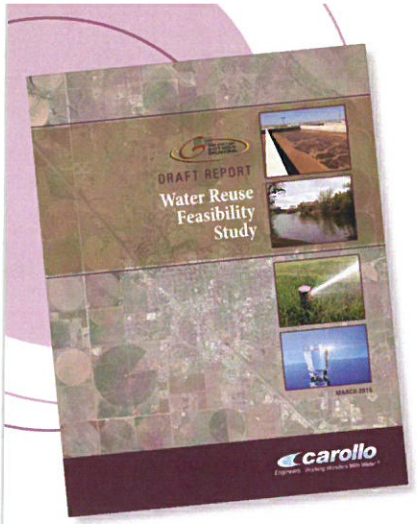
THE CITY OF GUYMON OKLAHOMA

DRAFT

WATER REUSE

Feasibility Study Fact Sheet

May 2016



What were the goals of the study?

The City of Guymon relies on deep groundwater from the Ogallala Aquifer as its sole source of water supply. Historically, the aquifer has provided ample water supplies to the region, but declining water levels in many parts of the Panhandle and surrounding states show the effect of continued use in excess of recharge rates.

With projections of continued strong population growth and in recognition of the link between economic prosperity and a reliable water supply, the City of Guymon initiated a multi-use water reuse planning project to assess the potential to offset fresh groundwater use through beneficial use of reclaimed water. The study assessed the potential costs and water efficiency benefits of a range of water reuse strategies. The study also quantified how water reuse could reduce the need to drill new wells and reduce reliance on the aquifer through recovery and beneficial use of this locally-available, drought-proof water resource.

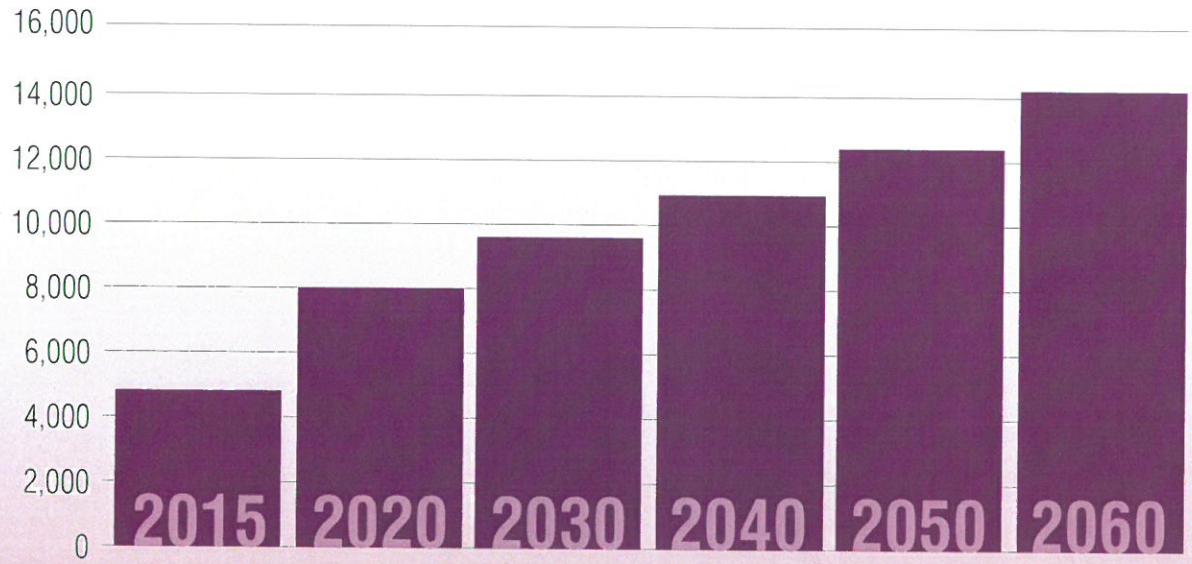
What is our projected water use?

The City operates 19 wells for public water supply for the community's residential, commercial, and industrial customers. Additionally, one well is dedicated to irrigating the City's Sunset Hills Golf Course. Today's use averages about 4.5 million gallons per day (mgd) and peaks at over 6 mgd. State projections show Guymon's water demands increasing from around 5,000 acre-feet per year (AFY) today to about 14,000 AFY by 2060. (One acre-foot equals about 326,000 gallons.) Without reuse, keeping up with demands will require investing some $27 million in 16 new wells by 2060 to supply the overall annual use and meet peak summer demands.

