersWater from Chinese factories via personal communications with Deckers Outdoor Corporation

WATER INTAKE (metric T)													
Factory ID	January	February	March	April	May	June	July	August	September	October	November	December	Total
1	27,397	27,178	24,995	25,628	25,992	26,301	28,194	28,242	26,786	26,469	26,316	24,388	317,886
2	31,728	27,018	29,439	50,192	46,972	40,304	41,646	43,365	42,118	40,368	38,654	37,000	468,804
3	35,443	26,422	35,165	35,272	40,200	35,947	49,731	49,522	48,162	46,327	43,111	45,260	490,562
4	4,270	3,651	3,861	1,646	3,600	2,093	1,761	8,420	1,327	806	733	10,039	42,207
5	61,064	55,262	48,473	67,607	84,625	74,671	92,674	96,717	70,337	52,216	76,597	72,232	852,475
6					322	884	783	595	588	492	513	478	4,655

WATER LEAVING (metric T)													
Factory ID	January	February	March	April	May	June	July	August	September	October	November	December	Total
1	27,397	27,178	24,995	25,628	25,992	26,301	28,194	28,242	26,786	26,469	26,316	24,388	317,886
2	31,728	27,018	29,439	50,192	46,972	40,304	41,646	43,365	42,118	40,368	38,654	37,000	468,804
3	35,443	26,422	35,165	35,272	40,200	35,947	49,731	49,522	48,162	46,327	43,111	45,260	490,562
4				49,036	7,264	1,476	22,685	25,670	19,945	16,294	8,433	9,883	160,685
5	136,759	110,479	14,291	19,933	24,951	22,016	27,324	28,516	20,738	15,395	22,584	21,297	464,283
6													

ELECTRICTY (kWh)													
Factory ID	January	February	March	April	May	June	July	August	September	October	November	December	Total
1	9,672,585	612,177	1,002,663	1,135,313	1,276,601	1,317,118	1,414,353	1,457,704	1,288,670	1,074,478	1,036,283	1,039,410	22,327,354
2	743,694	547,603	789,193	810,282	859,923	942,195	1,019,729	970,045	754,540	575,723	738,773	789,204	9,540,904
3	597,195	396,090	631,590	706,290	780,150	810,102	931,425	893,865	865,365	777,255	788,595	757,575	8,935,497
4	332,640	250,300	437,060	411,300	445,660	463,900	499,780	492,540	406,180	323,560	344,120	429,820	4,836,860
5	185,600	195,000	100,400	384,000	2,382,000	3,430,000	3,128,400	2,857,200	2,848,400	2,365,600	2,373,600	2,346,200	22,596,400
6					5,640	28,020	36,600	31,140	30,420	26,640	21,060	18,540	198,060

We do not have data for the volume of water leaving factory 6. The survey notes indicated that the water leaving the factory cannot be measured since the water is sourced from wells. We were not able to clarify this comment with the factory contact.

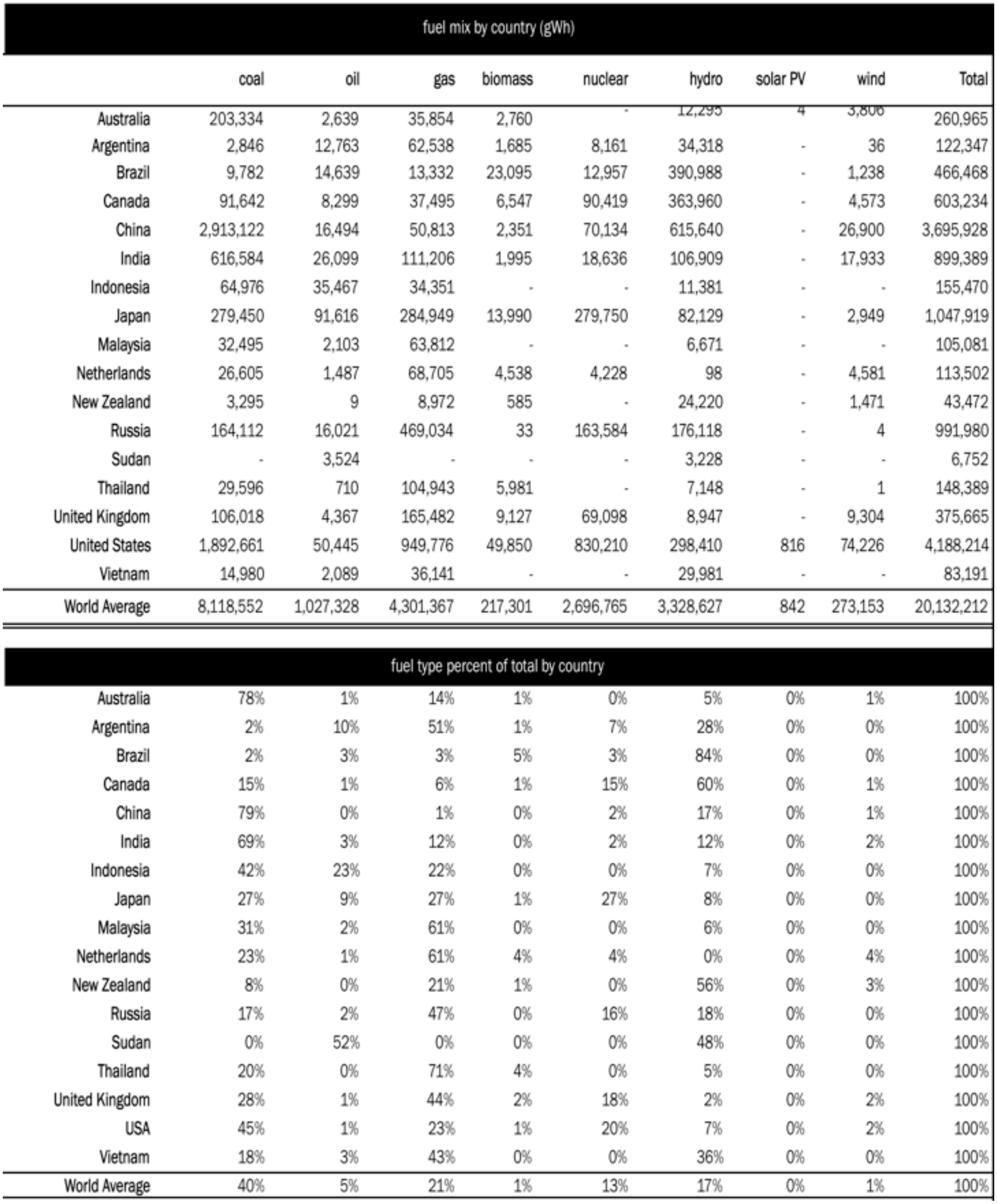
Appendix 6: Deckers facility data

Source(s): Deckers Outdoor Corporation personal communications; survey results; Google Maps; Weimar & Browning 2010; DOE Guidelines for Estimating Unmetered Landscaping Water Use,2010

Facility Name	Facility Type	Facility Location - City	Facility Location - State	Facility Location - Country	Square Footage	Refrigeration tons	GPD	Total m^3	kWh	With Transmission Loss	Area of Complex
Deckers Camarillo	Retail Store	Camarillo	California	USA	3016	4	186	190	89,163	94652	
Deckers Wrentham	Retail Store	Wrentham	Massachusetts	USA	3485	5	215	220	83,854	89016	764270
Deckers Riverhead	Retail Store	Riverhead	New York	USA	3000	4	185	189	84,816	90037	418162
Deckers Soho	Retail Store	New York	New York	USA	3358	5	207	212	97,094	103071	
Deckers Woodbury	Retail Store	Central Valley	New York	USA	3025	4	187	191	83,056	88169	96472
Deckers Chicago	Retail Store	Chicago	Illinois	USA	3908	6	241	247	206,795	219526	43201
Deckers San Franciscc	Retail Store	San Francisco	California	USA	4274	6	264	270	70,032	74343	
Deckers Lincoln Squar	Retail Store	New York	New York	USA	7054	10	435	445	118,763	126074	
Deckers New Jersey	Retail Store	Tinton Falls	New Jersey	USA	5253	8	324	331	120,993	128441	
Deckers Cabazon	Retail Store	Cabazon	California	USA	4000	6	247	252	94,364	100173	240042
Deckers Honolulu	Retail Store	Honolulu	Hawaii	USA	3753	5	232	237	90,000	95540	83863
Deckers Orlando	Retail Store	Orlando	Florida	USA	3037	4	187	192	90,000	95540	816316
Deckers Georgetown	Retail Store	Washington DC	Maryland	USA	2531	4	156	160	90,000	95540	
Deckers Miami	Retail Store	Miami Beach	Florida	USA	2295	3	142	145	90,000	95540	
Deckers LA Grove	Retail Store	Los Angeles	California	USA	2319	3	143	146	68,000	72186	
Deckers Las Vegas	Retail Store	Las Vegas	Nevada	USA	2922	4	180	184	95,000	100848	624237
Deckers NYC Madison	Retail Store	New York	New York	USA	4662	7	288	294	204,000	216558	
Deckers Ventura	Retail Store	Ventura	California	USA	1500	2	93	95	45,000	47770	
Flagstaff Office	Office	Arizona	Arizona	USA	9000	13	555	568	225,000	238851	
HQ - Goleta Office	Office	Goleta	California	USA	52000	74	3209	3280	1,537,000	1631618	
Richmond/Alameda O	Office	Richmond	California	USA	3000	4	185	189	90,000	95540	
Camarillo Distribution	Distribution	Camarillo	California	USA	300000	429	18514	18923	7,000,000	7430920	
Ventura Distribution Ce	Distribution	Ventura	California	USA	120000	171	7406	7569	3,000,000	3184680	
New York Showroom	Showroom	New York	New York	USA	4395	6	271	277	100,000	106156	
Long Acre Concept Sto	Retail Store	London		UK	2200	3	136	139	90,000	95540	
Manchester Concept S	Retail Store	Manchester		UK	4461	6	275	281	200,000	212312	
Westfield Concept Sto	Retail Store	London		UK	4283	6	264	270	200,000	212312	
Bicester	Retail Store	Bicester	Oxfordshire	UK	3674	5	227	232	100,000	106156	
UK Office	Office	Richmond		UK	7045	10	435	444	125,000	132695	
London Office	Office	London		UK	10431	15	644	658	250,000	265390	
Moscow	Retail Store	Moscow		Russia	2200	3	136	139	95,000	100848	
Benelux	Distribution	Netherlands		Netherlands	175000	250	10800	11038	4,611,000	4894853	
Tokyo Concept Store	Retail Store	Tokyo		Japan	862	1	53	54	51,260	54416	
Japan Office	Office	Tokyo		Japan	431.07	1	27	27	63,740	67664	
Beijing Concept Store	Retail Store	Beijing		China	1841	3	114	116	125,000	132695	
Guangzhou Office	Office	Guangzhou		China	10390	15	641	655	240,000	254774	
Hong Kong Office	Office	Hong Kong		China	1100	2	68	69	45,000	47770	
Macau Office	Office	Macau		China	2843	4	175	179	95,000	100848	
Beijing Corporate Offic	Office	Beijing		China	3948	6	244	249	45,000	47770	
Shanghai Country Offic	Office	Shanghai		China	215	0	13	14	35,000	37155	
Montreal	Retail Store	Canada		Canada	2200	3	136	139	95,000	100848	

