The Role of Water in the Rise, Prominence, and Decline of Nabataean Petra

Dennis Cummins

Graduate Center, City University of New York

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THE ROLE OF WATER IN THE RISE, PROMINENCE, AND DECLINE 
OF NABATAEAN PETRA 

by 

DENNIS P. CUMMINS 

A master’s thesis submitted to the Graduate Faculty in Middle Eastern Studies in partial 
fulfillment of the requirements for the degree of Master of Arts, The City University of 
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The manuscript has been read and accepted by the Graduate Faculty in Middle Eastern Studies in satisfaction of the requirement for the degree of Master of Arts

Approved by

__________________________________________________________ Date: ____________

Professor Elizabeth Macaulay-Lewis,
Advisor

__________________________________________________________ Date: ____________

Professor Simon Davis,
Second Reader

__________________________________________________________ Date: ____________

Professor Beth Baron,
Executive Director

THE CITY UNIVERSITY OF NEW YORK
Abstract

THE ROLE OF WATER IN THE RISE, PROMINENCE, AND DECLINE OF
NABATAEAN PETRA

by

DENNIS P. CUMMINS

Advisor: Professor Elizabeth Macaulay-Lewis

This paper evaluates the rise of Nabataean Petra, its prominence, and eventual decline. The predominant context is effective water management as a pivotal driving factor in the growth of the Nabataean kingdom, which fostered an environment in which its famous incense trade could develop. Rising incense demand was the catalyst for growth from the first century BC through the first century AD; in AD 106 when Rome annexed the Nabataean kingdom, Petra began its gradual decline. In AD 363 an earthquake destroyed much of the city, and Petra did not return to its earlier prominence. From the outset, water played a vital role in cementing Petra’s position economically and politically, and later ornamental uses of water legitimized the kingdom and its rulers to its population and rivals.
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Section 1: History of the Nabataeans and Petra from 300 BC to 363 AD

Introduction

This paper aims to evaluate the rise of Nabataean Petra, its prominence, and eventual decline. The predominant context will be effective water management as a pivotal driving factor in the growth of the Nabataean kingdom, which fostered an environment in which its famous incense trade could develop. Effective water management created an environment in which the city would flourish after its foundation around 300 BC. Rising incense demand was the catalyst for growth from the first century BC through the first century AD; in AD 106 when Rome annexed the Nabataean kingdom, Petra began its gradual decline. In AD 363 an earthquake destroyed much of the city, and Petra did not return to its earlier prominence.

Nabataean Petra emerged from nomadic origins to trading renown based on its location in Jordan’s Rift Valley. This was an ideal transshipment point linking the Euphrates River and the Red Sea, southern Arabia north into Syria, and across the Sinai or Negev to Gaza and the Mediterranean Sea (Joukowsky, 1). The gum resins frankincense, myrrh, and balsam were the most important commodities traded in Petra. Other important commodities that were traded through Petra include pearls, cinnabar, cardamom, gum, and styptic. Trading relationships also brought spices from India and silks from China through Petra (Graf and Sidebotham, 71). As Graf and Sidebotham remark, “It is difficult to ascertain what commodities the caravans received in exchange from the Mediterranean ports to return back to Petra or used in payment to south Arabia for purchasing aromatics” (Graf and Sidebotham, 71). However, archaeological finds in south Arabia
suggest that the Nabataeans may have received Mediterranean-made glass, ceramics, bronze objects, and Roman coins in exchange for aromatics (Graf and Sidebotham, 71). The caravan trade brought great wealth to Petra and funded large-scale construction projects throughout the city including temples, fountains, and pools.

Considering Petra's desert location, water resources were of the utmost importance to the city. The Nabataeans managed their water resources masterfully, as the highly developed water management infrastructure around the city attests. And yet, considering the desert environment in which their kingdom was located, it seems only logical that the Nabataeans would be parsimonious with their precious water resources. By contrast, archaeological evidence has shown several examples of extravagant uses of water in the city. As Leigh-Ann Bedal’s writings on the Petra Pool and Garden Complex show, water was used as a status symbol in Petra, and served ornamental, recreational, and religious purposes (Bedal, 97). The uses of water by the Nabataeans, both essential and nonessential, will be investigated in the second section of the paper.