What happens to the flows from Guymon's water reclamation facility today?

Water collected from the community is treated at the City's water reclamation facility in northeast Guymon, with a capacity of 3 mgd and an average flow today of about 1.2 mgd. Through a series of steps that include biological treatment and ultraviolet (UV) light disinfection, the water is treated to a quality suitable for today's uses. Water from the City's facility is either discharged to the Beaver River or blended with wastewater from the

City of Guymon's Projected Water Use (acre-feet per year)



Seaboard Farms facility for irrigation of crop circles, depending on irrigation needs. Water discharged to the river seeps into the riverbed, typically staying aboveground in the river channel for only about a half mile.

What reuse options were considered?

A range of options was considered for beneficial water reuse. These include:

- Seasonal landscape irrigation of Sunset Hills Golf Course, parks, schools, and other public areas in the community, requiring construction of a new pump station and pipeline system to deliver reclaimed water to reuse sites in town.
- Augmentation of Sunset Lake, to replace the use of well water that currently offsets seepage and evaporation losses from the lake to keep it full, providing community benefits and potential regional fire protection benefits.
- Makeup water for cooling towers at the High Plains Bioenergy (HPBE) facility in northeast Guymon.
- Addition of advanced water purification processes and augmentation of potable water supplies.

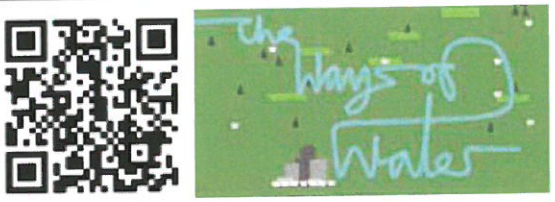
The first three approaches are different ways of using reclaimed water for non-potable uses to offset potable water demands from the City's wells. The fourth is potable water reuse, which can be accomplished by augmenting streams, lakes, or groundwater sources that are used for potable water supply (called "indirect potable reuse" or IPR), or by providing advanced water purification treatment to meet public health standards and then blending the purified water with the well water in the City's distribution system ("direct potable reuse" or DPR). IPR was found to be infeasible for Guymon, due primarily to a lack of surface water sources and concerns about the ability to recover water that might be recharged into the aquifer.

Where is water reuse being practiced?