Appendix 7: Breakdown of fuel mix by country

Source(s): International Energy Agency Database
(http://www.iea.org/stats/prodresult.asp?PRODUCT=Electricity/Heat)



fuel mix by country (gWh)

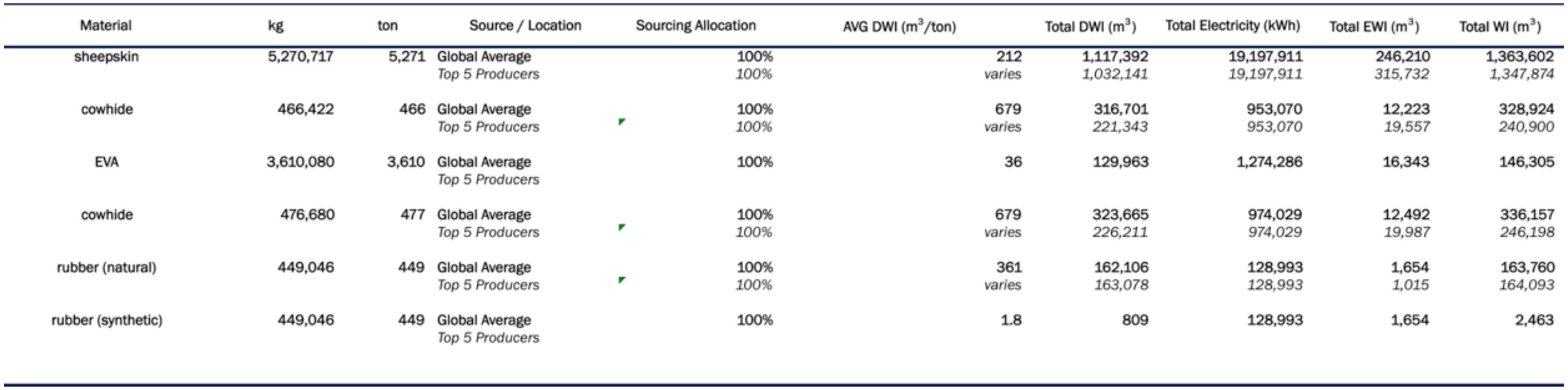
	coal	oil	gas	biomass	nuclear	hydro	solar PV	wind	Total
Australia	203,334	2,639	35,854	2,760	-	12,295	4	3,806	260,965
Argentina	2,846	12,763	62,538	1,685	8,161	34,318	-	36	122,347
Brazil	9,782	14,639	13,332	23,095	12,957	390,988	-	1,238	466,468
Canada	91,642	8,299	37,495	6,547	90,419	363,960	-	4,573	603,234
China	2,913,122	16,494	50,813	2,351	70,134	615,640	-	26,900	3,695,928
India	616,584	26,099	111,206	1,995	18,636	106,909	-	17,933	899,389
Indonesia	64,976	35,467	34,351	-	-	11,381	-	-	155,470
Japan	279,450	91,616	284,949	13,990	279,750	82,129	-	2,949	1,047,919
Malaysia	32,495	2,103	63,812	-	-	6,671	-	-	105,081
Netherlands	26,605	1,487	68,705	4,538	4,228	98	-	4,581	113,502
New Zealand	3,295	9	8,972	585	-	24,220	-	1,471	43,472
Russia	164,112	16,021	469,034	33	163,584	176,118	-	4	991,980
Sudan	-	3,524	-	-	-	3,228	-	-	6,752
Thailand	29,596	710	104,943	5,981	-	7,148	-	1	148,389
United Kingdom	106,018	4,367	165,482	9,127	69,098	8,947	-	9,304	375,665
United States	1,892,661	50,445	949,776	49,850	830,210	298,410	816	74,226	4,188,214
Vietnam	14,980	2,089	36,141	-	-	29,981	-	-	83,191
World Average	8,118,552	1,027,328	4,301,367	217,301	2,696,765	3,328,627	842	273,153	20,132,212

fuel type percent of total by country

Australia	78%	1%	14%	1%	0%	5%	0%	1%	100%
Argentina	2%	10%	51%	1%	7%	28%	0%	0%	100%
Brazil	2%	3%	3%	5%	3%	84%	0%	0%	100%
Canada	15%	1%	6%	1%	15%	60%	0%	1%	100%
China	79%	0%	1%	0%	2%	17%	0%	1%	100%
India	69%	3%	12%	0%	2%	12%	0%	2%	100%
Indonesia	42%	23%	22%	0%	0%	7%	0%	0%	100%
Japan	27%	9%	27%	1%	27%	8%	0%	0%	100%
Malaysia	31%	2%	61%	0%	0%	6%	0%	0%	100%
Netherlands	23%	1%	61%	4%	4%	0%	0%	4%	100%
New Zealand	8%	0%	21%	1%	0%	56%	0%	3%	100%
Russia	17%	2%	47%	0%	16%	18%	0%	0%	100%
Sudan	0%	52%	0%	0%	0%	48%	0%	0%	100%
Thailand	20%	0%	71%	4%	0%	5%	0%	0%	100%
United Kingdom	28%	1%	44%	2%	18%	2%	0%	2%	100%
USA	45%	1%	23%	1%	20%	7%	0%	2%	100%
Vietnam	18%	3%	43%	0%	0%	36%	0%	0%	100%
World Average	40%	5%	21%	1%	13%	17%	0%	1%	100%

Appendix 8: Material calculation summary

Source(s): DeckersWater calculations



Material	kg	ton	Source / Location	Sourcing Allocation	AVG DWI (m^3/ton)	Total DWI (m^3)	Total Electricity (kWh)	Total EWI (m^3)	Total WI (m^3)
sheepskin	5,270,717	5,271	Global Average	100%	212	1,117,392	19,197,911	246,210	1,363,602
			Top 5 Producers	*100%*	*varies*	*1,032,141*	*19,197,911*	*315,732*	*1,347,874*
cowhide	466,422	466	Global Average	100%	679	316,701	953,070	12,223	328,924
			Top 5 Producers	*100%*	*varies*	*221,343*	*953,070*	*19,557*	*240,900*
EVA	3,610,080	3,610	Global Average	100%	36	129,963	1,274,286	16,343	146,305
			Top 5 Producers						
cowhide	476,680	477	Global Average	100%	679	323,665	974,029	12,492	336,157
			Top 5 Producers	*100%*	*varies*	*226,211*	*974,029*	*19,987*	*246,198*
rubber (natural)	449,046	449	Global Average	100%	361	162,106	128,993	1,654	163,760
			Top 5 Producers	*100%*	*varies*	*163,078*	*128,993*	*1,015*	*164,093*
rubber (synthetic)	449,046	449	Global Average	100%	1.8	809	128,993	1,654	2,463
			Top 5 Producers						

Appendix 9: Natural material top producers

Source(s): DeckersWater calculations; Food and Agriculture Organization of the United Nations-FAOstat (http://faostat.fao.org/)

Supply Chain Stage	Brand	Material	kg	ton	(FAO Stat) Source / Location	Sourcing Allocation	AVG DWI (m^3/ton)	Total DWI (m^3)	Total Electricity (kWh)	Total EWI (m^3)	Total WI (m^3)
Material Prod	UGG	sheepskin	5,270,717	5,271	Global Averag	100%	212	1,117,392	19,197,911	246,210	1,363,602
					Top 5 Producers	*100%*	*varies*	*1,032,141*	*19,197,911*	*315,732*	*1,347,874*
					China	54%	183	521,355.35	10,376,886	134,730	
					India	15%	259	205,893	2,895,511	28,232	
					Australia	10%	185	101,988	2,007,998	9,964	
					New Zealand	10%	204	110,796	1,978,229	75,712	
					Sudan	10%	173	92,109	1,939,288	67,094	
Material Prod	UGG	cowhide	466,422	466	Global Averag	100%	679	316,701	953,070	12,223	328,924
					Top 5 Produc	*100%*	*varies*	*221,343*	*953,070*	*19,557*	*240,900*
					China	31%	515	73,818	292,886	3,803	
					United States	25%	658	75,433	234,251	1,533	
					Brazil	20%	246	23,370	194,120	11,136	
					India	16%	251	18,813	153,158	1,493	
					Argentina	8%	777	29,909	78,654	1,592	
Material Prod	UGG	EVA	3,610,080	3,610	Global Averag	100%	36	129,963	1,274,286	16,343	146,305
					Top 5 Producers						
Material Prod	Teva	cowhide	476,680	477	Global Averag	100%	679	323,665	974,029	12,492	336,157
					Top 5 Produc	*100%*	*varies*	*226,211*	*974,029*	*19,987*	*246,198*
					China	31%	515	75,441	299,327	3,886	
					United States	25%	658	77,092	239,402	1,567	
					Brazil	20%	246	23,884	198,389	11,381	
					India	16%	251	19,227	156,526	1,526	
					Argentina	8%	777	30,566	80,384	1,627	
Material Prod	Teva	rubber (natur	449,046	449	Global Averag	100%	361	162,106	128,993	1,654	163,760
					Top 5 Produc	*100%*	*varies*	*163,078*	*128,993*	*1,015*	*164,093*
					Thailand	37%	715	117,988.21	47,403	212.63	
					Indonesia	34%	0	-	43,311	300.89	
					Malaysia	10%	2	93	13,341	75.01	
					India	10%	836	38,469	13,219	128.89	
					Vietnam	9%	160	6,528	11,719	297.69	