The evaluation of the history of Petra, paying special attention to the importance of water management and the critical incense trade, begins below. A review of the existing literature on Nabataean Petra, documentary sources, and archaeological field reports will sustain my analysis of the overarching importance of water to the rise, prominence, and decline of Petra. The paper begins with a history of the Nabataeans and Petra, and is followed by a discussion of water management in the city.
Early Nabataeans

Hieronymus of Cardia presents one of the earliest accounts of the Nabataeans, whom he encountered around the end of the fourth century BC. At this time, the Nabataeans were nomads who were involved in trade, and operated out of a central “rock”, a stronghold where possessions were safeguarded. Petra means “rock” in Greek, and this stronghold may have been the location that would become Petra (Parr, 35). The origin of the Nabataeans is mysterious, and as Bowersock writes, “No source reveals the origins of the Nabataeans” (Bowersock, 19). Early denizens of the area that became Petra may have included some Edomites, who were displaced by the destruction of Edom by Nabonidus. Some intermarriage between Edomites who lived pastorally in the area and Nabataeans has been speculated (Parr, 33). As Parr explains: “Whether any element of Edomite culture survived strongly enough to have influenced the Nabataean nomads is, however, extremely doubtful” (Parr, 33).

Outside threats to the nomadic Nabataeans may well have encouraged centralization and settlement. From the north, the Macedonians were consolidating power in the vacuum that was left by the destruction of Judah and Edom, and aimed to seize control of Arabian trade (Parr, 35). In 312 BC, the Nabataeans resisted an attack on the central “rock” by Antigonus, successor to Alexander the Great (Bowersock, 19). Hellenistic rule over Egypt also proved a threat to the Nabataeans from the south, when Ptolemy II raided the Nabataeans east of the Gulf of Aqaba in 278 BC, after Nabataean pirates attacked Egyptian shipping (Parr, 35). These threats encouraged Nabataean sedentarisation and centralization of leadership (Parr, 35). However, pegging a date for the sedentarisation of
The Nabataean Kingdom

The exact date of the settlement of Petra as the capital of the Nabataean kingdom is uncertain. Information about the early monarchy is scarce, but settlement may have occurred in the early second century BC (Bedal, 11). Petra became the major entrepot of Nabataean trade as the Nabataeans gained control of caravan routes, primarily transporting valuable commodities frankincense and myrrh, which were only produced in south Arabia and northern Somalia. Two of these main routes were the east-west “Incense Route” which connected the Hadramaut and Gaza, and the north-south route, which connected Egypt and Syria (Bedal, 9-10). The main uses of incense during the Hellenistic and Roman periods were in religious rituals, cosmetics and perfumes, and medicines (Bedal, 10).
Figure 1: Map of Petra and surrounding settlements (Bedal, fig. 1).
The size and boundaries of the Nabataean kingdom fluctuated based on the political strength of the neighboring kingdoms, particularly Judea (Bedal, 13). Through the third and second centuries BC, the Nabataean kingdom included Petra and its surrounding areas, westward into the Negev including Nessana, Sobota, Elusa, Oboda, Rehovot, and Mampsis – and north into the Hawran around Bostra (Bedal, 13). The map in Figure 1 above depicts the region and its settlements. The kingdom reached its largest boundaries during the reign of Aretas III (85 through 62 BC), during which the kingdom included: “…all of Transjordan, much of the Sinai, the Negev, southern Syria (Damascus), and northwest Arabia (the Hejaz)...To the south, the Nabataeans had the important marketplace-emporium, Meda’in Saleh, and the two ports Leuce Come and Aila (modern Aqaba), which provided a link to the maritime trade with India” (Bedal, 13).

In 64 BC, with the arrival of Pompey’s forces, the Roman province of Syria was created, which checked the expansion of the Nabataean kingdom. The ensuing Pax Romana had a stabilizing effect on the region, which facilitated international trade. So, despite territorial limitation, this ironically greatly enriched the Nabataean kingdom, which remained a strong regional presence through the first century AD. This period, which coincided with the reigns of Obodas III (30 BC through 9 BC) and Aretas IV (9 BC through AD 40), was one of large-scale architectural construction in Petra, and general prosperity (Bedal, 12). During this period the Treasury (actually a tomb) and the Pool and Garden Complex were built. The Treasury, which is viewed as one walks through the canyon entrance of Petra, which is known as the Siq, is pictured in Figure 2 below.
After the death of Aretas IV, Malichus II (40-70 AD) ascended to the throne and ruled in relative peace and prosperity. After Malichus II, Rabbel II (70-106 AD) ascended to the throne, and in AD 93 he moved the capital of the Nabataean kingdom to Bostra in southern Syria (Bedal, 13). After Rabbel II transferred the capital from Petra to Bostra, Petra retained a diminished role (Bowersock, 73). Petra and the Nabataean kingdom remained largely independent, until AD 106, when Nabataea was quietly annexed by Rome under Trajan (Bedal, 14). Here the lineage of Nabataean kings ended.

**Roman Petra**

The state of post-annexation Petra is debated among historians. It was designated the metropolis of Roman Arabia by Trajan by AD 114. As Bowersock explains, “It had become clear from Trajan’s grant of the title of metropolis to Petra by 114 that it was not his intention, in placing the capital of the province at Bostra, to diminish the role of Petra.
as a center for the southern part of the Arabia territory” (Bowersock, 85). Changing economic circumstances and technological developments made this period in Nabataean history particularly noteworthy.