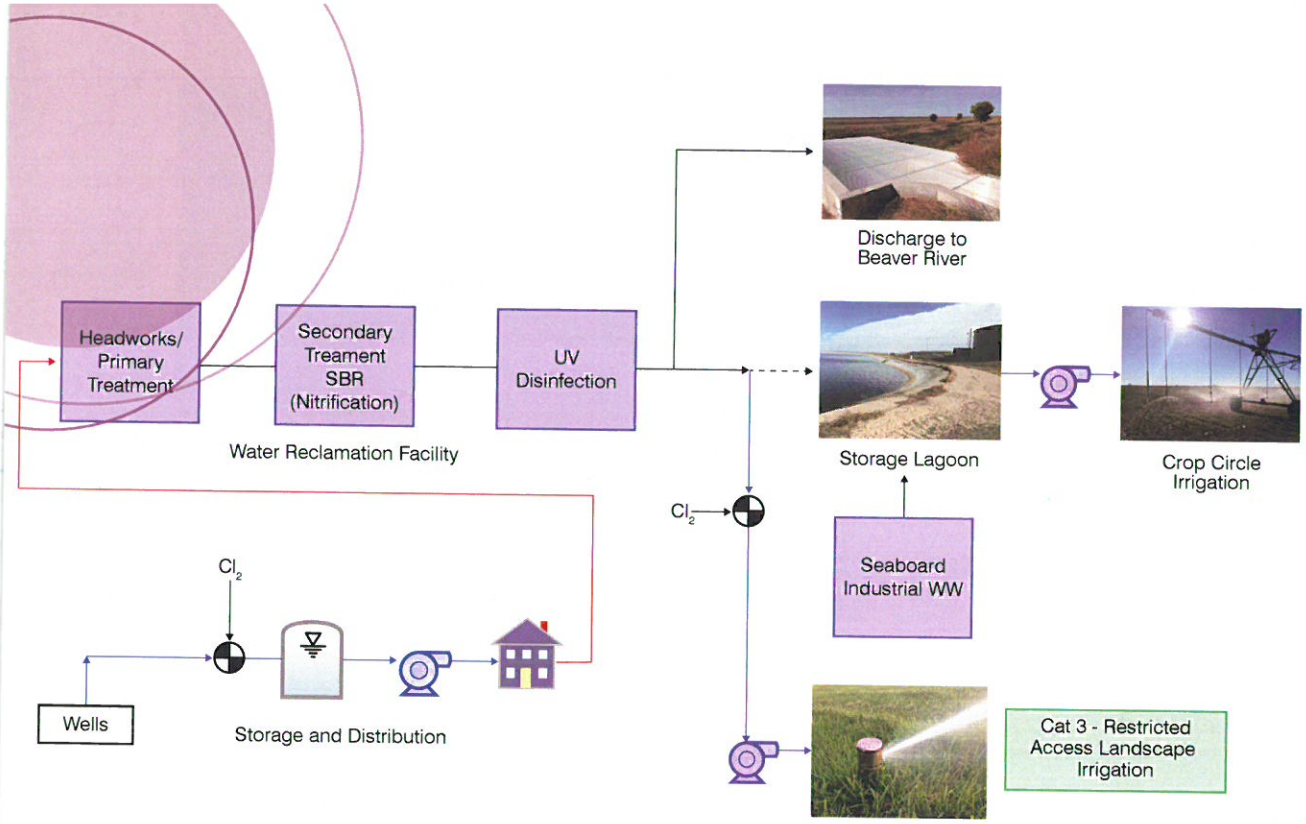
Several Oklahoma communities (e.g., Norman) have implemented non-potable reuse systems to help offset potable demands. These systems have primarily been established to provide water to seasonal non-potable irrigation demands (e.g., golf courses). Oklahoma City uses a portion of its treated effluent to provide water to meet power plant cooling tower water needs. Non-potable reuse for landscape irrigation and commercial and industrial uses is widely practiced across the western and southwestern U.S.

Much of Guymon's reusable water is currently discharged to the Beaver River.

The severe drought conditions that plagued the south-central U.S. in the early part of the current decade led to dramatic increases in reuse and the construction of DPR systems. The Colorado River Municipal Water District (CRMWD) in Big Spring, Texas implemented the first DPR system in the U.S. in 2012. The CRMWD's Raw Water Production Facility treats fully-treated reclaimed water with additional advanced water purification processes before blending the resulting raw water with other traditional sources of water supply from local reservoirs as source water for potable water treatment and distribution. A second DPR facility was constructed and operated by the City of Wichita Falls, Texas in response to the same drought conditions. However, as planned, the DPR system was modified to function instead as an IPR (lake augmentation) system in 2015 once the severe drought conditions in the area eased. The Village of Cloudcroft, New Mexico is constructing a DPR system, which is expected to



Scan this QR code or visit https://www.watereuse.org/foundation/ways-of-water to learn more about reuse and the community water cycle.



Potential Category 3 Non-Potable Water Reuse System

go online later in 2016. DPR demonstration facilities are now being constructed in Florida (Altamont Springs) and California (San Francisco Public Utilities Commission). Several other utilities across the country are contemplating or planning the potential implementation of DPR systems.

