CITY OF HENDERSON, NEVADA

TECHNICAL MEMORANDUM

WEST HENDERSON WATER INFRASTRUCTURE PHASING STRATEGY UPDATE

FINAL
November 2016

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CITY OF HENDERSON

TECHNICAL MEMORANDUM

WEST HENDERSON WATER INFRASTRUCTURE PHASING STRATEGY UPDATE

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1.0 PROJECT BACKGROUND

The purpose of this Technical Memorandum (TM) is to provide the engineering basis for determining the project cost and the cost for each Equivalent Dwelling Unit (EDU) for the infrastructure associated with the City of Henderson, Nevada (City) West Henderson 2630 and 2760 Pressure Zone Water Infrastructure Improvements. This TM serves to update the planning study previously documented in the "West Henderson Backbone Water Infrastructure Special Refunding Project," prepared by Carollo Engineers. This update is necessary to incorporate changes in the water supply source assumptions for West Henderson. Previously, the planning for all future supplies to West Henderson assumed full buildout demands to be met through the Southern Nevada Water Authority's (SNWA) Bermuda Rate of Flow Control Station (ROFCS). Current planning assumes water supplies being provided to West Henderson in two distinct phases. The first phase assumes a maximum of 20 million gallons per day (mgd) will be provided through the Bermuda ROFCS and additional required supplies will come from the SNWA Horizon Ridge ROFCS.

In addition, the previous approach presented a "buildout" or ultimate infrastructure framework only. As stated above, the current approach defines two incremental phases of infrastructure development that are expected to occur, thus providing guidance to the City in developing 5- and 10-year capital improvement plans.

It should also be noted that, similar to the previous planning study, the scope of this technical memorandum covers water service and associated infrastructure for the 2630 and 2760 pressure zones. It does not consider water service or infrastructure requirements for the remainder of West Henderson that lies within the corporate boundaries of the City, but extends outside of these pressure zones. See Figure 1 for details of the study area boundaries.

It is recognized that development may occur to some degree in each pressure zone in each planning phase. Therefore, the updated approach allocates infrastructure cost by planning phase and pressure zone. This provides the City with flexibility to adjust the infrastructure plan, based on actual growth patterns. If adjustments are necessary, this technical memorandum will be amended, accordingly.

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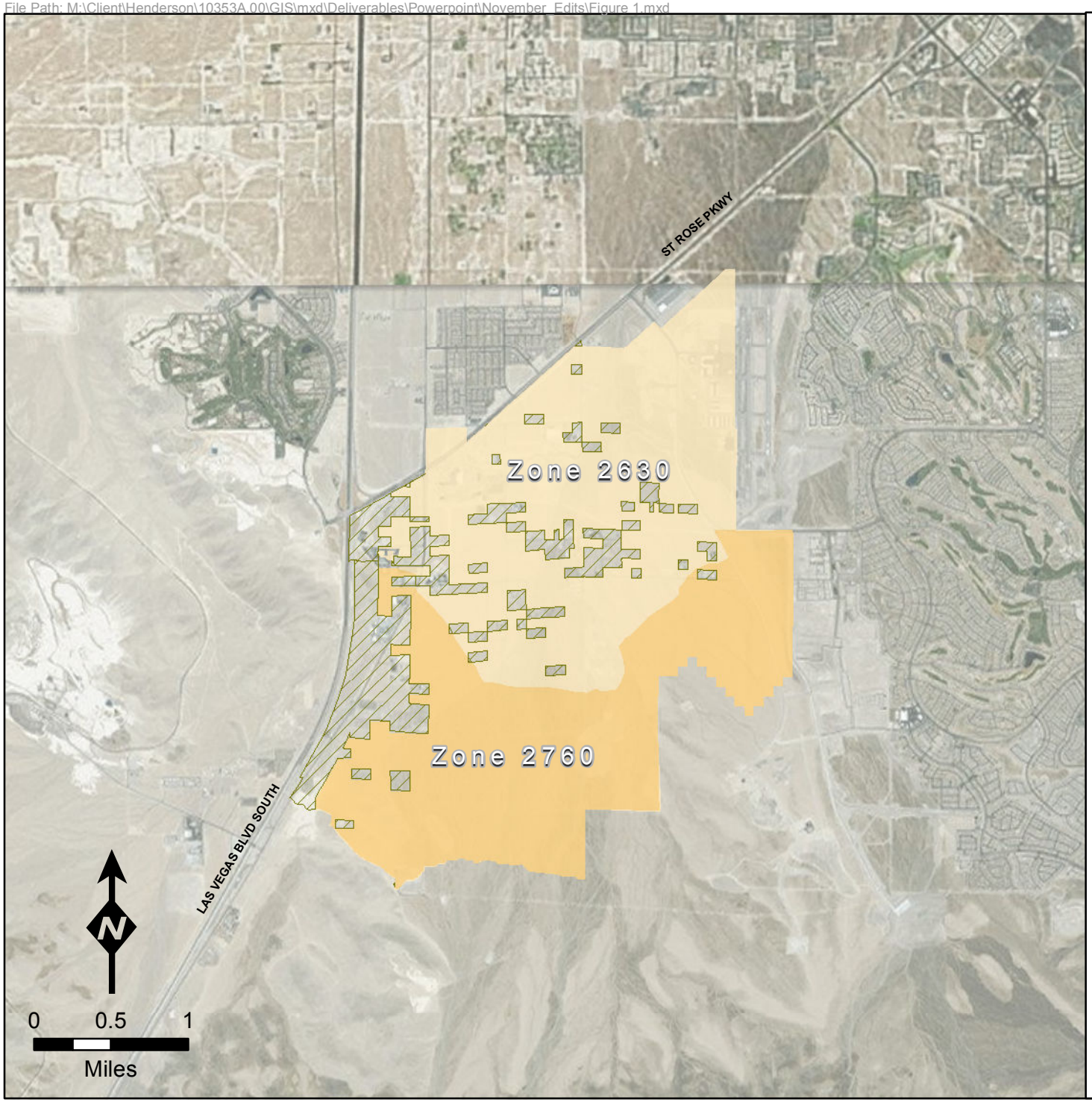

THE CITY OF HENDERSON
A Place To Call Home

Legend

- Zone 2630
- Zone 2760
- Unincorporated Clark County

STUDY AREA

FIGURE 1

WEST HENDERSON WATER INFRASTRUCTURE PHASING STRATEGY UPDATE

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As reflected in the cost per EDU per pressure zone shown below, the buildout projections for the West Henderson backbone water system consist of a phased approach, based upon two separate infrastructure phases. The second phase of infrastructure constructed, will build upon the framework of infrastructure put in place by the first phase. Given the water pipelines constructed as a part of the Phase 1 backbone water infrastructure are being sized to meet the capacity needs for the complete buildout of the study area, all developments that occur within the 2630 and 2760 pressure zones will be responsible for paying a proportionate share of the costs, on a $/EDU basis, for the construction of those pipelines. The costs associated with the remainder of the Phase 1 water backbone infrastructure will be distributed on a $/EDU basis, based upon the capacity of each reservoir and pump station, and pressure zone served.