Figure 3: Map of Petra city center (Web, http://petranationaltrust.org/ui/Photos/, accessed 26 March, 2014).

A rapidly changing economic environment in Roman Petra emerged from the increasing use of sea-borne shipment. Following the Roman annexation of Egypt in 30 BC, and the construction of Red Sea ports, trade through Roman Egypt between the Mediterranean,
the Red Sea, and Indian Ocean ports increased. Sea-borne shipping was more economical than caravan transport. The impact of this on the Nabataeans is uncertain. As Graf and Sidebotham explain, “It seems more likely that the demand for aromatics was so great that the newly constructed and enlarged Red Sea ports of the early Roman period merely complemented the flourishing trans-Arabian caravan trade conducted by the Nabataeans” (Graf and Sidebotham, 72). If the advent of sea-borne shipment coincided with an increase in the demand for incense, then as Fiema notes: “Under these circumstances, it would have been possible to sustain an intensification of the caravan trade without lowering the prices of goods as a result of oversupply…” (Fiema, 41). In addition to increasing shipment activity, the Nabataeans also diversified their participation in the incense trade into production and processing, as discussed below.

The incense processing industry was of great importance between the first and third centuries AD. Fiema explains that, “…archaeological evidence of unguent/perfume containers (‘unguentaria’), mass-produced in Petra between the first and at least the early third centuries AD, confirm the continued participation of Petra in the long-distance trade as well as the continuity of spice and perfume-related processing industry there” (Fiema, 49). Involvement in incense processing, and increasing caravan shipment amid high demand for incense fostered the continued prominence of Petra through the third century AD.

In the third century AD, main trade routes were changing, and instability in the Roman Empire led to a drop in incense demand. This caused major trouble for Petra. Excavations
along the formerly vital Petra-Gaza road revealed that its extensive use ceased by the third century AD (Fiema, 50). Northward shifting trade routes appear to have made Petra’s location sub-optimal. As further evidence, the incense containers, unguentaria, found in Petra in the latest levels of excavation were not new, but reused and reshaped from earlier periods (Fiema, 50). The ending of production of new unguentaria is suggestive of a greatly reduced incense trade.

In the year AD 363, an earthquake devastated Petra. As Fiema explains, “This historically and archaeologically well-documented earthquake is certainly a convenient marker to conclude the presentation of the Roman period in Petra. Post-363 Petra is a city of a very different socio-political and economic reality, and the fame and significance associated with the city in the previous periods are the things of the past” (Fiema, 53). The brilliance of the Nabataean period in Petra’s history was continued into the Roman period, until the waning of the caravan trade through Petra led to its decline.

Going back almost three hundred years, before the Roman period, large-scale construction in Petra had created a city with magnificent architecture and infrastructure to provide for the needs of its large population. The most important of these needs, especially considering the desert location of Petra, was water.
Section 2: Archaeological Evidence of Nabataean Water Infrastructure

**Water and Religion**

Water management is a topic of obvious importance for residents of a city in an arid and hot climate. The Nabataeans addressed the topic by applying existing technologies with ingenuity to exploit the limited water resources that were available to them. The Nabataeans were so successful in their management of water resources that they were able to provide not only adequate water for human consumption, hygiene, irrigation and agricultural use, but also for architectural, recreational, and religious uses. The Rift Valley, in which Petra is located, receives less than 10 centimeters of rain per year. In these unfavorable circumstances Nabataean engineers devised an intricate system to transport and store water, which provided ample resources for necessities, and a surplus, which was used ornamentally (Bedal, 228). This second half of the paper aims to investigate Nabataean water management technologies, methods, uses, and the overall success of the engineers at Petra.

Before delving into the technicalities of Nabataean water management in Petra, it is interesting to note the religious aspect of water in this city and kingdom. That desert nomads affix religious significance to water is unsurprising. The special reverence paid to water by the Nabataeans is confirmed by the many displays of water throughout the city. As Leigh-Ann Bedal explains, “Numerous religious icons, inscriptions and sanctuaries are found in association with springs, catchment pools, and channels throughout the city and its environs” (Bedal, 230).
Al-‘Uzza together with Dushara, the main god of the Nabataeans, were the patron gods of Petra (Zayadine, 62). The goddess Al-‘Uzza is connected with water and springs, and is associated with the Greek fertility goddess Aphrodite and the Syrian fertility goddess
Atargatis. At the Nabataean temple at Khirbet-Tannur, Nelson Glueck unearthed a statue thought to be Atargatis wearing a headdress of dolphins, which is pictured in Figure 4 above (Glueck, 333). Judith McKenzie revisited this interpretation, and explains: “This was accepted until the discovery of busts of personifications of the zodiac at Khirbet edh-Dharih revealed that the Grain Goddess and Fish Goddess represented signs of the zodiac - Virgo and the personification of Pisces. Thus, there is no longer any basis for identifying the goddess of Khirbet et-Tannur specifically as Atargatis, nor for suggesting instead that she was represented in the form of Atargatis” (McKenzie, 200). Other examples of the veneration of water have been found in Petra, and include a stele carved above the Wadi es-Siyagh includes an inscription dedicating it to Al-‘Uzza (Bedal, 100).