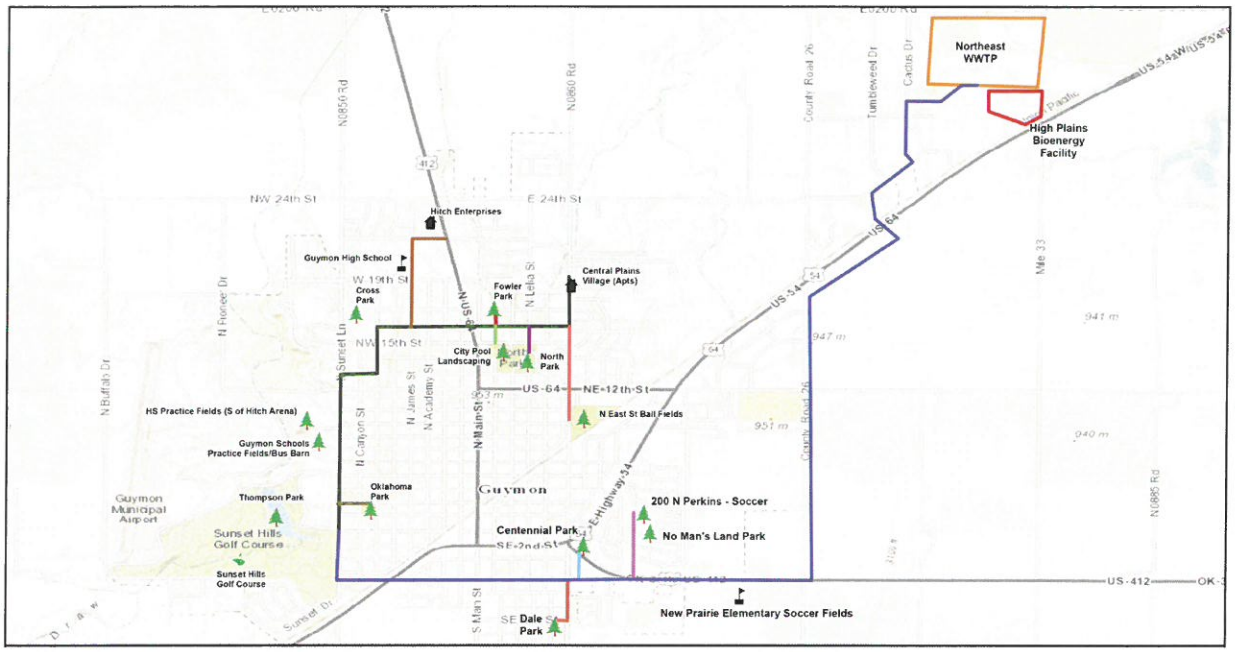
What would reuse system options consist of?

Augmentation of Sunset Lake was determined to be infeasible because it would require significant investments in additional treatment to remove nutrients (nitrogen and phosphorous) to meet regulatory requirements and avoid significant algal blooms in the lake. In-lake water quality management strategies are recommended in the study for continued use of groundwater to maintain lake levels. This reuse option can be reconsidered if future permit conditions for the Water Reclamation Facility eventually drive similar treatment requirements for Beaver River discharges.

Use of the water for HPBE cooling tower supply appears to be feasible, given the proximity of the facility to the Water Reclamation Facility and initial assessments of water quality requirements. HPBE estimates its potential demand for reclaimed water at about 150,000 gallons per day. The study recommends confirming water quality requirements for the cooling towers and development of agreements for providing reclaimed water to the facility.

For non-potable reuse in the community, Oklahoma Department of Environmental Quality (ODEQ) regulations require higher levels of treatment and water quality for uses that have higher potential for human contact with the water. The City's Water Reclamation Facility is capable of meeting the ODEQ "Category 3" requirements for restricted-access uses, but would require investments in additional treatment processes (coagulation and filtration) to meet the "Category 2" unrestricted access standards associated with irrigation at sports complexes and schools.

The amount of reuse that can be achieved is a function of how much distribution piping is installed and whether the water meets Category 3 or Category 2 standards. The study investigated a phased implementation plan that includes initial construction of a "main" pipeline to deliver Category 3 water with no improvements to the Water Reclamation Facility. This initial system could offset 24 AFY of water, at a capital cost of $37 million (includes constructing a reuse pump station and the main pipeline as well as future groundwater wells).