Phased construction costs yield the cost of EDU per phase, per pressure zone, based upon the following formulas:

$$\text{Cost per EDU} = \frac{\text{Total Cost for Backbone Infrastructure (\$)}}{\text{Total EDUs Served by Backbone Infrastructure}}$$

The engineering study necessary to determine the construction cost and cost per EDU was determined by:

- Modeling the potable water service area for demand based on the current approved land use plan.
- Integrating the new backbone infrastructure with existing infrastructure.
- Routing the pipelines through anticipated traffic corridors.
- Calculating pipeline size based on established City modeling and performance criteria.
- Calculating reservoir storage volumes.
- Calculating pump station capacities.
- Establishing land acquisition requirements.

2.0 LOCATION

The West Henderson Water Infrastructure Phasing Strategy Update Project is located at the southwest City boundary as presented on Figure 1 and described in Appendix A. The West Henderson 2630 and 2760 pressure zones encompass an area of approximately 4,845 acres within incorporated City limits, and unincorporated Clark County areas within the service area. Approximately 700 acres located within the service area are unincorporated Clark County areas. It is anticipated that the unincorporated Clark County areas may be annexed into the City in the future, or may obtain water service from the City and therefore the unincorporated Clark County areas are included in the water demand

analysis and factored into the cost per EDU for the West Henderson service area. The City's estimated buildout population for the service area is 45,313.

3.0 INFRASTRUCTURE PLANNING PHASES

There are two infrastructure planning phases established for development in West Henderson:

- Phase 1 - Year 2025 - 2033
- Phase 2 - Year 2033 - 2043

These planning phases were defined using annual water demand projections developed for West Henderson from 2016 through year 2043. The system capacity added in each phase is sufficient to meet the demands of that planning year and includes enough reserve capacity to enable growth to continue to the next planning year.

4.0 PRESSURE ZONES

There are two pressures zones located in the West Henderson service area: Pressure Zone 2630 and Pressure Zone 2760. At final buildout, 40 mgd of water supply is modeled to originate from the SNWA South Valley Lateral (SVL). 20 mgd will come from the Bermuda ROFCS, and be pumped to reservoirs located within each pressure zone. An additional 20 mgd of water supply is modeled to originate from the SNWA Horizon Ridge ROFCS, and be pumped to reservoirs located within each pressure zone.

5.0 MODELING CRITERIA

Modeling criteria for the West Henderson Water Infrastructure Phasing Strategy Update Project is based on sizing the pipelines for peak hour demands (PHD), which for the buildout condition was greater than the maximum day demands plus fire flow requirements. Scenarios were modeled for PHD and maximum day demands plus fire flow requirements for each planning Phase. Table 1 presents the system performance criteria used in modeling the West Henderson Backbone Water Infrastructure. All system performance criteria for pressure and flow meet the City's requirements. Pipe velocity criteria are generally met with the proposed backbone infrastructure. In some cases, minor exceedances were allowed to pipe velocity criteria where maximum head loss criteria were met.

Table 1	**Hydraulic Modeling Performance Criteria West Henderson Water Infrastructure Phasing Strategy Update City of Henderson, Nevada**
Minimum Pressure During Maximum Day	40 psi
Minimum Pressure During Peak Hour	30 psi
Minimum Residual Pressure During a Fire Flow Event	20 psi
Maximum Velocity During Peak Hour Demand	4 fps (1)
Maximum Velocity During a Fire Flow Event	20 fps
Maximum Head Loss During Peak Hour Demand	5 ft/1,000 ft
Maximum Head Loss During a Fire Flow Event	10 ft/1,000 ft
Maximum Fire Flow and duration (non-residential)	6,000 gpm for 4 hrs
Maximum Day to Average Day Demand Peaking Factor (MDD/ADD)	1.7 (2)
Peak Hour to Average Day Demand Peaking Factor (PHD/MDD)	1.7

Notes:

(1) Maximum Velocity Criteria for some pipelines exceed the 4 fps in the Peak Hour analysis for a portion of the 16-inch pipeline in 2760. The final design for this pipeline will require a detailed Hydraulic Analysis to confirm the required size at buildout.

(2) The Maximum Day to Average Day Demand Peaking Factor (MDD/ADD) has been adjusted from 2.0 down to 1.7 in order to take into account the reduction in maximum day demand value assumed for West Henderson. See Section 6 below, for further clarification.

Abbreviations:

psi = pounds per square inch; fps = feet per second; ft = foot/feet; gpm = gallons per minute; hrs = hours

Other criteria relevant to the West Henderson water infrastructure study area model include:

1. Demands were calculated for areas inside the City limits and all unincorporated Clark County areas within the study area based on land use and the City's EDU per acre factors as summarized in Appendix B.

2. Reservoir 36 is an existing above grade reservoir, with a capacity of 3.5 million gallons (MG) located at Site 36. Reservoir 36A (R-36A) will be constructed at Site 36 above grade to complement the hydraulics of the existing system.

3. Pressure Reducing Valve 88 (PRV-88) is assumed closed during the modeling scenarios.

4. SNWA is assumed the sole source of potable water supplied from the SVL. 20 mgd will be provided through the COH Bermuda ROFCS and 20 mgd will be provided through the Horizon Ridge ROFCS to meet the demands for the West Henderson study area. An additional 15 mgd will be provided through the Horizon Ridge ROFCS, and is necessary to meet long-term operational and planning needs that provide a higher level of system reliability for the City's water system.

Appendix C includes a summary of the major assumptions used to guide this study.

6.0 POTABLE WATER DEMAND

Water demands were updated from the July 2014 analysis to reflect a more current understanding of demand trends in areas adjacent to West Henderson and increased conservation within the City in general. Previously, a maximum day demand value of 0.93 gpm/EDU was used to determine the system capacity for West Henderson. The City's current demand projections for West Henderson assume that water-efficient landscaping and fixtures will be in place for most, if not all, new development, which may reduce the demand per EDU. Taking into account current customer water use trends and recognizing there is potential for per-capita water demands to be less in the future, the buildout demand projections were reduced by approximately 16 percent to 0.78 gpm/EDU. The maximum day demand (MDD) and peak hour demand (PHD) for ***all*** land areas within the West Henderson Water Infrastructure Phasing Strategy study area are presented in Table 2 by pressure zone and Phase.

Table 2 Potable Water MDD and PHD Zone 2630 and Zone 2760
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

	Maximum Day Demand (mgd)			Peak Hour Demand (mgd)		
Phase	**PZ 2630**	**PZ 2760**	**Total**	**PZ 2630**	**PZ 2760**	**Total**
1	4.35	4.35	**8.7**	7.4	7.4	**14.8**
2	8.95	8.95	**17.9**	15.2	15.2	**30.4**
Ultimate	**20.0**	**20.0**	**40.0**	**34.0**	**34.0**	**68.0**

Projected potable water demands for land areas located within the service area, but not currently incorporated into the City limits are presented in Table 3. The unincorporated Clark County area potable water demand represents approximately 16 percent of the total MDD presented in Table 3.