Appendix 10: Flow-sheet of a shoe making factory

Source(s): M. Herva et al 2011

M. Herva et al. / Journal of Hazardous Materials 192 (2011) 1876–1881

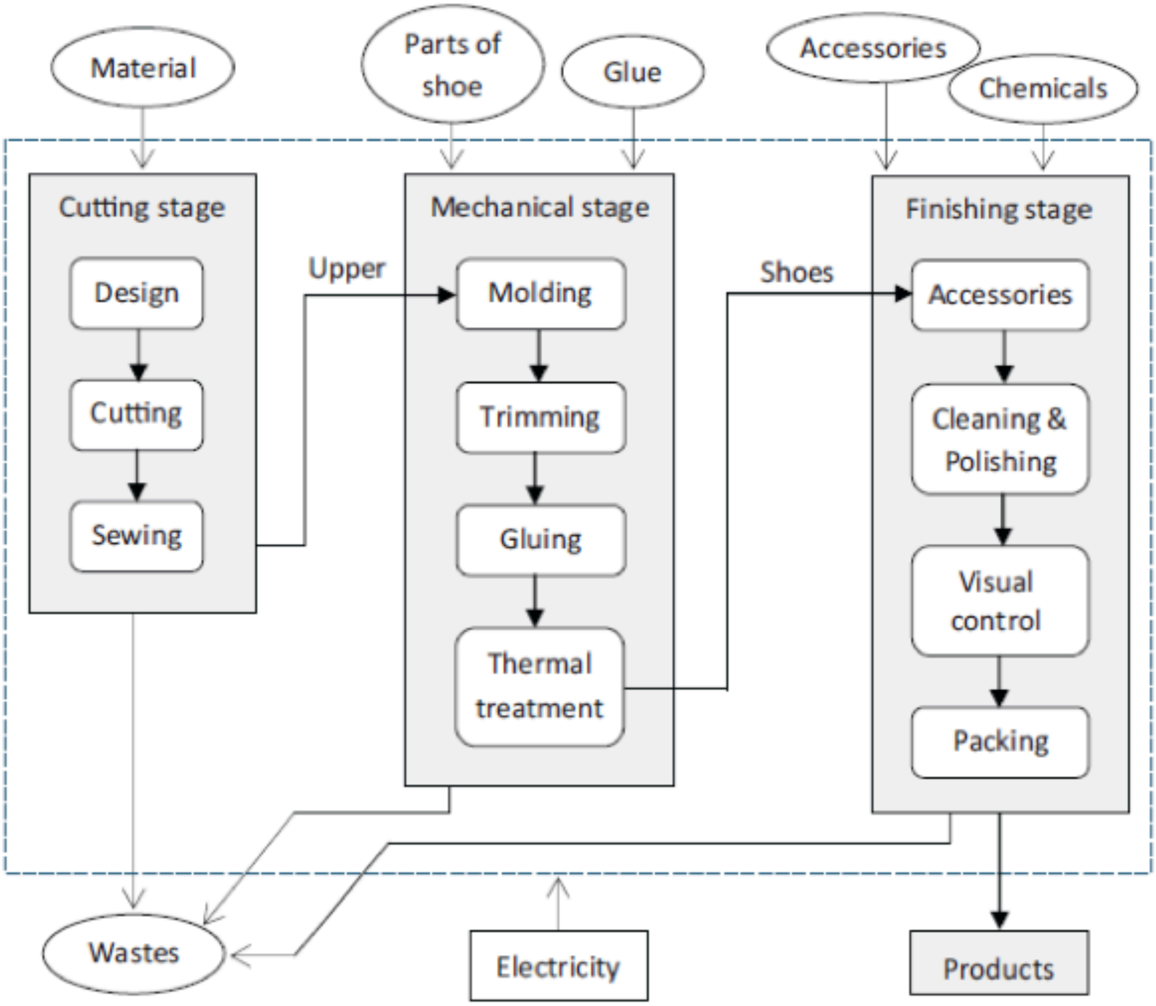


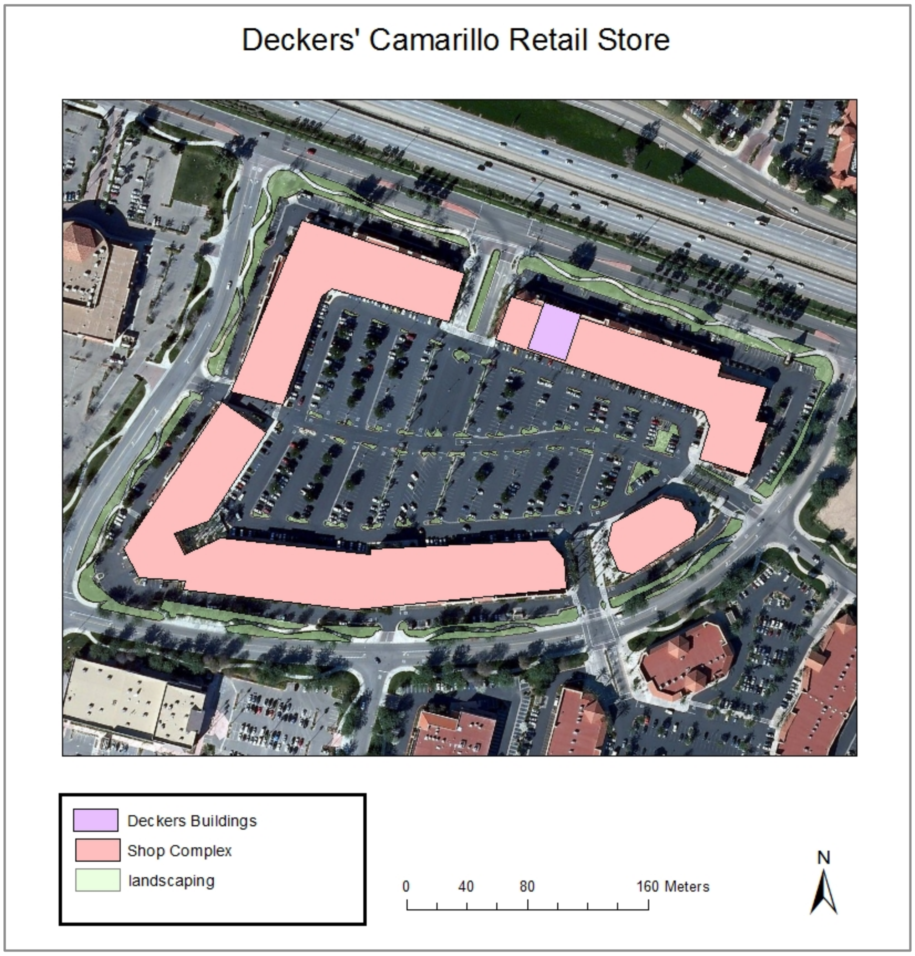
Fig. 1. Flowsheet of the shoemaking factory.

Appendix 11: Detailed Landscaping Methods & Maps

Source(s): listed in body of text

Deckers Facilities Direct Water - Landscaping methodology:

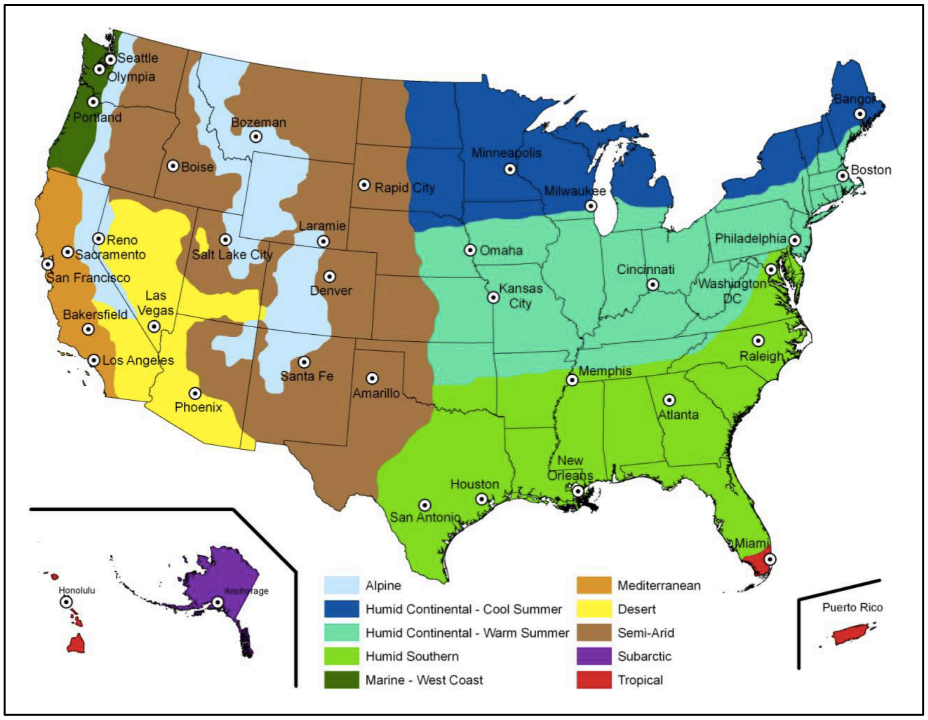
Annual Landscape Water Calculation (DOE, Guidelines for Estimating Unmetered Landscaping Water Use, 2010)



Took percentage of landscaping attributed to Deckers Facility using ArcGIS

$$\text{Annual Landscape Water Use}\left(\frac{gal}{yr}\right)=\frac{\text{Annual Irrigation Factor}\left(\frac{gal}{sqft-yr}\right)\times \text{Irrigation Area }(sqft)}{\text{Irrigation System Efficiency}}$$

Deckers Facilities Direct Water – US Climate Zones



(DOE, Guidelines for Estimating Unmetered Landscaping Water Use, 2010)

Climate Zones Descriptions:

- *Alpine*: high mountain regions of the Rocky Mountains, Sierra Nevada, and Cascade Mountain ranges
- *Desert*: regions of the U.S. that receive very little precipitation including southern Arizona, south eastern California, southern Utah, and Nevada
- *Humid Continental (cool summer):* northeastern areas of the U.S. that typically have cooler summers and harsh winters such as up-state New York, Vermont, Minnesota, and Wisconsin
- *Humid Continental (warm summer):* Midwestern and northeastern areas of the U.S. with hotter summers and milder winters such as Ohio, Indiana, and Pennsylvania
- *Humid Southern*: hot humid regions of the southern U.S. such as Mississippi, middle and eastern Texas, Georgia, and Florida
- *Mediterranean*: western regions of California
- *Marine - West Coast*: coastal regions of Oregon and Washington
- *Semi-arid*: regions of the U.S. which are characterized by grasslands or sparsely treed areas that have relatively low levels of precipitation such as western Kansas, New Mexico, Idaho, and eastern Wyoming and eastern Colorado
- *Subarctic*: Very cold regions, namely Alaska
- *Tropical*: regions in the U.S. that are hot and humid and have no significant seasonal changes including the southern tip of Florida, Hawaii, and Puerto Rico