**Water Infrastructure in Petra**

The interaction between traders in the ancient world and the Nabataeans of Petra facilitated exchange of ideas relating to culture, politics, and technology. As Ortloff explains, “Consequently, the water supply system may be expected to reflect borrowings from the best civil-engineering practices of neighboring civilizations and innovations derived from demands of the complex topography and limited water resource base of the area” (Ortloff, 94). This includes the development of canals, technology that predated Petra. As Ortloff explains, “Canal-building technology…was widespread throughout the ancient Middle East and primarily used for agricultural purposes…An early technology base, utilizing pipeline and canal systems, existed well before Nabataean times and was surely available to aid in the planning and development of Petra’s water system” (Ortloff, 95). Although the Nabataeans did not develop canals, they did need to be adapted and
applied to the unique environment at Petra by them. As Zeidoun al-Muheisen and Dominique Tarrier explain:

“These canals were covered with a strong layer of tiles to prevent the leakage of water. This covering with stone tiles kept the water inside the canal away from pollution and also decreased the evaporation level of the water during very dry periods…The Nabataeans also knew about stone-carved canals that were connected by cement. Mostly, this kind of canal was designed to bring spring water…The Nabataeans took into consideration in building the canals that they should run down in an angular way, so that the water should run smoothly. Many of the canals that passed through buildings and installations or on the grounds of a carved cemetery were hidden from view. The canals were maintained with screens or filters that kept them clean” (Al-Muheisen and Tarrier, 518-9).

These canals, similar to the one pictured below, were built to harness one of the primary water resources available to Petra: the Ain Mousa spring.
Figure 5: A carved canal in the Siq leading to Petra (Petra; water conduit running through Siq, the narrow gorge leading to inner city, Erich Lessing, In ARTstor. Accessed 19 January, 2014).
The Ain Mousa spring, which is located about 7 kilometers from Petra, was the primary source of water for Nabataean Petra (Ortloff, 96). The spring water was led to Petra at first by an open channel system, along a direct path, which led through the Siq. This open channel system was later replaced by a piping system, but the Ain Mousa spring remained the primary supplier of potable water to Petra (Ortloff, 97-8). The water supplied by the year-round flow of the Ain Mousa spring and other smaller springs, was supplemented by rainwater, which was stored in cisterns and reservoirs. These sources provided sufficient water for the needs of the inhabitants of Petra (Glueck, 62).

Cisterns also played an important role in water storage in Nabataean Petra. The Nabataeans utilized surface cisterns to collect rainwater runoff, which offered a source of lower-quality water either for drinking in the absence of spring water, or otherwise for non-consumption uses such as gardening (Ortloff, 100-1). Steven Mithen explained that, “The Nabataeans perfected bottle-shaped cisterns cut into solid rock to minimize evaporation and the risk of pollution; they created plasters to line such constructions which were resistant to percolation and the corrosive effects of water” (Mithen, 5254). Eadie and Oleson further explain: “These skills were already famous in antiquity and are alluded to by the Augustan historian Diodorus in his account of the region:

For in the waterless region, as it is called, they have dug wells at convenient intervals and have kept the knowledge of them hidden from the peoples of all other nations, and so they retreat in a body into this region out of danger. For since they themselves know about the places of hidden water and open them up they have for their use drinking water in abundance…they take refuge in the desert…for it lacks water and cannot be crossed by others, but by themselves alone, since they have prepared subterranean reservoirs lined with stucco, it furnishes safety. So the earth
in some places is clayey and in others is of soft stone, they make great excavations in it, the mouths of which they make small, but by constantly increasing the width as they dig deeper, they finally make them of such size that each side has a length of one plethrum. After filling these reservoirs with rain water, they close the opening, making them even with the rest of the ground (Diodorus Siculus, 2.48).

Many other passages by Greek and Roman authors imply the highest level of Nabataean skill in using the water resources of the desert, but none explicitly describes the mechanics of this technology” (Eadie and Oleson, 53). By 1999, and the publishing of the results of the Petra Survey Project, 188 cisterns have been identified in Petra (Nehme, 158).
Figure 6: A channel leading to a cistern in Petra (Taylor, 119).
Figure 6 above is an example of a channel leading to a cistern in Petra. Both cisterns and channeling water pre-date Petra, as do pipeline systems. One important Nabataean water management innovation came in the form of pipe design, and is described below.