Table 3 Unincorporated Clark County Area MDD and PHD Zone 2630 and Zone 2760
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

	Maximum Day Demand (mgd)			Peak Hour Demand (mgd)		
Phase	**PZ 2630**	**PZ 2760**	**Total**	**PZ 2630**	**PZ 2760**	**Total**
Ultimate	**3.5**	**2.8**	**6.3**	**5.9**	**4.8**	**10.7**

7.0 SUPPLY SOURCE

Currently, all water supplies to West Henderson are through PRV-88, which is connected to the P-19A/R-36 transmission line. It is anticipated that once the City's Bermuda Pump Station is constructed it will be the primary supply source for West Henderson. PRV-88 may remain in place for emergencies or to provide operational flexibility.

During Phase 1, the City's Bermuda Pump Station will supply the initial West Henderson Demands. The 20 mgd buildout capacity of the City's Bermuda Pump Station may be phased between years 2025 and 2033 to align with future projected growth needs until the Phase 2 infrastructure is constructed after year 2033.

During Phase 2, the P-19A/R-36 transmission line is planned to be re-purposed to convey water supplies from the Horizon Ridge ROFCS through a new, future pump station. The existing pipeline currently serves the 2760 Pressure Zone, but will be repurposed to serve the 2630 Pressure Zone, feeding R-35. A new transmission line from the Horizon Ridge ROFCS will be needed and will connect to the P-19/R-36 transmission line at approximately Sun City Anthem Drive and Eastern Avenue. This will enable P-19 to continue to fill R-21 with existing infrastructure.

The West Henderson supply source is summarized in Table 4 by planning phase.

Table 4 West Henderson Supply Source
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Phase	Year	Maximum Water Supply (mgd)			
		PRV-88 (1)	R-36 (2)	City Bermuda Pump Station (3)	Horizon Ridge ROFCS (4)
Current	2016 - 2025	1.0	0	0	0
1	2025 - 2033	0	1.0	20	0
2	2033 - 2043	0	0	20	35

Notes:
(1) Currently provides supply to Zone 2630 (M-Resort).
(2) May provide some support to Zone 2760 while capacity is available from the Inspirada Development to leverage existing infrastructure.
(3) City Bermuda Pump Station buildout capacity of 20 mgd, may be phased to align with future projected growth needs until the Phase 2 backbone water system is constructed.
(4) Will require separating P-19A/R-36 and P-19A/R-21 transmission line to re-purpose for Horizon Ridge supplies to R-35. The buildout capacity of 35 mgd, may be phased to align with future projected growth needs.

8.0 PROJECT ELEMENTS

8.1 Pipelines

The West Henderson Water Infrastructure Phasing Strategy Update includes a system-wide assessment and provides an overall plan to achieve a complete water system, and includes pipelines 12 inches and larger. However, only the transmission pipelines that convey water between pump stations and reservoirs are included within the Phase 1 backbone water infrastructure costs. The remainder of the pipelines included on Figure 2 and Figure 3 are illustrated to demonstrate a complete and functional system. Pipeline routing is modeled using the probable traffic corridors established in the City of Henderson Master Streets & Highways Plan dated November 2011.

Table 5 presents the total breakdown of pipeline diameter and lengths by planning Phase. Costs for backbone pipelines are allocated 100 percent to the Phase in which they are planned to be constructed (see Note 2 in Table 5). The pipeline design parameters are based on the City of Henderson pipeline requirements as required by the Henderson Utility Guidelines (HUGS).

Table 5 Pipeline Diameters and Lengths By Phase
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Diameter (inch)	Pipeline Length (feet)		
	Phase 1	Phase 2	Phase 1 or Phase 2 (2)
12	0	0	13,157
16	8,000	0	39,798
20	0	0	1,366
24 (1)	0	0	53,717
30	23,486	0	5,474
36	2,349	0	1,656
42	4,411	15,700	0
Total	**38,246**	**15,700**	**115,168**
Total (mi)	**7**	**3**	**22**

Notes:
(1) Some portions of the 24-inch pipeline shown on Figure 2 are scheduled to be installed by others, and not included in this project.
(2) Pipelines shown to be constructed by developers may be constructed during Phase 1 or Phase 2 because the timing of development is currently unknown.

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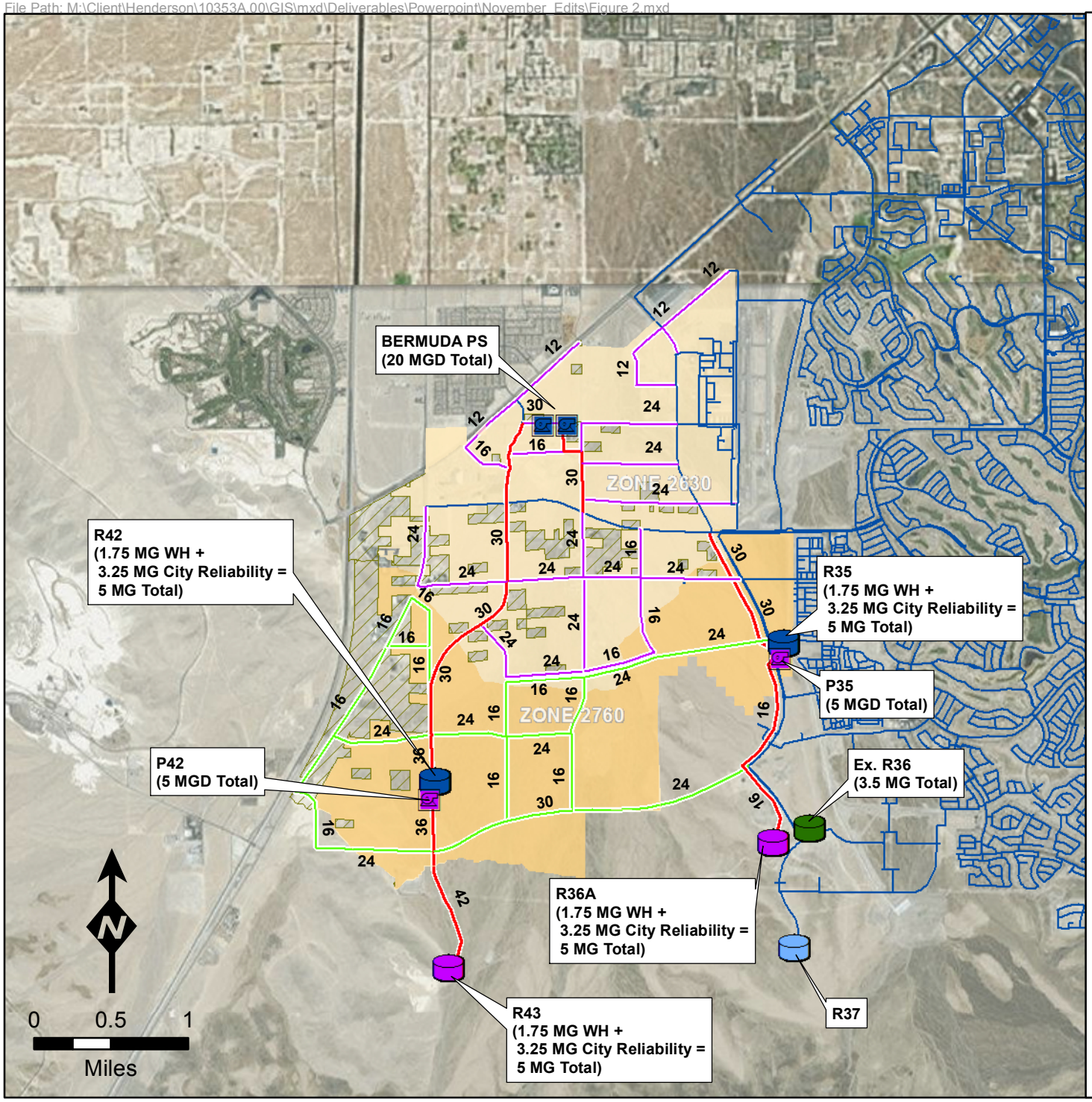