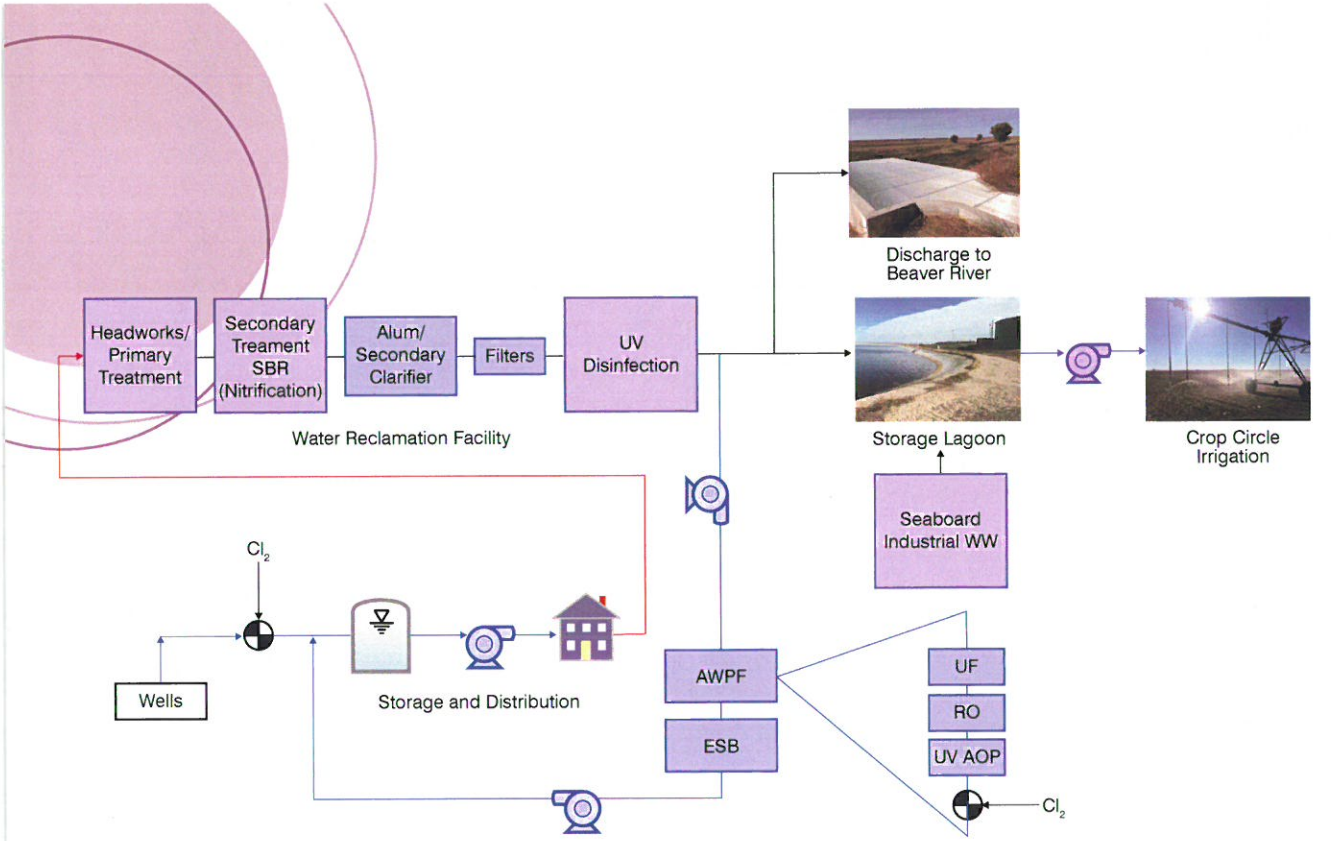


Potential Non-Potable Water Reuse Distribution System

Over time, addition of a "spur" pipeline to serve additional sites and process upgrades at the Water Reclamation Facility would increase non-potable reuse system demands. Altogether, serving the Category 3 and 2 sites would require construction of 7.8 miles of dedicated non-potable reuse piping starting ranging in diameter from 2 to 12 inches. If implemented in conjunction with HPBE use, the Category 2 main and spur pipeline system would be capable of offsetting 212 AFY of potable water, with a 20-year life cycle cost (including capital and operating and maintenance costs) of $42 million, including the 14 new groundwater wells that would still need to be constructed by 2035 to meet potable demands.

Implementing a potable reuse system would avoid the need to construct new non-potable distribution piping through the community, because it uses the City's existing potable water distribution system. However, it would require construction and operation of an Advanced Water Purification Facility (AWPF) to treat the water to potable standards. The study evaluated treatment technology alternatives, and based its recommendations on a process that would include improvements to the Water Reclamation Facility (coagulation and filtration) and a

Sunset Hills Golf Course and Guymon parks could be irrigated with a non-potable reuse system, saving groundwater for potable use.