**Survey Results from the Wadi Musa Water Supply and Wastewater Project**

Archaeological reports on excavations at Petra and surrounding locations immediately outside the boundaries of the city exemplify the extensive water management infrastructure in the ancient city. One such document is “The Preliminary Report on the Archaeological Component of the Wadi Musa Water Supply and Wastewater Project”, compiled by Khairieh ‘Amr and Ahmed al-Momani, hereafter referred to as the preliminary report. The preliminary report was the product of archaeologists being consulted before and during the construction of pipelines to support the modern population of Wadi Musa between 1998 and 2000, to ensure that minimal damage was done to the archaeological remains.

The archaeologists accompanied the engineers and oversaw the construction. Before construction began, the archaeologists surveyed the sites with soundings, testing below the surface for archaeological remains. During this process many Nabataean artifacts were discovered, as well as evidence of water infrastructure and technology. These findings, which will be discussed below support the assertion of a complex Nabataean water infrastructure.
This project also offered an opportunity for archaeologists to survey a large area that may not otherwise have been evaluated. The task was still daunting to archaeologists who carefully work on excavations to preserve the integrity to the site. As the authors of the preliminary report 'Amr and al-Momani explain, “The team therefore had to face excavation by mechanical means – done by no archaeologists – through kilometers of archaeological deposits. The shock of this happening right before us was overcome, to an extent, by our regarding the project as an opportunity to get a 300 km long sounding through areas that could not otherwise be excavated, as most of them were under modern streets, and thick modern deposits” (‘Amr and al-Momani, 255). The construction site was broken into sectors, and the archaeologists used the construction sectors for the preliminary report.

The Wadi Musa sector was particularly important for the archaeologists because this sector had a very high concentration of planned construction and archaeological sites. Soundings in the Wadi Musa sector uncovered many water infrastructure artifacts and sites. ‘Amr and al-Momani explain, “We recorded a number of water channels exposed by the pipeline trenches at Wadi Musa. They were either lead pipes, ceramic pipes, or stone-lined conduits. Stone-lined conduits seem to span all time periods from the Nabataean up to the modern, while the ceramic channels we could date range from the early first century BC to the mid fourth century AD” (‘Amr and al-Momani, 270). The Nabataean ceramic pipes show signs of increasing sophistication over time. Figure 7 below shows a Nabataean pipe with tapered ends.
The authors of the report do not say how they dated the ceramic pipes, but they describe characteristics of the pipes, which they utilize to suggest an approximate century of production and use. According to the authors, the pipes of the first century BC were long and plain, and the ends of the pipes had one side with a wider end and one side with a narrower end to fit in the next pipe; some of these pipes have vertical trimming marks on the exteriors (‘Amr and al-Momani, 270). The pipes that the authors dated to the mid-first century AD were characterized by “collar rims” with curving shoulders, and varying internal diameters. The pipes, which were dated to the early second century AD, were characterized by angular shoulders and unvarying body diameters (‘Amr and al-Momani, 270). The pipes that the authors indicate are from the third century AD had shoulders that were smaller and sharper, which led to the difference between the diameters at the ends of the pipes being reduced. The latest dated pipes, the early-to-mid fourth century pipes, were characterized by “waisted” bodies, with much better fitting joins (‘Amr and al-Momani, 270). The gradual development of better pipes exemplifies the advancement of Nabataean water management, and the desire to continuously improve the efficiency of their water infrastructure.
Run-Off Farming

Nabataean run-off farming aimed to capture rain, which fell rarely but heavily and often caused flash-flooding. This rainwater, which was not absorbed into the dry soil, was captured through a network of terraces and walls. These terraces and walls were built along wadi systems, and aimed to trap rain and silt and divert them to side plots. From the side plots the rainwater and silt were spread out for agricultural use (Bedal, 91-2). The Nabataeans utilized run-off farming with great effect, and these techniques enabled them to successfully irrigate their fields and grow wheat, barley, legumes, almonds, olives, dates, figs, and grapes in the arid Negev desert (Mithen, Thirst, 113). As the Nabataean population grew, food demands increased. The agricultural productivity made possible by run-off farming enabled the Nabataeans to feed their population.

Water Management System

With such highly developed water collection, transport, and storage technology, capable management of these tools was required. The Nabataeans at Petra seem to have had a bureaucracy in place to manage water usage and systems operations, to ensure a steady supply was in place. As Ortloff writes, “The Nabataean water system incorporated both intermittent, on-demand supplies piped from large reservoirs or drawn from cisterns and continuous supply systems from remote springs to provide the daily requirements of city inhabitants. These supplies were consciously regulated to meet demand fluctuations arising from special events in different areas of the city, superimposed upon daily requirements delivered to urban fountains… Regulation of the system required bureaucratic oversight, as decisions regarding storage or release needed not only day vs.
night but also seasonal adjustments” (Ortloff, 102). The fact that the Nabataean system required monitoring and decision-making is used to hypothesize that the Nabataeans had an administration in place to manage water resources, but it is unknown how the bureaucracy worked. The above mentioned water management practices enabled consumption of water in Nabataean Petra for both essential and nonessential uses.