Deckers Facilities Direct Water – Irrigation Factors

Climate Zone	City	State	Cool Season Turf	Warm Season Turf
Alpine	Bozeman	MT	8.92	4.61
Alpine	Laramie	WY	11.62	8.62
Alpine	Santa Fe	NM	12.67	7.77
Desert	Bakersfield	CA	30.76	22.28
Desert	Las Vegas	NV	44.13	31.85
Desert	Phoenix	AZ	44.96	32.16
Desert	Reno	NV	20.22	14.78
Humid Continental - Cool Summer	Bangor	ME	0.85	0.05
Humid Continental - Cool Summer	Milwaukee	WI	3.63	0.73
Humid Continental - Cool Summer	Minneapolis	MN	5.3	0.73
Humid Continental - Warm Summer	Boston	MA	4.63	0.97
Humid Continental - Warm Summer	Cincinnati	OH	3.66	0.47
Humid Continental - Warm Summer	Kansas City	MO	4.31	0.81
Humid Continental - Warm Summer	Omaha	NE	5.67	1.75
Humid Continental - Warm Summer	Philadelphia	PA	3.31	0.37
Humid Southern	Atlanta	GA	4.55	0.7
Humid Southern	Houston	TX	6.5	1.15
Humid Southern	Memphis	TN	7.35	3.22
Humid Southern	New Orleans	LA	1.47	0.1
Humid Southern	San Antonio	TX	19.37	10.82
Humid Southern	Raleigh	NC	3.33	0.2
Humid Southern	Washington	DC	5.2	0.91
Marine - West Coast	Olympia	WA	6.03	3.28
Marine - West Coast	Portland	OR	7.2	4.1
Marine - West Coast	Seattle	WA	7.45	4.43
Mediterranean	Los Angeles	CA	20.72	14.64
Mediterranean	Sacramento	CA	22.86	17.35
Mediterranean	San Francisco	CA	14.13	10.34
Semi-arid	Amarillo	TX	25.53	15.47
Semi-arid	Boise	ID	13.68	9.41
Semi-arid	Denver	CO	14.3	9.57
Semi-arid	Rapid City	SD	11.98	6.78
Semi-arid	Salt Lake City	UT	18.83	13.24
Subarctic	Anchorage	AK	3.49	1.78
Tropical	Honolulu	HI	0.34	0
Tropical	Miami	FL	7.92	3.3

(DOE, Guidelines for Estimating Unmetered Landscaping Water Use, 2010)

Appendix 12: Summary of findings for each level of the supply chain

Source(s): DeckersWater calculations

Supply Chain Stage	Brand	Material	kg	ton	Source / Location	Sourcing Allocation	AVG DWI (m^3/ton)	Total DWI (m^3)	Total Electricity (kWh)	Total EWI (m^3)	Total WI (m^3)
Material Production	**UGG**	**sheepskin**	**5,270,717**	**5,271**	**Global Average**	**100%**	**212**	**1,117,392**	**19,197,911**	**246,210**	**1,363,602**
					Top 5 Producers	*100%*	*varies*	*1,032,141*	*19,197,911*	*315,732*	*1,347,874*
Material Production	**UGG**	**cowhide**	**466,422**	**466**	**Global Average**	**100%**	**679**	**316,701**	**953,070**	**12,223**	**328,924**
					Top 5 Producers	*100%*	*varies*	*221,343*	*953,070*	*19,557*	*240,900*
Material Production	**UGG**	**EVA**	**3,610,080**	**3,610**	**Global Average**	**100%**	**36**	**129,963**	**1,274,286**	**16,343**	**146,305**
					Top 5 Producers						
Material Production	**TEVA**	**cowhide**	**476,680**	**477**	**Global Average**	**100%**	**679**	**323,665**	**974,029**	**12,492**	**336,157**
					Top 5 Producers	*100%*	*varies*	*226,211*	*974,029*	*19,987*	*246,198*
Material Production	**TEVA**	**rubber (natural)**	**449,046**	**449**	**Global Average**	**100%**	**361**	**162,106**	**128,993**	**1,654**	**163,760**
					Top 5 Producers	*100%*	*varies*	*163,078*	*128,993*	*1,015*	*164,093*
Material Production	**TEVA**	**rubber (synthetic)**	**449,046**	**449**	**Global Average**	**100%**	**1.8**	**809**	**128,993**	**1,654**	**2,463**
					Top 5 Producers						
Product Assembly	**ALL**	**ALL**	**-**	**-**	**Factories - ALL**	**100%**	**varies**	**439,480**	**-**	**-**	
					Factories - Sample	*-*	*-*	*133,887*	*-*	*-*	
Product Assemby	**ALL**	**ALL**	**-**	**-**	**Factories - ALL**	**100%**	**-**	**-**	**101,473,809**	**1,317,506**	
					Factories - Sample	*-*	*-*	*-*	*26,864,260*	*348,798*	
Deckers Facillities	**ALL**	**ALL**	**-**	**-**	**ALL**	**100%**	**1,208**	**71,542**	**21,484,839**	**120,117**	**191,659**
					US Operations	*59%*	*1,450*	*34,804*	*14,620,792*	*95,683*	
					International Operations	*41%*	*865*	*14,704*	*6,864,047*	*24,434*	

Appendix 13: Findings comparisons by supply chain stage

Source(s): DeckersWater calculations

	DWI	EWI	TWI
Material Production (Global Average)	2,050,636	290,576	2,341,212
Material Production (Top Producers)	1,773,545	374,289	2,147,834
Product Assembly	439,480	1,317,506	1,756,986
Deckers Facilites	71,542	120,117	191,659
Company Total (Global Average)	2,561,658	1,728,199	**4,289,857**
Company Total (Top Producers)	2,284,567	1,811,912	**4,096,479**

Supply Chain	Material Production		Product Assembly		Deckers Facilities	
Method	*Global Avg*	*Top Five*	*Global Avg*	*Top Five*	*Global Avg*	*Top Five*
Direct Water	48%	43%	10%	11%	2%	2%
Electricity	7%	9%	31%	32%	3%	3%
Total Water	55%	52%	41%	43%	4%	5%

Inventory breakdown by category (direct, electricity, or total water) and supply chain as a percent of the total company water inventory. For example, using global averages, direct water at the material production stage comprises 48 percent of the total company water inventory; electricity water at the material production stage comprises 7 percent of the total company water inventory; total water at the material production stage comprises 55 percent of the total company water inventory.

Supply Chain	Material Production		Product Assembly		Deckers Facilities	
Method	*Global Avg*	*Top Five*	*Global Avg*	*Top Five*	*Global Avg*	*Top Five*
Direct Water	80%	69%	17%	19%	3%	3%
Electricity	17%	21%	76%	73%	7%	7%
Total Water	55%	52%	41%	43%	4%	5%

Inventory breakdown by category (direct, electricity, or total water) and supply chain as a percent of the company total for that category across the supply chain. For example, using global averages, direct water at the material production stage comprises 80 percent of the total company direct water; electricity water at the material production stage comprises 17 percent of the total company electricity water; total water at the material production stage comprises 55 percent of the total company water inventory.

Appendix 14: Detailed findings for Teva and UGG brands

Source(s): DeckersWater calculations, tables represent findings using global averages

UGG						
	Material Production			Product Assembly	Deckers Facilities	Total
	Sheepskin	*Cowhide*	*EVA*	*All*	*All*	*All*
Direct Water Inventory	1,117,392	316,701	129,963	383,227	62,384	2,009,667
Electricity Water Inventory	246,210	12,223	16,343	1,148,865	104,742	1,528,383
Total Water Inventory	1,363,602	328,924	146,305	1,532,092	167,127	3,538,050

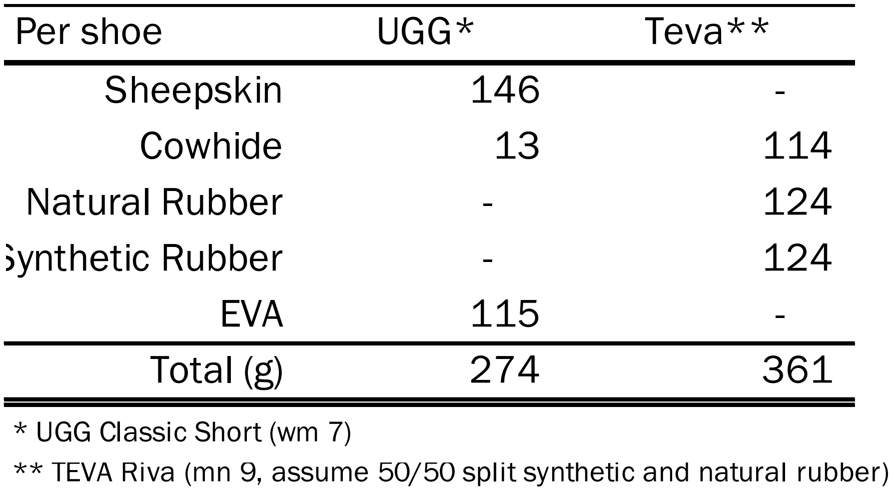
TEVA						
	Material Production			Product Assembly	Deckers Facilities	Total
	Cowhide	*Natural Rubber*	*Synthetic Rubber*	*All*	*All*	*All*
Direct Water Inventory	323,665	162,106	809	44,388	7,226	538,193
Electricity Water Inventory	12,492	1,654	1,654	133,068	12,132	161,000
Total Water Inventory	336,157	163,760	2,463	177,456	19,358	699,194

UGG				
	Material Production	Product Assembly	Deckers Facilities	Total
Direct Water Inventory	1,564,056	383,227	62,384	2,009,667
Electricity Water Inventory	274,776	1,148,865	104,742	1,528,383

TEVA				
	Material Production	Product Assembly	Deckers Facilities	Total
Direct Water Inventory	486,580	44,388	7,226	538,193
Electricity Water Inventory	15,800	133,068	12,132	161,000

Appendix 15: Material composition of sample shoes

Source(s): DeckersWater calculations; Food and Agriculture Organization of the United Nations-FAOstat (http://faostat.fao.org/)



Per shoe	UGG*	Teva**
Sheepskin	146	-
Cowhide	13	114
Natural Rubber	-	124
Synthetic Rubber	-	124
EVA	115	-
Total (g)	274	361

* UGG Classic Short (wm 7)

** TEVA Riva (mn 9, assume 50/50 split synthetic and natural rubber)

FAO Code	Description
836	Hevea brasiliensis Latex. The liquid secreted by the rubber tree. Includes stabilized or concentrated latex and prevulcanized rubber latex. In trade figures, liquid weight is converted to dry weight at 60%.
919	Green hide or skin as removed from the carcass of the animal (adult bovine). Used for production data only.
995	See 919. Both adult and young animals.