Legend

Booster Pump Station
- PZ 2630
- PZ 2760

Reservoir
- Existing (PZ 2870)
- Existing (PZ 2760)
- PZ 2630
- PZ 2760

Water Pipe
- Existing
- PZ 2630 Installed by Developers (Timing Unknown)
- PZ 2760 Installed by Developers (Timing Unknown)
- Installed by City

Study Area
- Pressure Zone 2630
- Pressure Zone 2760
- Unincorporated Clark County

PHASE 1 (YEAR 2025 - 2033)
WATER SYSTEM INFRASTRUCTURE

FIGURE 2

WEST HENDERSON WATER INFRASTRUCTURE PHASING STRATEGY UPDATE

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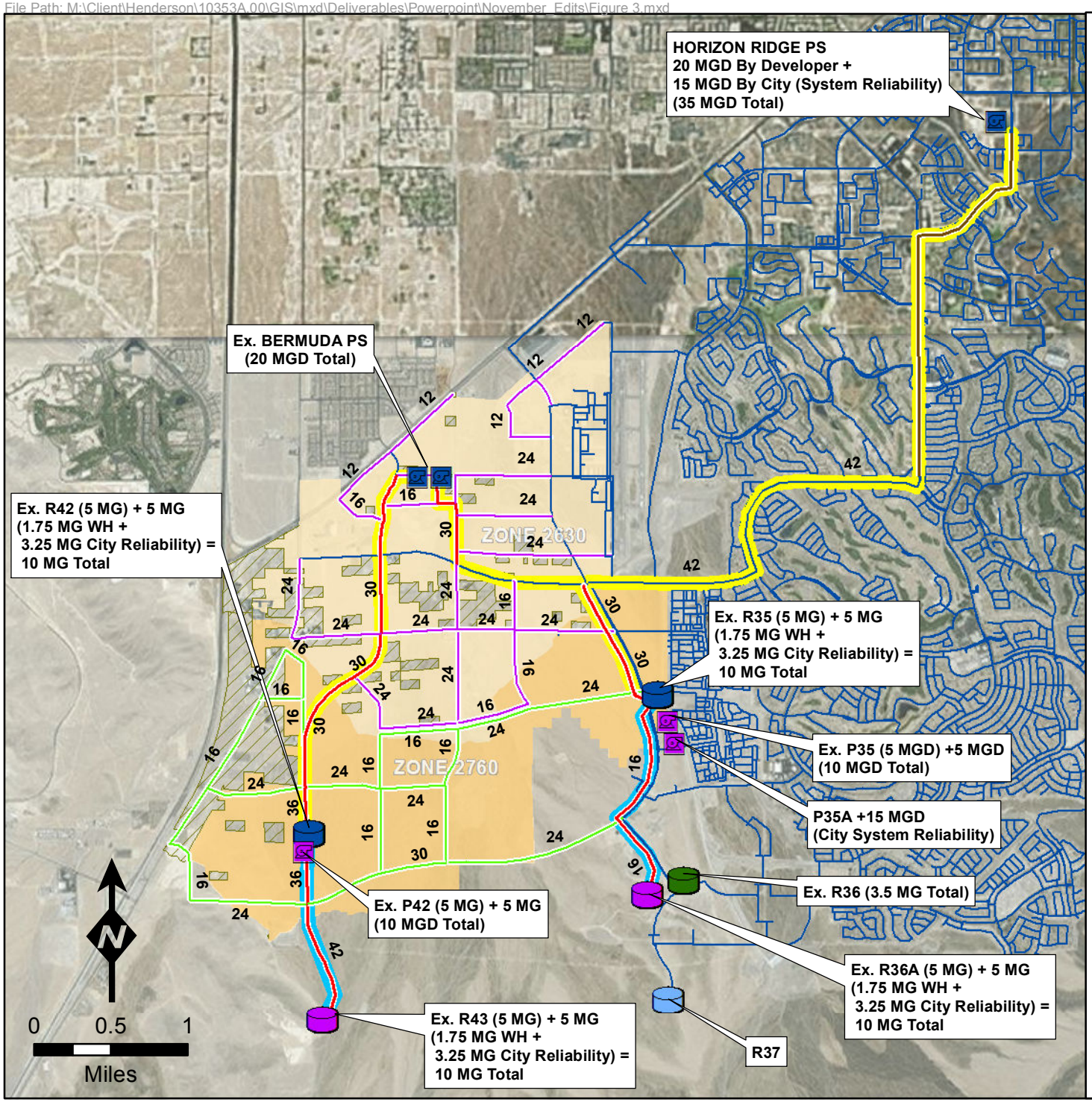

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Legend

Booster Pump Station
- PZ 2630
- PZ 2760

Reservoir
- Existing (PZ 2870)
- Existing (PZ 2760)
- PZ 2630
- PZ 2760

Water Pipe
- Existing
- PZ 2630 Installed by Developers (Timing Unknown)
- PZ 2760 Installed by Developers (Timing Unknown)
- Installed by City
- Installed by Developers
- Transmission to PZ 2630 Reservoir
- Transmission to PZ 2760 Reservoir

Study Area
- Pressure Zone 2630
- Pressure Zone 2760
- Unincorporated Clark County

PHASE 2 (YEAR 2033 - 2043)
WATER SYSTEM INFRASTRUCTURE

FIGURE 3

WEST HENDERSON WATER INFRASTRUCTURE PHASING STRATEGY UPDATE

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8.2 Pump Stations

At final buildout, half of the water supply (20 mgd) for the West Henderson study area is modeled to originate from the SNWA SVL through the Bermuda ROFCS. The City of Henderson Bermuda Pump Station (COH-Bermuda) will be located adjacent to the existing Bermuda Pump Station (operated by the Las Vegas Valley Water District). The COH-Bermuda PS is physically located within Zone 2630; however, the capacity of the COH-Bermuda PS is modeled to provide capacity for Pressure Zone 2630 and Pressure Zone 2760.

The COH-Bermuda PS will use canned Vertical Turbine Pumps (VTPs). Pump Station 35 (P-35), and Pump Station (P-42) will incorporate a cast-in-place concrete wet well connected to an expandable below-grade baffled reservoir. A separate air-conditioned building constructed of CMU will be used for electrical equipment.