The Petra Pool and Garden Complex

One of the most remarkable sites in Petra is the Pool and Garden Complex, a paradeisos in the middle of the city. The site, appearing as a large open space, was originally designated as the “Lower Market” by a German expedition led by Bachmann in 1921 (Bedal, 39). The identification of the site as the “Lower Market” stuck until 1998, when an investigation yielded evidence of a huge structure inconsistent with a market. Leigh-Ann Bedal wrote *The Petra Pool Complex* in 2003, which describes the process of identifying the Pool and Garden Complex, and delves into the significance of the complex, and water in general, in Petra. The Pool and Garden Complex and the use of water both ornamentally and politically in Petra will be described in detail below.

During the 1998 investigation the “Lower Market” was identified as the Pool Complex. A large pool, measured 43 meters long, 23 meters wide, and 2.5 meters deep, with a total capacity of 2056 cubic meters (Bedal, 53-4). The function of this pool was indicated by the discovery of a decorative island pavilion in the center of the pool. The rectangular pavilion was elevated on a pedestal, and measures 11.5 by 14.5 meters (Bedal, 54). A reconstruction drawing of the pool, pavilion, and hydraulic system is pictured in Figure 8.
below. Sitting around and beneath the pool and island pavilion was an extensive hydraulic system.

![Figure 8: Reconstruction drawing of Pool Complex (Bedal, Plate XXXIII).](image)

The Pool Complex is abutted by the East-West Wall, which was extremely important to its hydraulic system. The wall functioned as a retaining wall for the pool, and also contained built-in water distribution infrastructure for the pool, including channels and pipelines, which sat atop the wall and converged in the center (Bedal, 60). Bedal explains, “All of the water conduits in the East-West Wall – the east and west channels and the double pipeline - converged at this point and emptied into a central holding tank, a *castellum divisorium*, where water was collected and then redistributed” (Bedal, 61). An overflow passage was built directly connecting the castellum and the pool, but was
later sealed. Three holes in the East-West Wall near the castellum may have also functioned to prevent overflow (Bedal, 61-2).

The original purpose of the construction that Aretas IV (9 BC through AD 40) undertook, which included the Petra Pool and Garden Complex, was legitimation of authority (Bedal, 180). As Bedal writes, “Like other Hellenistic rulers, Aretas IV appears to have built himself a Hellenistic-style palace whose monumentality, lavish decoration, multi-functionality, and commanding position reflected the king’s wealth and status and his position as the ruler over all facets of Nabataean society” (Bedal, 180).

The garden, an important component of the Petra Pool and Garden Complex, is a tradition with a long history in the Near East. Elaborate gardens became a standard feature of royal palaces in ancient Mesopotamia, and terminology for the palace garden is dated to the reign of the Babylonian king Adad-shuma-usur who reigned between 1218 and 1189 BC (Bedal, 121). The garden played an important function in these early civilizations of the Near East. As Leigh-Ann Bedal explains, “Its role was not merely as decoration or as filler in the open spaces between buildings and monuments. The garden itself is a place of social agency, a place where specific activities – religious, official, social, and recreational – are carried out” (Bedal, 122). The multi-functional palace garden was adopted by the expanding Achaemenid Persian empire in the sixth century BC. The tradition spread as the empire did, from Mesopotamia to Anatolia (Bedal, 141). The garden tradition generally passed forward with the Persians influencing the Hellenists, then the Hellenists influencing the Herodians and Nabataeans (Bedal, 141-55).
The historical context of the Petra Pool and Garden Complex yields an interesting comparison between the site and the very similar Pool Complex at Herodium. A comparison between the plans of the two sites is depicted in Figure 9 below (Bedal, 172). The Petra complex was built during the reign of Aretas IV, between 9 BC and AD 40 (Bedal, 171), the Herodium complex between 23 and 20 BC (Bedal, 166). Bedal explains, “Its plan is virtually identical to the pool-complex at Herodium: monumental pool with island-pavilion at one end of a large-earthen terrace supported by double retaining wall…The scale of the Petra Pool-Complex, however, is significantly smaller than the Herodium example, the former covering an area less than half the size of the latter…” (Bedal, 171). The relationship between the Nabataeans and the Herodians was complex. Rivalry, intermarriage, and diplomatic relations, as well as the similarity in design of the complexes suggest that Aretas IV was emulating the Herodium Pool Complex, as a symbol of power and status, in the building of the Petra Pool and Garden Complex (Bedal, 173).
Figure 9: Scale comparison of Petra Pool Complex (top) and Herodium Pool Complex (bottom) (Bedal, fig. 29).
In the second century AD, around the time of the annexation by Rome, major urban development was occurring in Petra. As Leigh-Ann Bedal writes, “The former royal audience/banquet hall (the Great Temple) was converted into a theatron that probably functioned as a council hall, bouleutereion, or odeion (or a combination of these fronted by a large public plaza. The current archaeological record indicates that this transformation may have begun as early as the late first century CE, during the reign of Rabb’el II, although it was not completed until after the Roman annexation in 106 CE” (Bedal, 183). The central location of the Pool Complex and its association with the Great Temple suggest that the Pool Complex was likely converted into a public facility around this time. Considering the widespread use of gardens in Roman landscapes, it is likely that the complex remained a garden after annexation in 106 AD (Bedal, 183).