FAOSTAT (http://faostat.fao.org/) material category descriptions.

Appendix 16: Data tables from sensitivity analysis

Source(s): DeckersWater calculations

Pairs of Shoes Sold (no change to market share)	Baseline	18000000	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-15%	15300000	3938675.398	-8%	3774304.24	-8%
	-10%	16200000	4055736.007	-5%	3881695.958	-5%
	-5%	17100000	4172796.617	-3%	3989087.676	-3%
	0%	18000000	4289857.226	0%	4096479.393	0%
	5%	18900000	4406917.835	3%	4203871.111	3%
	10%	19800000	4523978.445	5%	4311262.829	5%
	15%	20700000	4641039.054	8%	4418654.547	8%
	20%	21600000	4758099.664	11%	4526046.264	10%
	25%	22500000	4875160.273	14%	4633437.982	13%
UGG/Teva Market Share	Baseline (change to UGG)	0.872	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-10%	0.7848	4539712.611	6%	4279330.046	4%
	-5%	0.8284	4414784.918	3%	4187904.72	2%
	0%	0.872	4289857.226	0%	4096479.393	0%
	5%	0.9156	4164929.534	-3%	4005054.067	-2%
	10%	0.9592	4040001.841	-6%	3913628.741	-4%
Cutting Waste	Baseline	1.15	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-10%	1.035	4086988.89	-5%	3912982.158	-4%
	-5%	1.0925	4188423.058	-2%	4004730.776	-2%
	0%	1.15	4289857.226	0%	4096479.393	0%
	5%	1.2075	4391291.394	2%	4188228.011	2%
	10%	1.265	4492725.562	5%	4279976.629	4%
	15%	1.3225	4594159.73	7%	4371725.247	7%
Sheepskin to Cowhide Composition (UGG)	Baseline change sheepskin composition	292	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-15%	248.2	4642857.894	8%	4302635.866	5%
	-11%	259.88	4548724.382	6%	4247660.807	4%
	-7%	271.56	4454590.871	4%	4192685.747	2%
	-3%	283.24	4360457.36	2%	4137710.688	1%
	1%	294.92	4266323.848	-1%	4082735.628	0%
	5%	306.6	4172190.337	-3%	4027760.569	-2%
	9%	318.28	4077929.533	-5%	3972692.282	-3%
Cowhide Composition (Teva)	Baseline	228	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-15%	193.8	4239433.642	-1.2%	4059549.66	-1%
	-10%	205.2	4256241.503	-0.8%	4071859.571	-1%
	-5%	216.6	4273049.365	-0.4%	4084169.482	0%
	0%	228	4289857.226	0.0%	4096479.393	0%
	5%	239.4	4306665.087	0.4%	4108789.304	0%

	10%	250.8	4323472.949	0.8%	4121099.215	1%
	15%	262.2	4340280.81	1.2%	4133409.127	1%
Natural to Synthetic Rubber Allocation	Baseline	247	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
	change to natural		4289857.226		4096479.393	
	-100%	0	4128560.801	-3.8%	3934849.799	-4%
	-50%	123.5	4209209.013	-1.9%	4015664.596	-2%
	0%	247	4289857.226	0.0%	4096479.393	0%
	50%	370.5	4370505.439	1.9%	4177294.19	2%
	100%	494	4451153.651	3.8%	4258108.987	4%
Global average consumption sheepskin	Baseline	212	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
			4289857.226		4096479.393	
	-25%	159	4010509.236	-6.5%	4096479.393	n/a
	-15%	180.2	4122248.432	-3.9%	4096479.393	n/a
	-5%	201.4	4233987.628	-1.3%	4096479.393	n/a
	5%	222.6	4345726.824	1.3%	4096479.393	n/a
	15%	243.8	4457466.02	3.9%	4096479.393	n/a
	25%	265	4569205.216	6.5%	4096479.393	n/a
	35%	286.2	4680944.413	9.1%	4096479.393	n/a
	45%	307.4	4792683.609	11.7%	4096479.393	n/a
Global average consumption cowhide	Baseline	679	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
			4289857.226		4096479.393	
	-25%	509.25	4129765.672	-3.7%	4096479.393	n/a
	-15%	577.15	4193802.294	-2.2%	4096479.393	n/a
	-5%	645.05	4257838.915	-0.7%	4096479.393	n/a
	5%	712.95	4321875.537	0.7%	4096479.393	n/a
	15%	780.85	4385912.158	2.2%	4096479.393	n/a
	25%	848.75	4449948.78	3.7%	4096479.393	n/a
Global average consumption natural rubber	Baseline	361	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
			4289857.226		4096479.393	
	-70%	108.3	4176383.302	-2.6%	4096479.393	n/a
	-50%	180.5	4208804.423	-1.9%	4096479.393	n/a
	-30%	252.7	4241225.544	-1.1%	4096479.393	n/a
	-10%	324.9	4273646.665	-0.4%	4096479.393	n/a
	10%	397.1	4306067.787	0.4%	4096479.393	n/a
	30%	469.3	4338488.908	1.1%	4096479.393	n/a
	50%	541.5	4370910.029	1.9%	4096479.393	n/a
	70%	613.7	4403331.15	2.6%	4096479.393	n/a
Global average consumption synthetic rubber	Baseline	1.8	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
			4289857.226		4096479.393	
	10%	1.98	4289937.156	0.002%	4096559.324	0.00%
	20%	2.16	4290017.985	0.004%	4096640.152	0.00%
	30%	2.34	4290098.813	0.006%	4096720.98	0.01%
	40%	2.52	4290179.641	0.008%	4096801.808	0.01%
	50%	2.7	4290260.469	0.009%	4096882.637	0.01%
	Baseline	36	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
			4289857.226		4096479.393	

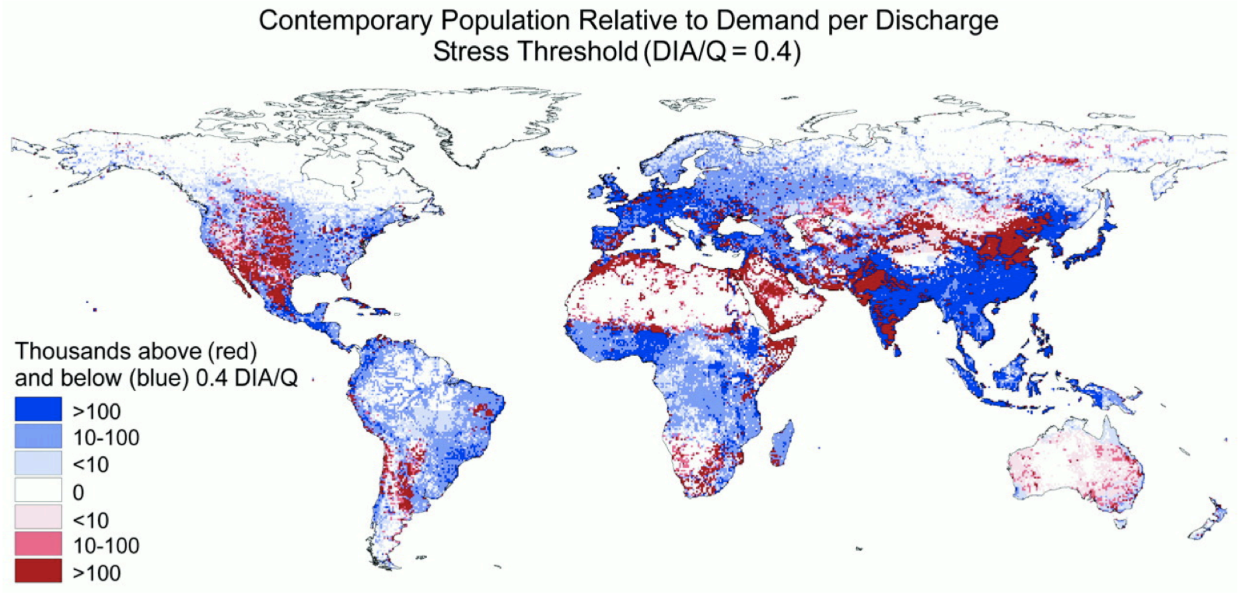
Global average consumption EVA	-50%	18	4224875.786	-1.5%	4031497.953	-1.59%
	-25%	27	4257366.506	-0.8%	4063988.673	-0.79%
	0%	36	4289857.226	0.0%	4096479.393	0.00%
	25%	45	4322347.946	0.8%	4128970.113	0.79%
	50%	54	4354838.666	1.5%	4161460.833	1.59%
Electricity requirement sheepskin	Baseline	3436.2	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-25%	2577.15	4228304.621	-1.4%	4017546.304	-1.9%
	-15%	2920.77	4252925.663	-0.9%	4049119.54	-1.2%
	-5%	3264.39	4277546.705	-0.3%	4080692.775	-0.4%
	5%	3608.01	4302167.747	0.3%	4112266.011	0.4%
	15%	3951.63	4326788.789	0.9%	4143839.247	1.2%
	25%	4295.25	4351409.831	1.4%	4175412.483	1.9%
Electricity requirement cowhide	Baseline	1927.7	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-25%	1445.775	4283678.536	-0.1%	4086593.186	-0.2%
	-15%	1638.545	4286150.012	-0.1%	4090547.669	-0.1%
	-5%	1831.315	4288621.488	0.0%	4094502.152	0.0%
	5%	2024.085	4291092.964	0.0%	4098456.635	0.0%
	15%	2216.855	4293564.44	0.1%	4102411.118	0.1%
	25%	2409.625	4296035.916	0.1%	4106365.601	0.2%
Electricity requirement natural and synthetic rubber	Baseline	271	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-25%	203.25	4289443.647	-0.01%	4096225.618	-0.01%
	-15%	230.35	4289609.079	-0.01%	4096327.128	0.00%
	-5%	257.45	4289774.51	0.00%	4096428.638	0.00%
	5%	284.55	4289939.942	0.00%	4096530.148	0.00%
	15%	311.65	4290105.373	0.01%	4096631.659	0.00%
	25%	338.75	4290270.805	0.01%	4096733.169	0.01%
Electricity requirement EVA	Baseline	333	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-25%	249.75	4285771.593	-0.10%	4092393.76	-0.10%
	-15%	283.05	4287405.846	-0.06%	4094028.013	-0.06%
	-5%	316.35	4289040.099	-0.02%	4095662.267	-0.02%
	5%	349.65	4290674.353	0.02%	4097296.52	0.02%
	15%	382.95	4292308.606	0.06%	4098930.773	0.06%
	25%	416.25	4293942.859	0.10%	4100565.027	0.10%
product assembly WATER: change consumption factor	Baseline	0.15	Global Average TWI 4289857.226	Percent Change to TWI	Top Five Countries TWI 4096479.393	Percent Change to TWI
	-35%	0.0975	4136039.112	-3.59%	3942661.279	-3.75%
	-25%	0.1125	4179987.144	-2.56%	3986609.312	-2.68%
	-15%	0.1275	4223935.177	-1.54%	4030557.344	-1.61%
	-5%	0.1425	4267883.21	-0.51%	4074505.377	-0.54%
	5%	0.1575	4311831.242	0.51%	4118453.41	0.54%
	15%	0.1725	4355779.275	1.54%	4162401.442	1.61%
	25%	0.1875	4399727.308	2.56%	4206349.475	2.68%
	35%	0.2025	4443675.341	3.59%	4250297.508	3.75%