8.2.1 Zone 2630 Pump Stations

COH-Bermuda is located in Zone 2630. The modeled capacity of the COH-Bermuda PS is approximately 14,000 GPM. The capacity of the COH-Bermuda PS is based on one half of the combined MDD for Zone 2630 and Zone 2760. It is anticipated that the COH-Bermuda PS may be constructed in two phases. At buildout, the COH-Bermuda PS would have six duty and one standby canned VTPs. Cost of the COH-Bermuda PS construction is included in the Engineers Opinion of Probable Construction Cost. COH-Bermuda PS design parameters are provided in Table 6.

Table 6 COH-Bermuda PS Design Parameters
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Parameter	Phase 1
Type of Pump (1)	Canned VTPs
Station Buildout Capacity (gpm)	14,000
Pump Capacity (gpm)	2,400
Number of Pumps (2)	7
Total Dynamic Head (ft)	190
Horse Power	200

Notes:
(1) Three- or four-stage VTP, depending on manufacturer.
(2) One redundant pump installed for facility reliability.

8.2.2 Zone 2760 Pump Stations

There are two pump stations modeled for Zone 2760, Pump Station 35 (P-35), and Pump Station 42 (P-42). Zone 2760 Pump Station design parameters are provided in Table 7.

Table 7 Zone 2760 Pump Station Design Parameters
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Parameter	P-35	P-42
Station Capacity by Phase (mgd)		
Phase 1	5.0	5.0
Phase 2	5.0 +15.0(1)	5.0
Total	25.0 (1)	10.0
Type of Pump	VTPs in Wet Well (2)	
Station Buildout Capacity (gpm)	17,500	7,000
Total Dynamic Head (ft)	180	180
Pump Capacity (gpm)	3,500	2,400
Number of Pumps	5+1 (3)	3+1 (3)
Horsepower	300	200

Notes:
(1) 15 mgd is for City water system operational flexibility and reliability.
(2) Three or four stage VTP, depending on pump manufacturer.
(3) One redundant pump will be installed.

8.3 Reservoirs

Chapter 445A of the Nevada Administrative Code (NAC), states:

NAC 445A.6674 Storage capacity. (NRS 445A.860) Except as otherwise provided in NAC 445A.66755:

1. A supplier of water shall ensure that:
   (a) An existing public water system maintains a storage capacity that, as determined by an engineer on the basis of historical data, accepted engineering judgment and a network hydraulic analysis, is sufficient to ensure that the total capacity of the public water system will meet current and anticipated demands for water while maintaining the pressures indicated in NAC 445A.6711.
   (b) A new public water system maintains a storage capacity that is sufficient to provide the amount of water required for sufficient operating storage, emergency reserve and fire demand.

2. Storage requirements for fire demand must be calculated according to the requirements of the fire authority. The Division or the appropriate district board of health shall evaluate the design of a public water system based upon appropriate documentation of those requirements.

3. A supplier of water for an existing public water system shall ensure that the total storage capacity and capacity of booster pumps for each zone of pressure in the distribution system are sufficient to meet the maximum day demand within that zone. Water stored in a higher zone of pressure may be provided to serve a lower zone of pressure if:
   (a) An appropriate pressure regulator is installed between the zones; and
   (b) The requirements for the higher zone of pressure are not compromised.

Therefore, in order to ensure the above requirements are met for West Henderson while increasing overall water system reliability for existing and future customers, reservoir capacity is based on providing a 24-hour, maximum day storage volume.

All reservoirs are modeled as below grade, cast-in-place concrete, with the exception of R-36A. R-36A is modeled as an above-grade reservoir to complement the existing hydraulics at Site 36, where an existing above-grade reservoir exists (R-36). All below-grade reservoirs will use a metal raised seam roof. Cost of reservoir construction is included in the Engineers Opinion of Probable Construction Cost. Two reservoirs are provided at each site for reliability.

8.3.1 Zone 2630 Reservoirs

There are two reservoirs modeled for Zone 2630. Table 8 presents the volume of each reservoir serving Zone 2630.

Table 8 Zone 2630 Reservoir Sizing
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Reservoir Sites	Volume (MG)		
	Phase 1	Phase 2	Total
R-35	5.0	5.0	10.0
R-42	5.0	5.0	10.0
Total Reservoir Volume Zone 2630			**20.0**

8.3.2 Zone 2760 Reservoirs

There are three reservoirs modeled for Zone 2760. Table 9 presents the volume of each reservoir serving Zone 2760. The existing R-36 serves as the additional reservoir required to meet the total 23.5 MG storage requirement required for the 2760 Pressure Zone.

Table 9 Zone 2760 Reservoir Sizing
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Reservoir Sites	Volume (MG)		
	Phase 1	Phase 2	Total
R-36 (Existing)	N/A	N/A	3.5
R-43	5.0	5.0	10.0
R-36A	5.0	5.0	10.0
Total Reservoir Volume Zone 2760			**23.5**

9.0 LAND ACQUISITION

All reservoir and pump station sites are proposed to be located on BLM-owned land. The City has stated it is already in the process of preparing grant applications to submit to BLM, for issuance of Recreation and Public Purpose (R & PP) leases to secure these sites for future use by the City. Therefore, all land acquisition costs incorporated into the Engineers Opinion of Probable Project Cost for each phase, are intended to cover costs associated with securing necessary rights-of-way for the pipeline corridors. Anticipated land requirements are provided in Table 10.

Table 10 Anticipated Land Requirements
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Site	Attributes	Required Land Acquisition (acres)
COH-PS	COH-PS	5.0
Site 35	R-35, R-35A, P-35	6.0
Site 42	R-42, R-42A, P-42	6.0
Site 43	R-43, R-43A	4.0
Total		**21.0**

10.0 ENGINEERS OPINION OF PROBABLE PROJECT COST

The Engineers Opinion of Probable Construction Cost for each phase is presented in Table 11, with a breakdown by infrastructure component included in Appendix D. The cost estimates are based on standard methodologies and best practices as prescribed by the Association for the Advancement of Cost Engineering (AACE). This is a Class 5 cost estimate (order of magnitude cost estimate), in accordance with AACE, the expected accuracy of the cost estimate is +50 percent to -30 percent. An Engineers Opinion of Probable Construction Cost for the proposed replacement infrastructure is also provided.

Table 11 Engineers Opinion of Probable Project Cost
West Henderson 2630 and 2760 Pressure Zone –
Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Phase	City Contribution ($M)	Developer Contribution ($M)	Total Estimated Project Cost [(1)] ($M)	Total Estimated Project Cost - Escalated ($M) [(2)]
1	$22.6	$64.4	$87.0	$100.0
2 [(3)]	$58.2	$50.6	$108.8	-
Total	**$80.8**	**$115.0**	**$195.8**	**-**

Notes:

(1) Total estimated project costs per phase reflect current market conditions (2016) and thus do not account for inflation or the projected market conditions at the time the projects are projected to be constructed.

(2) The cash flow associated with the construction activity was analyzed with a 1.5 percent cost escalation per year through 2033 when it is anticipated that the Phase 1 water backbone infrastructure will be fully constructed. The 1.5 percent cost escalation per year is presented as an example for planning purposes, only. The City may elect to modify the cost escalation at a different rate based on yearly review or more often, as overall economic factors change.

(3) Escalation of Phase 2 costs were not considered because the planning horizon is too distant.