**Ornamental Display of Water**

The Nabataeans harnessed their limited resources to such an extent that they were able to utilize water recreationally and ornamentally in the city, in addition to the essential amount required by the population. The Petra Pool and Garden Complex is one example of the nonessential yet central uses of water the city. Bedal explains, “The mere presence of a large pool of water whose sole purpose was for pleasure surely would have impressed those who understood the implications of this show of abundance. In addition, the aesthetic effect of a large pool of water in the heart of Petra would have held equal importance” (Bedal, 104).
The garden paradeisos at the Pool and Garden Complex is an important ornamental display of water. Bedal explains, “The success of the garden as metaphor is a result of a variety of forms of symbolic display – monumental architecture, specialized skills and labor, display of rare and exotic species, manipulation of nature, and the conspicuous consumption of precious resources” (Bedal, 182). A garden paradeisos would have left a very strong impression on travelers and dignitaries arriving in Petra after the journey through the desert (Bedal, 183). As Bedal writes, “For the Nabataean king to develop and maintain a hydraulic system that provided sufficient water to the inhabitants of this desert city was accomplishment enough to earn the respect and acknowledgment of this contemporaries, but to exploit and command the natural resources in such a way as to be able to fill a recreational pool and to water a paradeisos was truly remarkable” (Bedal, 182-3).

Another prominent example of ornamental usage of water is the nymphaeum, a large fountain. Nymphaeas were commonplace in Greco-Roman cities of the late first and early second centuries AD. The Romans used nymphaeas as public monuments, and Petra’s nymphaeum was a powerful status symbol for the city (Bedal, 101). Petra’s nymphaeum was located on the city’s central Colonnaded Street and was one of the first sights that would have been observed as one entered the city center (Bedal, 34). Bedal explains, “The nymphaeum of Petra provided passers-by with a convenient resting spot and gathering place, where one could refresh oneself with a drink and cool spray from the fountains. As a place of congregation for citizens and nonresidents alike, the nymphaeum stood as a symbol of the volume of water entering Petra and thus held an important role
as a status marker for the city” (Bedal, 101). Only the foundation of the Petra nymphaeum remains at the site of the ruins. Pictured below in Figure 10 is the ruins of the nymphaeum at Gerasa, which was built in the second century AD, and is better preserved.

![Image](image-url)

**Figure 10: The ruins of the nymphaeum at Gerasa (Nymphaeum façade. Looking west, John French, In ARTstor. Accessed 9 April, 2014).**

Another example of ornamental water display in Petra is the man-made waterfalls. Two in particular stand out, the first of which is a towering 20-meter tall waterfall adjacent to the Palace Tomb. As Leigh-Ann Bedal explains,
This man-made waterfall is remarkable not only for its size, but for its negative impact on the Nabataeans’ efforts towards water conservation. Although splendid to behold, the amount of evaporation off of a waterfall of such magnitude is unnecessarily wasteful of the city’s most precious resource. Therefore the creation of a waterfall, a feature of purely ornamental value, must have held enough significance to its creator and/or the inhabitants of the city to justify its existence (Bedal, 102).

Another much smaller man-made waterfall has been found in Petra’s city center and was used to transport water to the Petra Pool and Garden Complex. The use of a waterfall to carry water is impractical, and other methods such as pipelines or covered channels would save the water that a waterfall loses to evaporation. As Leigh-Ann Bedal notes, “…the creation of a waterfall must have been desirable as a visual effect, an impressive and meaningful use of water display in the heart of Petra” (Bedal, 104).