Deckers facilities: working days	Baseline	270	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
			4289857.226		4096479.393	
	15%	310	4297191.874	0.17%	4103814.041	0.18%
	29%	347	4303976.424	0.33%	4110598.591	0.34%
	35%	365	4307277.015	0.41%	4113899.183	0.43%
Electricity: transmission loss	Baseline	1.06	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
			4289857.226		4096479.393	
	0.39%	1.06417	4296183.36	0.15%	4103134.85	0.16%
	-1.10%	1.04837	4272213.835	-0.41%	4077917.531	-0.45%
	-4.49%	1.01244	4217705.922	-1.68%	4020572.07	-1.85%
	-2.64%	1.03204	4247440.27	-0.99%	4051854.315	-1.09%

Appendix 17: Water Stress Projection

Source(s) Vorosmarty et al 2000

The global distribution of population in 1985 with respect to the relative water stress threshold of DIA/Q = 0.4 indicating severe water scarcity (10).

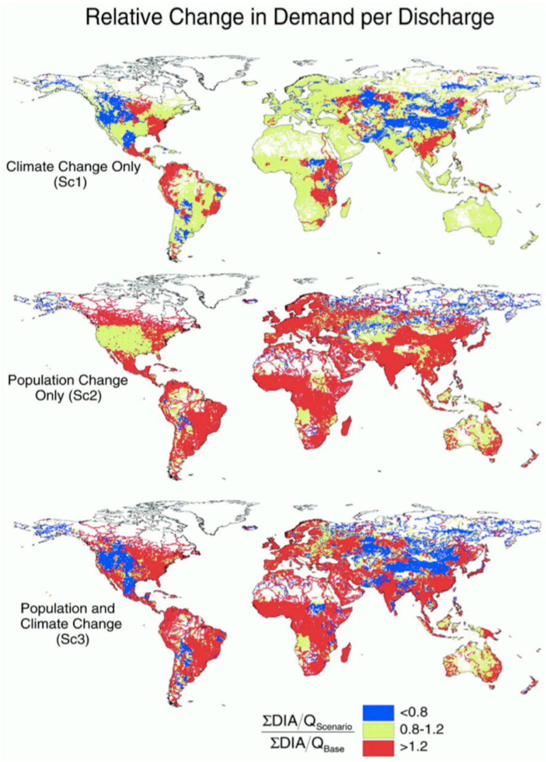


C J Vörösmarty et al. Science 2000;289:284-288

Published by AAAS

Only Scenario 3 was used to for the DeckersWater assessment

Maps of the change in water reuse index ($\Sigma DIA/Q$) predicted by the CGCM1/WBM model configuration under Sc1 (climate change alone), Sc2 (population and economic development only), and Sc3 (both effects).



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C J Vörösmarty et al. Science 2000;289:284-288

Appendix 18: Data Tables for product assembly stage

Source(s): DeckersWater calculations

Product Assembly Water and Electricity Extrapolation and Attributional Allocation Tests

product assembly WATER extrapolation: change number of users (no change to Deckers allocation)	Baseline	7,11,3	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
	low, med, high		4289857.226		4096479.393	
		7,3,11	4,172,439	-2.74%	3,978,516	-2.88%
		11,7,3	4,174,617	-2.69%	3,980,694	-2.83%
		11,3,7	4,114,890	-4.08%	3,920,967	-4.28%
		3,7,11	4,289,716	0.00%	4,095,793	-0.02%
		3,11,7	4,349,443	1.39%	4,155,520	1.44%
		7,7,7	4,232,167	-1.34%	4,038,244	-1.42%
		10,11,0	4,248,732	-0.96%	4,054,809	-1.02%
		11,10,0	4,219,413	-1.64%	4,025,490	-1.73%
		0,10,11	4,377,673	2.05%	4,183,751	2.13%
		0,11,10	4,392,605	2.40%	4,198,682	2.49%
		11,0,10	4,070,094	-5.12%	3,876,171	-5.38%
		10,0,11	4,084,482	-4.79%	3,890,559	-5.03%
product assembly ELECTRICITY extrapolation: change number of users (no change to Deckers allocation)	Baseline	7,11,3	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
	low, med, high		4289857.226		4096479.393	
		7,3,11	4097776	-4.48%	3903852	-4.70%
		11,7,3	4131246	-3.70%	3937324	-3.89%
		11,3,7	3743010	-12.75%	3549087	-13.36%
		3,7,11	3582362	-16.49%	3388439	-17.28%
		3,11,7	3776481	-11.97%	3583558	-12.52%
		7,7,7	3937128	-8.22%	3743205	-8.62%
		10,11,0	4010761	-6.51%	3816838	-6.83%
		11,10,0	3922069	-8.57%	3728146	-8.99%
		0,10,11	4363850	1.72%	4169927	1.79%
		0,11,10	4412380	2.86%	4218457	2.98%
		11,0,10	3436774	-19.89%	3242851	-20.84%
		10,0,11	3476935	-18.95%	3283013	-19.86%
product assembly ELECTRICITY extrapolation: change Deckers allocation (no change to number of users)	Baseline	100,81,13	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
	low, med, high		4289857.226		4096479.393	
		100,13,81	5006132	16.70%	4812209	17.47%
		13,81,100	6284285	46.49%	6090362	48.67%
		13,100,81	6085112	41.85%	5891186	43.81%
		81,13,100	5440945	26.83%	5247022	28.09%
		81,100,13	4528940	5.57%	4335017	5.82%
		all 100	6529126	52.20%	6335203	54.65%
		all 50	4751757	10.77%	4557834	11.26%
		all 25	3863073	-9.95%	3669150	-10.43%

	Baseline	100,51,14	Global Average TWI	Percent Change to TWI	Top Five Countries TWI	Percent Change to TWI
	low, med, high					
			4289857.226		4096479.393	
product assembly WATER extrapolation: change Deckers allocation (no change to number of users)		100,14,51	4171007	-2.77%	3977084	-2.91%
		14,51,100	4597740	7.18%	4403817	7.50%
		14,100,51	4753988	10.82%	4560065	11.32%
		51,100,14	4621154	7.72%	4427231	8.07%
		51,14,100	4346923	1.33%	4153000	1.38%
		all 100	4963117	15.69%	4769194	16.42%
		all 50	4407765	2.75%	4213842	2.86%
		all 25	4130089	-3.72%	3936166	-3.91%