11.0 COST PER EQUIVALENT DWELLING UNIT (EDU)

Based upon the Engineers Opinion of Probable Project Cost for Phases 1 and 2, along with applying the methodology described in Section 1.0 of this report, yields a cost per equivalent dwelling unit ($/EDU) for each phase, as summarized in Table 12, Table 13, and Table 14.

Table 12 Engineers Opinion of Probable Project Cost Per EDU ($/EDU)
West Henderson 2630 and 2760 Pressure Zone – Phase 1
Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Backbone Infrastructure Required	Size	Cost	EDUs Served	$/EDU
West Henderson 2630 Pressure Zone – Phase 1:				
1. Bermuda Pump Station (1)	10 mgd	$10,254,882	8,903	$1,152
2. Reservoirs R35 + R42 (2)	3.5 MG	$6,074,045	8,903	$682
3. Pipelines - Phase 1 (3)	Varies	$6,113,706	17,806	$343
4. Land Acquisition (4)	1 LS	$1,183,256	17,806	$66
Total Cost per EDU, Phase 1 = 2630 PZ (5) =				**$2,243**
City Water System Reliability 2630 Pressure Zone – Phase 1:				
1. Reservoirs R35 + R42 (2)	6.5 MG	$11,280,370	N/A	N/A
West Henderson 2760 Pressure Zone – Phase 1:				
1. Bermuda Pump Station (1)	10 mgd	$10,254,882	8,903	$1,152
2. Pump Stations P35 + P42	10 mgd	$10,254,882	8,903	$1,152
3. Reservoirs R36A + R43 (2)	3.5 MG	$6,074,045	8,903	$682
4. Pipelines - Phase 1 (3)	Varies	$13,018,005	17,806	$731
5. Land Acquisition (4)	1 LS	$1,183,256	17,806	$66
Total Cost per EDU, Phase 1 - 2760 PZ (5) =				**$3,783**
City Water System Reliability 2760 Pressure Zone – Phase 1:				
1. Reservoirs (R36A + R43)	6.5 MG	$11,280,370	N/A	N/A

Notes:

(1) The cost for the Bermuda PS is split equally between the 2630 and 2760 pressure zones (10 mgd per zone).
(2) The costs for the R35, R42, R36A, and R43 are split to reflect a 35% benefit to West Henderson EDUs, and 65% benefit for City's water system reliability.
(3) The proportional cost allocation of the Phase 1 backbone water pipelines benefitting the entire 2630 and 2760 pressure zones (i.e. Phases 1 and 2).
(4) The Land Acquisition cost is split equally and provides benefit to the 2630 and 2760 pressure zones (i.e. Phases 1 and 2).
(5) Total cost per EDU reflects current market conditions (2016) and thus do not account for inflation or the projected market conditions at the time the projects are projected to be constructed.

Table 13 Engineers Opinion of Probable Project Cost Per EDU ($/EDU)
West Henderson 2630 and 2760 Pressure Zone – Phase 2
Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Backbone Infrastructure Required	Size	Cost	EDUs Served	$/EDU
West Henderson 2630 Pressure Zone – Phase 2:				
1. Horizon Ridge Pump Station (1)	10 mgd	$10,254,882	8,903	$1,152
2. Reservoirs R35A + R42A (2)	3.5 MG	$6,074,045	8,903	$682
3. Pipelines - Phase 2 (3)	42-in	$3,269,572	8,903	$367
4. Land Acquisition (4)	1 LS	$591,628	8,903	$66
Total Cost per EDU, Phase 2 - 2630 PZ (5) =				**$2,268**
West Henderson 2760 Pressure Zone – Phase 2:				
1. Horizon Ridge Pump Station (1)	10 mgd	$10,254,882	8,903	$1,152
2. PS Expansions P35 + P42	10 mgd	$10,254,882	8,903	$1,152
3. Reservoirs R36A + R43 (2)	3.5 MG	$6,074,045	8,903	$682
4. Pipelines - Phase 2 (3)	42-in	$3,269,572	8,903	$367
5. Land Acquisition (4)	1 LS	$591,628	8,903	$66
Total Cost per EDU, Phase 1 - 2760 PZ (5) =				**$3,420**
City Water System Reliability – Phase 2:				
1. Reservoirs R35A + R42A (2)	6.5 MG	$11,280,370	N/A	N/A
1. Horizon Ridge Pump Station (1)	15 mgd	$15,382,322	N/A	N/A
2. Reservoirs R36B + R43A (2)	6.5 MG	$11,280,370	N/A	N/A
3. Pump Station P35A (6)	15 mgd	$15,382,322	N/A	N/A
4. 42" Diameter Pipeline (7)	15,700 LF	$4,904,358	N/A	N/A
Total Cost City Water System Reliability		**$58,229,742**		

Notes:

(1) The cost for the Horizon Ridge PS is split 20 mgd for West Henderson and 15 mgd for City water system reliability. For West Henderson, the costs are further split equally between the 2630 and 2760 pressure zones (10 mgd per zone).
(2) The costs for the R35A, R42A, R36B, and R43A are split to reflect a 35% benefit to West Henderson EDUs, and 65% benefit for City's water system reliability.
(3) The proportional cost allocation of the 42-inch diameter water pipeline benefitting the remainder of EDUs within the West Henderson 2630 and 2760 pressure zones.
(4) The Land Acquisition cost is split equally between the 2630 and 2760 pressure zones.
(5) Total cost per EDU reflects current market conditions (2016) and thus do not account for inflation or the projected market conditions at the time the projects are projected to be constructed.
(6) New Pump Station P35A for City water system reliability.
(7) The proportional cost allocation for the 42-inch diameter pipeline providing system reliability.

Table 14 Engineers Opinion of Probable Project Cost Per EDU Summary ($/EDU)
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Phase	Total Estimated Project Cost [1] ($M)	Equivalent Dwelling Unit (EDU)		Preliminary Cost Per EDU[2]	
		Zone 2630	Zone 2760	Zone 2630	Zone 2760
1	$64.4	8,903	8,903	$2,243	$3,783
2	$50.6	8,903	8,903	$2,268 + $410 = $2,678	3,420 + $798 = $4,217
Total	**$115.0**	**17,806**	**17,806**	**-**	**-**

Notes:

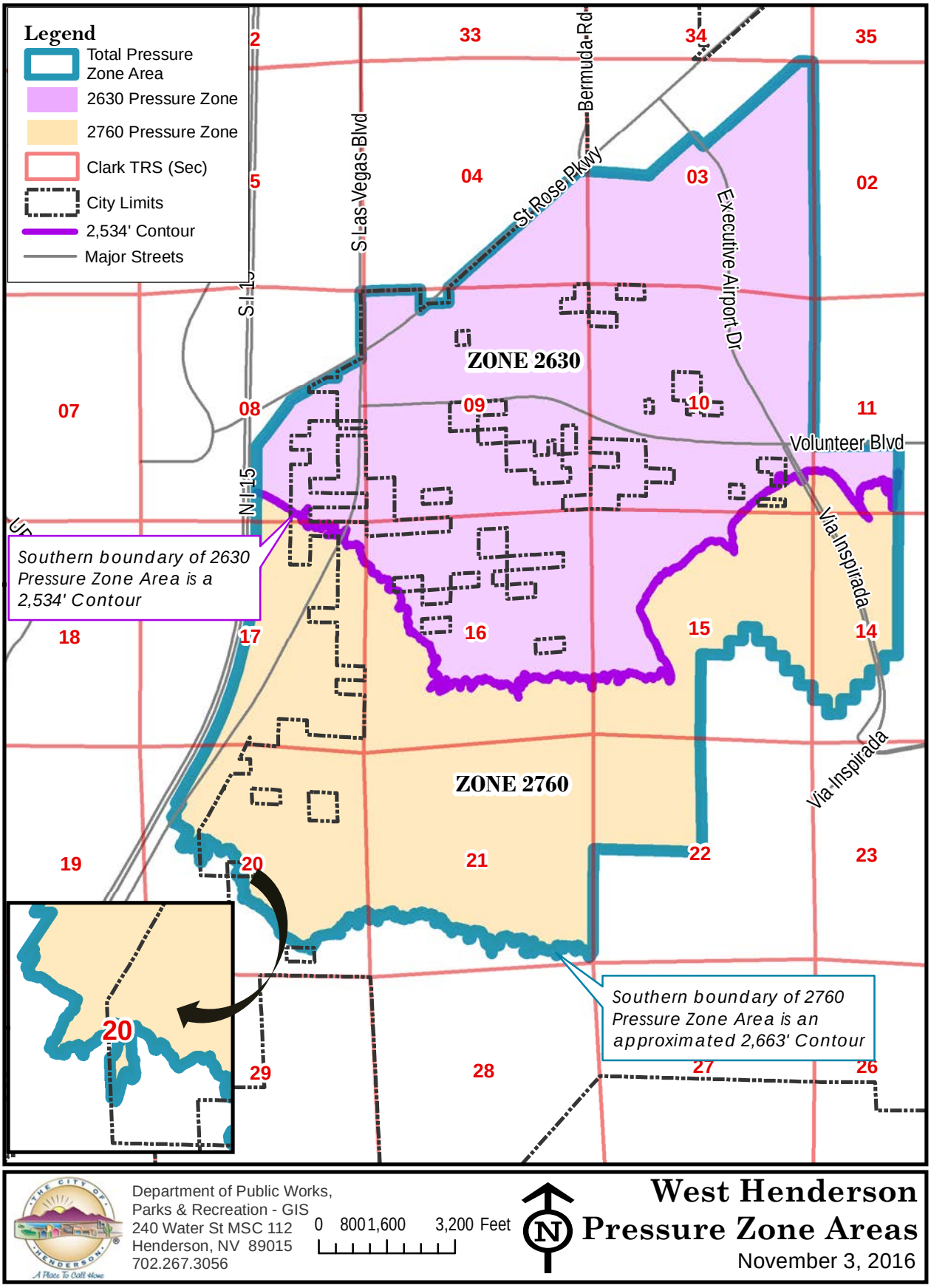
(1) Total estimated project cost, per phase, benefitting West Henderson developers/property owners. Costs reflect current market conditions (2016) and thus do not account for inflation or the projected market conditions at the time the projects are projected to be constructed.

(2) Cost per EDU to be assessed, per pressure zone, for each phase. Cost per EDU reflect current market conditions (2016) and thus do not account for inflation or the projected market conditions at the time the projects are projected to be constructed. Cost per EDU also do not account for additional financing charges to be applied, prior to finalizing the cost per EDU, per pressure zone for each phase.

12.0 FINANCING STRATEGY

The City is considering assuming the responsibility for constructing the infrastructure for Phase 1. If this were to occur, additional costs would need to be included in order to account for escalation in construction costs, the interest payments, and associated bond financing costs. The City's estimate of adjustments to the $/EDU costs to account for these factors is $3,151 for Pressure Zone 2630 and $5,293 for Pressure Zone 2760 and is included in Appendix E.

APPENDIX A – STUDY AREA LEGAL DESCRIPTION



Department of Public Works,
Parks & Recreation - GIS
240 Water St MSC 112
Henderson, NV 89015
702.267.3056

0 800 1,600 3,200 Feet

West Henderson Pressure Zone Areas

November 3, 2016

WEST HENDERSON PRESSURE ZONE AREAS

The following describes the 2630 and 2760 Pressure Zones in the West Henderson area located in Sections 3, 4, 8, 9, 10, 11, 14, 15, 16, 17, 20, 21, and 22, Township 23 South, Range 61 East, M.D.M., Clark County, Nevada, described as follows:

The South Half (S 1/2) of Section 3.

TOGETHER WITH: That portion of the North Half (N 1/2) of Section 3, lying southeast of the northwesterly line of Lot 1 of the Henderson Quail Air Center in Book 141, Page 79 of Plats, Clark County, Nevada and the prolongation of said line to the northeasterly line of Lot 1 of the Sage Mountain Commerce Center in Book 111, Page 6 of Plats, Clark County, Nevada and south of the northeasterly and northwesterly lines of said Lot 1 of the Sage Mountain Commerce Center.

TOGETHER WITH: All of the South Half (S 1/2) of Section 4, lying southeast of State Highway 146, also known as the St. Rose Parkway.

TOGETHER WITH: All of Section 8, lying southeast of State Highway 146, also known as the St. Rose Parkway, and east of the easterly right-of-way of I-15.

TOGETHER WITH: All of Section 9, excepting that portion of the Northeast Quarter (NE 1/4) of the Northwest Quarter (NW 1/4) lying northwest of State Highway 146, also known as the St. Rose Parkway.

TOGETHER WITH: All of Section 10.

Together with: The South Half (S 1/2) of the Southwest Quarter (SW 1/4) of the Northeast Quarter (NE 1/4) of the Southwest Quarter (SW 1/4); the West Half (W 1/2) of the Southeast Quarter (SE 1/4) of the Southwest Quarter (SW 1/4); the Southwest Quarter (SW ¼) of the Southwest Quarter (SW 1/4) and the South Half (S 1/2) of the South Half (S 1/2) of the Northwest Quarter (NW 1/4) of the Southwest Quarter (SW 1/4) of Section 11.

TOGETHER WITH: The Northwest Quarter (NW 1/4) of the Northeast Quarter (NE 1/4) of the Southwest Quarter (SW 1/4); the Northwest Quarter (NW 1/4) of the Southwest Quarter (SW 1/4) of the Northeast Quarter (NE 1/4) of the Southwest Quarter (SW 1/4); the Northwest Quarter (NW 1/4) of the Northeast Quarter (NE 1/4) of the Southwest Quarter (SW 1/4) of the Southwest Quarter (SW 1/4); the North Half (N 1/2) of the Northwest Quarter (NW 1/4) of the Southwest Quarter (SW 1/4) of the Southwest Quarter (SW 1/4); the Northwest Quarter (NW 1/4) of the Southwest Quarter (SW 1/4); the Southeast Quarter (SE 1/4) of the Northwest Quarter (NW 1/4) of the Southwest Quarter (SW 1/4) of the Southwest Quarter (SW 1/4); the West Half (W 1/2) of the East Half (E 1/2) of the Northwest Quarter (NW 1/4) and the West Half (W 1/2) of the Northwest Quarter (NW 1/4) of Section 14.