Beyond the salient aesthetic effect of water display is the symbolism. The use of ornamental displays of water such as the nymphaeum, waterfalls, and the Petra Pool and Garden Complex would have reminded visitors and residents of the city of the beneficence and power of the leaders (Bedal, 105). As Leigh-Ann Bedal writes, “Ultimately, water display is a luxury item, a symbol of wealth and status. Only the richest and most powerful cities could afford to devote resources to an art form that consumes large quantities of water out of the context of everyday usefulness” (Bedal, 107). This conspicuous use of water promoted Petra’s reputation as the central city in the Nabataean kingdom (Bedal, 120). The Nabataeans thwarted the natural shortage of water afforded them by their location, and in doing so sent a clear political message through ornamental water display to its population and neighboring kingdoms: self-sufficiency, wealth, and power.
The Petra Pool and Garden Complex, the nymphaeum, and man-made waterfalls were luxurious facilities, which required large amounts of water. The Nabataeans were able to spare this water, but this does not necessarily mean that they were wasteful with their water resources. One example of this conservation in ornamental use is the planting pots found at the site of the Petra Pool and Garden Complex. Elizabeth Macaulay-Lewis surveyed these planting pots, known as *ollae perforatae*. Planting pots were utilized to conserve water. The *ollae perforatae* date from the first century BC through the mid second century AD. As Macaulay-Lewis notes, “They are identified by their distinctive, single base hole, which was purposefully placed for the drainage and aeration of a plant’s roots. Sometimes the pots also had intentionally placed side holes” (Macaulay-Lewis, 159). The *ollae perforatae* were categorized by Macaulay-Lewis into two types, A and B. Type A pots are vessel-shaped, with wheel ridges on the interior and exterior, with one base hole and no side holes. The one Type B pot that Macaulay-Lewis identified has side-holes and is of greater size than the Type A pots (Macaulay-Lewis, 159-60). When the pots were planted, the water in the potted soil was enclosed by the pot, which reduced the plant’s water requirements. This efficient planting technique can be considered an example of the Nabataeans conserving water, even in their ornamental uses.

The ability to use water as a status symbol does show mastery of water management. This mastery is enumerated below in a breakdown of water resources and usage in Petra compared to standard usage in Rome.
Roman Perception of Water in Petra

In a study by Charles Ortloff, a comparison is made between the available and required water in Petra with the water usage in Rome. He explains that approximately 40 liters or 0.04 cubic meters of water was available per day for each of the 30,000 residents of Petra, which was adequate for hygiene and consumption requirements. Survival in the hot desert climate in which Petra is located required approximately 0.003 cubic meters of water per person per day. In addition to the Wadi Mousa spring, the cisterns and dams located around Petra held an additional 0.36 cubic meters of water person per day, which equates to a two month supply at survival consumption rate of 0.003 cubic meters per person per day (Ortloff, 107). This shows the size of the surplus available for the Nabataeans in public use in recreation and beautification projects such as the Pool and Garden Complex. In Rome, the daily urban water usage rate was 0.6 cubic meters per person. It is important to note the obvious, which is the location of Rome versus the desert location of Petra. As Ortloff concludes from this interesting analysis, “While per capita water supply for Petra were somewhat lower than that of Rome, the amounts supplied on a continuous basis would have been more than sufficient to maintain quality living standards” (Ortloff, 107). This success in harnessing water resources is further indicated by the inaction of the Romans in making changes to the water management system.

The Romans annexed the Nabataean kingdom, and just as the in other parts of the ancient world, the Romans sought to make improvements, as required, in infrastructure and design in Petra. The absence of changes to the water management systems is stark.
Ortloff explains, “It is traditional to look from Roman technological advances that improved the Nabataean system, but few are found. This indicated that Roman engineers might have viewed the Nabataean system as near-optimum” (Ortloff, 108). Indeed, it appears that Nabataeans had harnessed all available water supplies prior to annexation by Rome in AD 106.

**Conclusions**

The earthquake of AD 363 caused devastating damage to the Petra’s infrastructure and buildings. After this point, the city never returned to prosperity, and spiraled into decline. This marked the end of the illustrious prominence of Petra. From its initial settlement around 300 BC, the location of that would become Petra seemed an unlikely site for a large city and busy trade hub. The arid climate in which Petra is situated necessitated Nabataean water systems and management to make the settlement habitable. In light of these circumstances, Nabataean Petra exemplifies the transformation of an environment through the harnessing of natural resources. Conservation of rainfall and controlling nearby springs, through the use of canals, cisterns, pipes, and run-off farming, converted a location with scant water resources into an desert oasis.

Beyond the necessities of Petra's population, the Nabataeans further provided water for extravagant ornamental and religious uses. As the above discussion of the Petra Pool and Garden Complex evidences, highly advanced water engineering was employed by the Nabataeans, and brought prestige and status to the desert city. This mastery of water resources, paired with the location of the city, enabled the Nabataeans to make Petra into
a major transshipment hub of the crucial incense trade. The above evidence conveys the importance of water to the economy of Nabataean Petra and the importance of water as a symbol of Petra’s wealth and status.
References