Appendix 19: Natural material country sourcing scenarios

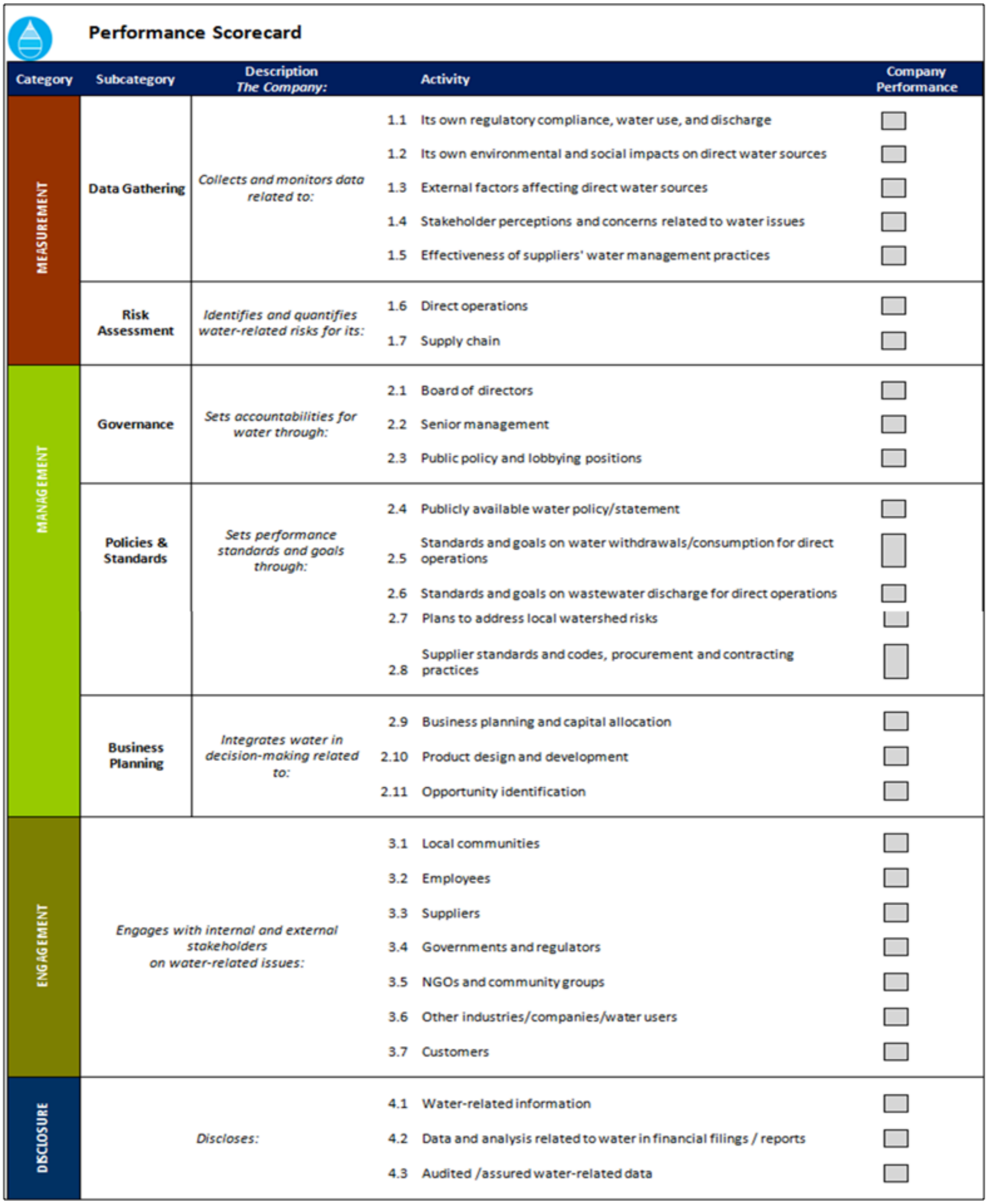
Source(s): DeckersWater calculations

Material	Country Sourcing Scenario	Percent Change in TWI
SHEEPSKIN	100% Australia	**-7%**
	50% China, 50% Australia	-5%
	100% China	-3%
	33% China, 33% Australia, 33% Sudan	-1%
	50% Australia, 50% New Zealand	2%
	100% India	5%
	100% Sudan	6%
	100% New Zealand	**11%**
COWHIDE	100% Brazil	**-6%**
	50% India, 50% Brazil	-5%
	100% India	-4%
	100% China	1%
	33% United States, 33% Brazil, 33% Argentina	2%
	100% United States	4%
	50% United States, 50% Argentina	5%
	100% Argentina	**7%**
NATURAL RUBBER	100% Indonesia	**-4%**
	100% Malaysia	-4%
	50% Indonesia, 50% Malaysia	-4%
	100% Vietnam	-2%
	100% Thailand	4%
	100% India	**5%**

Appendix 20: Business risk tools

Source(s): Ceres Aqua Gauge - http://www.ceres.org/issues/water/aqua-gauge/aqua-gauge ;
Gemi Water Sustainability Tool - http://www.gemi.org/water/overview.htm

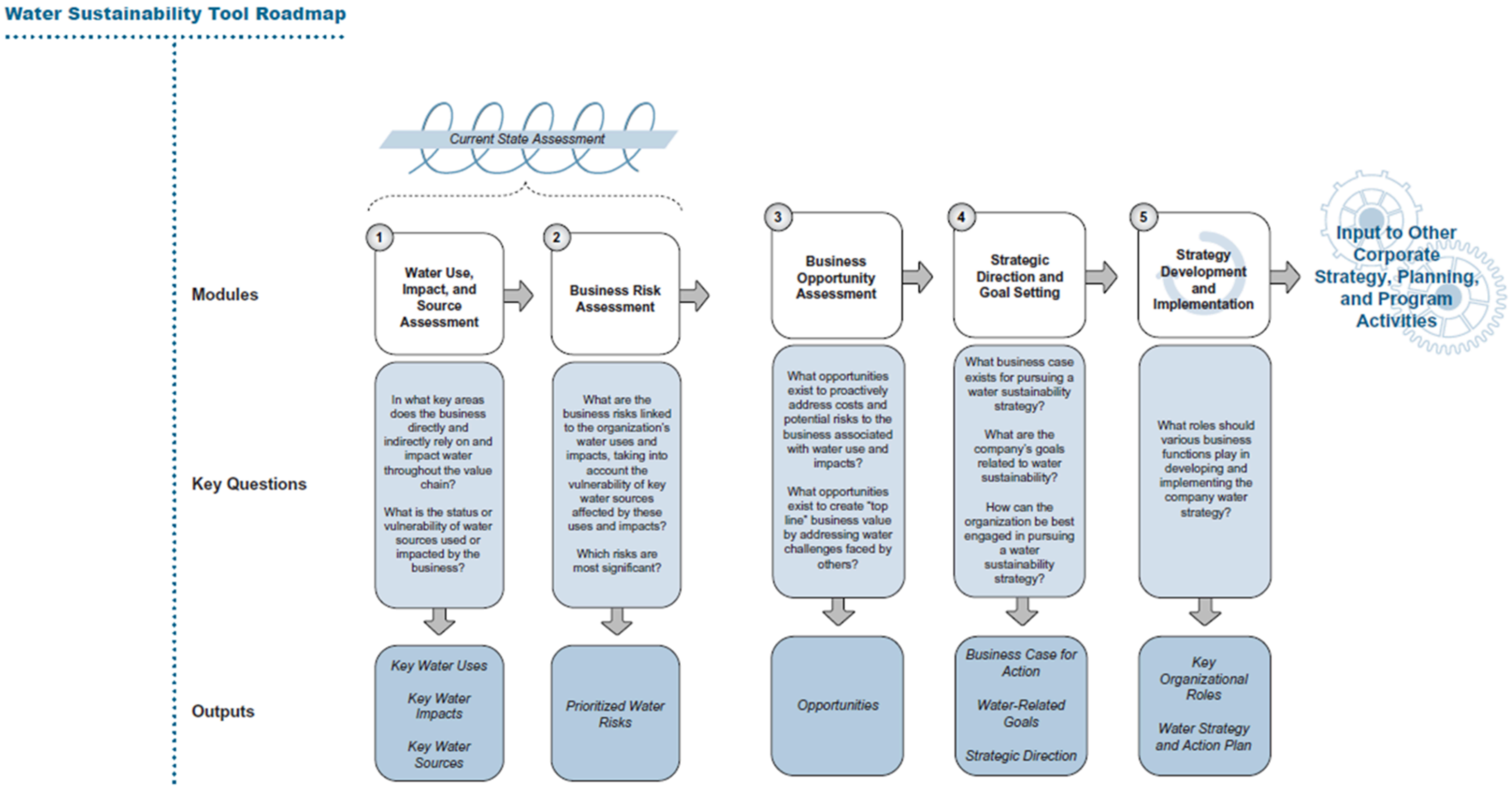
Ceres Tool “Scorecard” Sample



Performance Scorecard

Category	Subcategory	Description *The Company:*		Activity	Company Performance
MEASUREMENT	Data Gathering	*Collects and monitors data related to:*	1.1	Its own regulatory compliance, water use, and discharge	☐
			1.2	Its own environmental and social impacts on direct water sources	☐
			1.3	External factors affecting direct water sources	☐
			1.4	Stakeholder perceptions and concerns related to water issues	☐
			1.5	Effectiveness of suppliers' water management practices	☐
	Risk Assessment	*Identifies and quantifies water-related risks for its:*	1.6	Direct operations	☐
			1.7	Supply chain	☐
MANAGEMENT	Governance	*Sets accountabilities for water through:*	2.1	Board of directors	☐
			2.2	Senior management	☐
			2.3	Public policy and lobbying positions	☐
	Policies & Standards	*Sets performance standards and goals through:*	2.4	Publicly available water policy/statement	☐
			2.5	Standards and goals on water withdrawals/consumption for direct operations	☐
			2.6	Standards and goals on wastewater discharge for direct operations	☐
			2.7	Plans to address local watershed risks	☐
			2.8	Supplier standards and codes, procurement and contracting practices	☐
	Business Planning	*Integrates water in decision-making related to:*	2.9	Business planning and capital allocation	☐
			2.10	Product design and development	☐
			2.11	Opportunity identification	☐
ENGAGEMENT		*Engages with internal and external stakeholders on water-related issues:*	3.1	Local communities	☐
			3.2	Employees	☐
			3.3	Suppliers	☐
			3.4	Governments and regulators	☐
			3.5	NGOs and community groups	☐
			3.6	Other industries/companies/water users	☐
			3.7	Customers	☐
DISCLOSURE		*Discloses:*	4.1	Water-related information	☐
			4.2	Data and analysis related to water in financial filings / reports	☐
			4.3	Audited /assured water-related data	☐

GEMI Tool Categories



Addendum-Updated 2010 Water Footprint

New data were obtained from the client after our study was complete. Therefore, we modified methods associated with raw material country sourcing and the allocation of natural and synthetic rubber to reflect the new information. We chose to represent these new measures in an addendum to the main report so that our methods and assumptions presented there can be used by other corporations working to establish baseline water footprints. The results presented in this addendum are preliminary findings and highlight the main differences between our previous estimate and this improved more accurate estimate of Deckers' 2010 water footprint.

Changes to Methods

Our methods using global averages did not change except for the removal of the natural rubber input. Methods involving country level data were updated to reflect the revised estimations of material sourcing countries. In the case of sheepskin, the client was able to provide a close approximation of the percentage of sheepskin from Australia and the United Kingdom of 80 percent and 20 percent, respectively. For cowhide, the client was able to provide the countries from where cowhide is sourced, but the percentage of cowhide sourced from each country was unclear. Therefore, we used the same methods discussed in the main report for the top producing countries by replacing the top five producers with the United States, Brazil, the European Union, and Argentina to determine the material allocation. Finally, the majority of shoes under the Teva brand use synthetic rubber; thus, we updated our model to reflect 100 percent synthetic rubber.

Changes to Model Inputs

Estimated sheepskin country sourcing allocation:
Australia - 80 percent
United Kingdom - 20 percent

Estimated cowhide country sourcing allocation:
United States – 35 percent
Brazil– 29 percent
European Union – 25 percent
Argentina – 12 percent

Estimated natural to synthetic rubber analysis:
100 percent synthetic rubber

Updated Estimates

Deckers' updated 2010 estimated water footprint range is 3.7 to 4.1 million m^3. This reflects a 10 and 5 percent decrease from previous estimates using country level data and global averages, respectively. This decrease is largely due to the change in country sheepskin sourcing; on average, Australia sheepskin production consumes much less water per ton of material than the countries used in the previous estimation.