Potential Potable Water Reuse Facilities

multi-barrier system at the AWPF that include ultra-filtration (UF), reverse osmosis (RO), and advanced disinfection (UV AOP) technologies. An engineered storage buffer (ESB) is used as an additional step in conjunction with advanced monitoring technologies to assure the water meets all treatment requirements and water quality standards before being distributed to the community. Brine generated from the RO process would be disposed either via co-disposal with oil and gas fluids or deep well injection via a dedicated onsite or nearby injection well.

The study assessed a phased implementation plan for the potable reuse option, with initial construction of an 0.5 mgd system and expansions over time to a 2.0 mgd system. The fully-developed system would offset 1,060 AFY of groundwater use, and carries a 20-year life cycle cost of $51M, including the 10 new groundwater wells that would still need to be constructed by 2035 to meet potable demands. The rate of implementation, and ultimate target for DPR flow as a percent of total supply could be adjusted based on the City's renewable water supply goals, financial capabilities, and other factors.

What does the study recommend?

The table below summarizes key information for the non-potable reuse and direct potable reuse alternatives, relative to the "no reuse" option where

Alternative	Number of New Wells to Meet 2035 Demand	Capital Cost (2015 $M)[1]	Avg. Annual Power Cost (2015 $M/year)	20-Year Life Cycle Cost ($M)	Avg. Annual Ground-water Savings (AFY)	Cost per Acre-Foot of Water Saved
No Reuse	16	$27M	$0.08M	$28M	0	N/A
Non-potable Reuse (Cat. 2 + Cat. 3 sites, Main + Spur pipe, HPBE)	14	$40M	$0.10M	$42M	212	$190,000
Direct Potable Reuse[2] (2 mgd system)	10	$35M	$0.80M	$51M	1,060	$51,000

1 - Total for full system build-out; systems would be phased in and expanded over time.
2 - Not including RO brine disposal costs

demands would continue to be met exclusively with groundwater.

The study concluded that either non-potable reuse or DPR are viable alternatives for Guymon. Neither alternative eliminates the need for new groundwater wells to meet projected growth in water use, but the DPR alternative reduces the number of wells much more significantly than the non-potable reuse alternative. Even without reuse, the community will have to invest an estimated $27M to meet future demands. Under the reuse alternatives, those costs increase, but provide the benefit of reducing Ogallala Aquifer use for a more sustainable water supply for the community. The study recommends pursuing HPBE reuse under all scenarios.

Comparing non-potable reuse to DPR, capital costs are lower for DPR, but operating costs associated with the AWPF are higher. As a result, the 20-year life cycle cost is higher for DPR. However, the water supply benefit for DPR is five times that of the non-potable reuse alternative. When considered on a unit cost basis – the cost per acre-foot of water saved, the DPR option is a significantly more cost-effective approach for reducing groundwater use.

Given that the overall intent of water reuse in Guymon is to offset groundwater use and to increase sustainable water management, coupled with the cost-effectiveness of the DPR option relative to the non-potable reuse system, the study recommends phased implementation of DPR as the preferred water reuse approach for Guymon.

What precautions will be taken to ensure our drinking water is safe?

ODEQ is developing regulatory standards for potable water reuse, recognizing that several communities are considering or planning to implement potable water reuse as part of their future water supply systems. The City of Norman is actively implementing its planned potable water reuse system, and several others are contemplating similar systems. In lieu of ODEQ regulations, the Guymon DPR system was planned using regulatory precedents from national guidance and other states' regulatory approaches. This includes 12-log (99.9999999999%) removal of viruses and 10-log removal of other pathogens. The proposed water purification facility will also remove constituents such as personal care products and pharmaceuticals. Advanced monitoring equipment will be used to continuously assure treatment and water quality and compliance with regulatory standards and ODEQ permit requirements.

What are the next steps?

The study recommends the following steps toward implementation of the reuse system:

- Confirm HPBE water quality requirements and initiate development of a service agreement.
- Initiate discussions with ODEQ to confirm anticipated regulatory requirements for DPR.
- Confirm and refine the treatment, monitoring, and engineered storage facilities needed to meet the regulatory requirements ultimately set by ODEQ for the system, and investigate RO brine disposal options further.
- Conduct distribution system modeling to evaluate where to tie in DPR supplies into the existing system and assess the potential need for additional system storage.
- Initiate preliminary design of the first phase of the DPR system, once the above steps are completed and funding for the project is in place.
- Initiate a public outreach program to garner public support for the proposed DPR system.

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