Of this total, approximately 53 percent comes from material production, 43 percent comes from product assembly, and 4 percent comes from Deckers facilities (see figure I). These findings are not substantially different than our previous estimate.

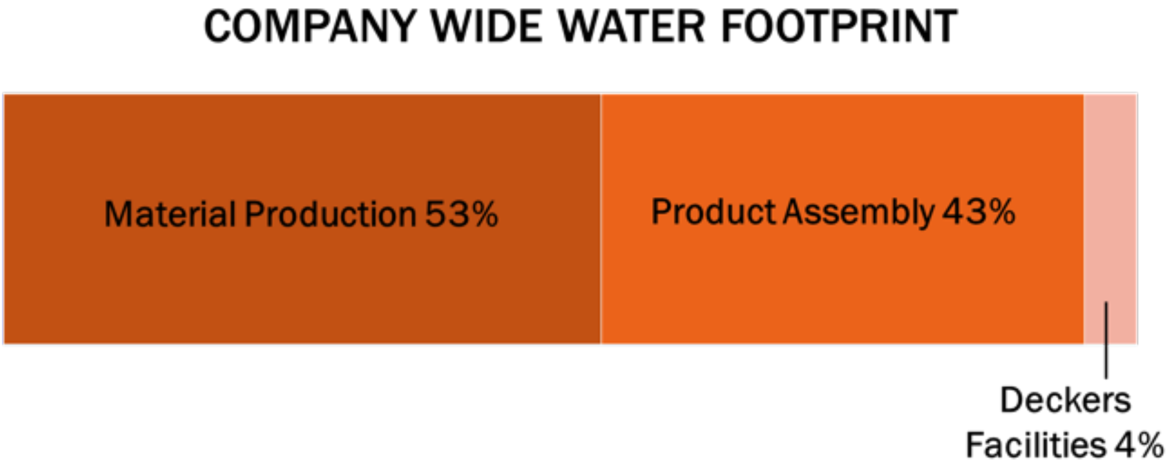


Figure I: *Breakdown of Deckers' estimated 2010 water footprint by supply chain stage.*

The breakdown of direct water and electricity water throughout the supply chain were also affected by the updated model inputs. Direct water increased from 53 percent to 57 percent and electricity water decreased from 47 percent to 43 percent. The detailed breakdown of direct water and electricity water is visualized in figure II, below. The distribution of water consumption within the direct and electricity water categories was not significantly affected by the updated model inputs. Additionally, the relative inventory breakdown for both UGG and Teva brands by direct water and electricity water categories at each stage in the supply chain did not change.

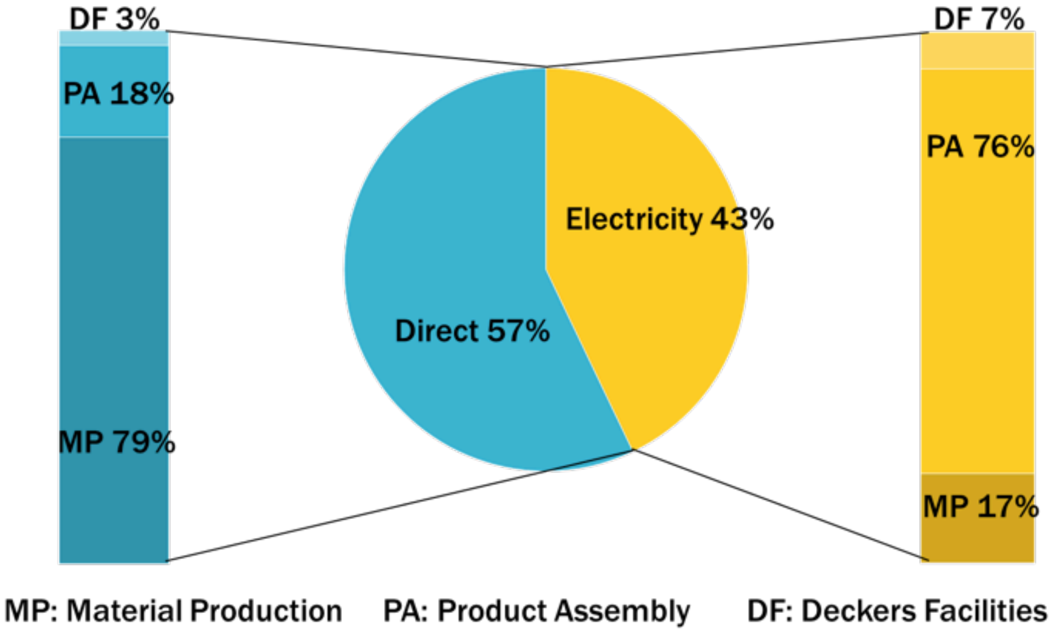


Figure II: *Direct water comprises 57 percent of the total water inventory; electricity water comprises 43 percent. Inventory breakdown of direct water and electricity water are shown to the left and right of the pie chart, respectively. The bar graphs represent each component as a percentage of either the total direct water or total electricity water, not of the total company inventory.*

The UGG Classic Short and the Teva Riva per pair water consumption estimates were also adjusted based on the new model inputs. The UGG Classic Short estimate of 230 liters per pair did not change using the global average but decreased to 200 liters per pair using the updated country level data. With both methods (global and country level data), the Teva Riva per pair estimates decreased to 300 liters per pair using global averages and 260 per pair using country level data. The change in the Teva Riva estimate using global averages is due solely to the removal of the natural rubber component.

Using global averages (in liters):
UGG: 230
Teva: 300

Using country level data (in liters):
UGG: 200
Teva: 260

Updates to Water Stress Analysis as it Relates to Deckers

With the changes to country sourcing locations, some of our previous analysis of Deckers' operations in relation to stress is less relevant to Deckers. Highlights from our updated analysis are represented in figure III and figure IV. We now estimate that 97 percent of Deckers' 2010 water consumption occurred in countries with medium water stress levels. We no longer estimate that Deckers' 2010 water consumption occurred in countries with high water stress levels (see figure III). However, it is still relevant that the sample of countries in which water consumption did occur are predicted to experience high water stress by 2025, as show in figure IV (Vorosmarty et al 2000).

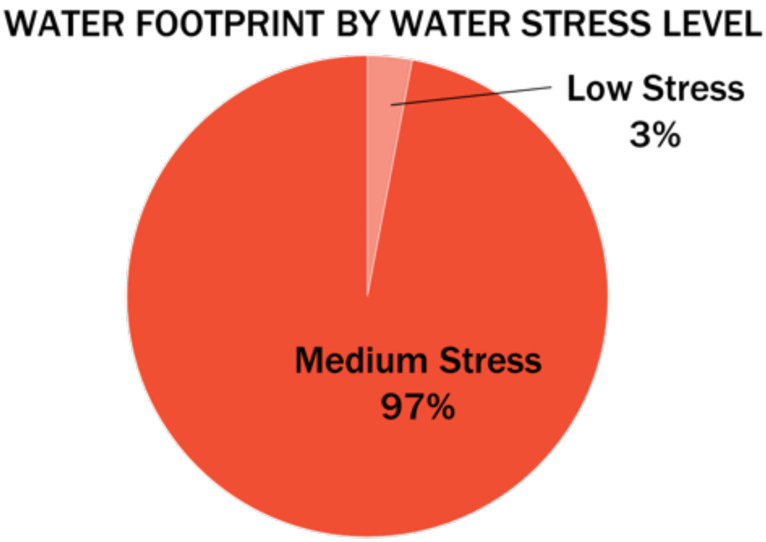


Figure IV: *Distribution of Deckers' estimated water consumption within low, medium and high stress levels. (Pfister et al 2009)*

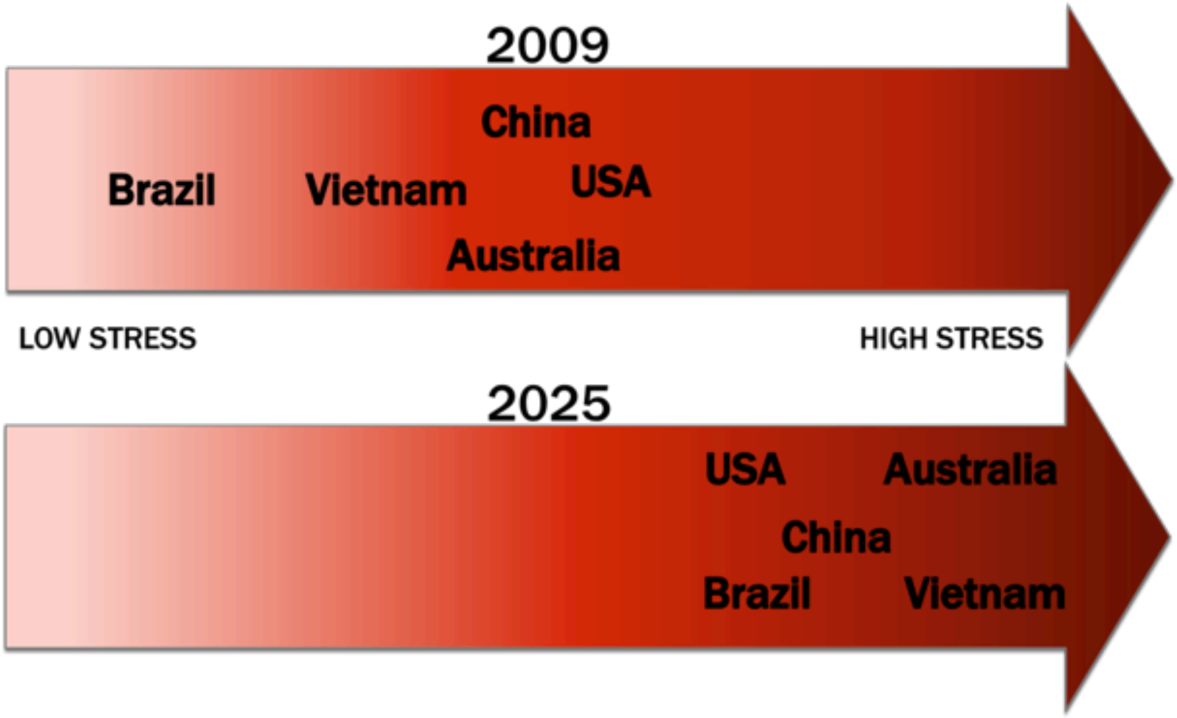


Figure V: *Deckers' vulnerability from climate change and population growth (Pfister et al 2009; Vorosmarty et al 2000)*