TOGETHER WITH: The North Half (N 1/2); the Northeast Quarter (NE 1/4) of the Northeast Quarter (NE 1/4) of the Southeast Quarter (SE 1/4); the North Half (N 1/2) of the Southeast

Quarter (SE 1/4) of the Northeast Quarter (NE 1/4) of the Southeast Quarter (SE 1/4); the Southeast Quarter (SE 1/4) of the Southeast Quarter (SE 1/4) of the Northeast Quarter (NE 1/4) of the Southeast Quarter (SE 1/4); the North Half (N 1/2) of the Northwest Quarter (NW 1/4) of the Northeast Quarter (NE 1/4) of the Southeast Quarter (SE 1/4); the Southeast Quarter (SE 1/4) of the Northwest Quarter (NW 1/4) of the Northeast Quarter (NE 1/4) of the Southeast Quarter (SE 1/4); the Northwest Quarter (NW 1/4) of the Northwest Quarter (NW 1/4) of the Southeast Quarter (SE 1/4); the Northwest Quarter (NW 1/4) of the Northeast Quarter (NE 1/4) of the Northwest Quarter (NW 1/4) of the Southeast Quarter (SE 1/4) and the Southwest Quarter (SW 1/4) of Section 15.

TOGETHER WITH: All of Section 16.

TOGETHER WITH: All of Section 17, lying east of the easterly right-of-way of I-15.

TOGETHER WITH: All of Section 20, lying north of the 2663-foot Contour line and east of the easterly right-of-way of I-15.

TOGETHER WITH: All of Section 21, lying north of the 2663-foot Contour line.

TOGETHER WITH: The Northwest Quarter (NW 1/4) of Section 22.

Containing 4847 Acres, more or less.

11-2-16

APPENDIX B – WEST HENDERSON WATER INFRASTRUCTURE BACKGROUND INFORMATION

B.1 – West Henderson Projected Land Use and EDUs per Zone

- Table B.1.1 – 2630 Pressure Zone Land Use and Acreage
- Table B.1.2 – 2630 Pressure Zone EDUs
- Table B.1.3 – 2760 Pressure Zone Land Use and Acreage
- Table B.1.4 – 2760 Pressure Zone EDUs

B.2 – West Henderson Water Demand Projections

APPENDIX B.1 – WEST HENDERSON PROJECTED LAND USE AND EDUs PER ZONE

Table B.1.1 2630 Pressure Zone Land Use and Acreage
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Land Use Type	Inside City	Unincorporated Clark County Area	Total
Very Low Density Residential	0.0	0.0	0.0
Low-Density Residential	335.1	128.8	463.9
Medium-Density Residential	99.7	19.6	119.3
High-Density Residential	97.2	8.5	105.7
Public and Semi-Public	0.0	20.2	20.2
PS – Parks	80.0	0.0	80.0
PS – Schools	70.0	0.0	70.0
PS – Other	352.0	0.0	352.0
Neighborhood Commercial	0.0	0.0	0.0
Commercial	305.9	39.9	345.8
Tourist Commercial	351.0	125.9	476.9
Transit-Oriented Development	0.0	0.0	0.0
Business Industrial	427.9	5.1	433.1
Undefined	32.2	23.7	55.9
Total Acreage - All Land Uses	**2,151.0**	**371.8**	**2,522.8**

Table B.1.2 2630 Pressure Zone EDUs
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Land Use Type	EDUs/ Acre	Equivalent Dwelling Units (EDUs)		
		Inside City	Unincorporated Clark County Area	Total
Very Low Density Residential	3.00	0.0	0.0	0.0
Low-Density Residential	8.00	2,681.0	1,030.2	3,711.2
Medium-Density Residential	12.96	1,292.2	254.2	1,546.4
High-Density Residential	18.36	1,783.9	156.1	1,939.9
Public and Semi-Public	14.40	0.0	290.6	290.6
PS – Parks	14.40	1,152.0	0.0	1,152.0
PS – Schools	1.20	84.0	0.0	84.0
PS – Other	7.65	2,692.8	0.0	2,692.8
Neighborhood Commercial	7.65	0.0	0.0	0.0
Commercial	7.65	2,339.8	305.5	2,645.4
Tourist Commercial	7.65	2,685.2	963.3	3,648.4
Transit-Oriented Development	12.96	0.0	0.0	0.0
Business Industrial	0.22	94.2	1.1	95.3
Undefined	0.0	0.0	0.0	0.0
Total EDUs - All Land Uses		**14,805**	**3,001.0**	**17,806**

Table B.1.3 2760 Pressure Zone Land Use and Acreage
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Land Use Type	Inside City	Unincorporated Clark County Area	Total
Very Low Density Residential	0.0	0.0	0.0
Low-Density Residential	224.3	4.7	229.0
Medium-Density Residential	55.2	0.0	55.2
High-Density Residential	41.5	0.0	41.5
Public and Semi-Public	0.0	38.5	38.5
PS – Parks	80.0	0.0	80.0
PS – Schools	70.0	0.0	70.0
PS – Other	309.7	0.0	309.7
Neighborhood Commercial	4.8	0.0	4.8
Commercial	512.3	0.3	512.6
Tourist Commercial	186.4	294.8	481.2
Transit-Oriented Development	186.7	15.5	202.2
Business Industrial	343.9	0.0	343.9
Undefined	0.0	14.4	14.4
Total Acreage - All Land Uses	**2,014.8**	**368.2**	**2,383.0**

Table B.1.4 2760 Pressure Zone EDUs
West Henderson Water Infrastructure Phasing Strategy Update
City of Henderson, Nevada

Land Use Type	EDUs/Acre	Equivalent Dwelling Units (EDUs)		
		Inside City	Outside City	Total
Very Low Density Residential	3.00	0.0	0.0	0.0
Low-Density Residential	8.00	1,794.3	37.9	1,832.2
Medium-Density Residential	12.96	715.9	0.0	715.9
High-Density Residential	18.36	762.3	0.0	762.3
Public and Semi-Public	14.40	0.0	554.3	554.3
PS – Parks	14.40	1,152.0	0.0	1,152.0
PS – Schools	1.20	84.0	0.0	84.0
PS – Other	7.65	2,369.2	0.0	2,369.2
Neighborhood Commercial	7.65	36.3	0.1	36.4
Commercial	7.65	3,919.3	2.0	3,921.3
Tourist Commercial	7.65	1,426.2	2,255.2	3,681.4
Transit-Oriented Development	12.96	2,419.9	201.1	2,621.0
Business Industrial	0.22	75.7	0.0	75.7
Undefined	0.0	0.0	0.0	0.0
Totals - All Land Uses		**14,755.1**	**3,050.6**	**17,805.7**

APPENDIX B.2 – WEST HENDERSON WATER DEMAND PROJECTIONS

Note: West Henderson water demand projections were provided by City of Henderson, Department of Utility Services' staff. These projections were utilized to determine the estimated timeframe for constructing the three phases of the West Henderson water infrastructure.

MDD EDU: 0.78 gpm/EDU

	Cumulative Growth						Annual Growth					
				mgd						mgd		
Year	Total Inspirada EDUs	Total WH EDUs	TOTAL EDUs	Inspirada	WH	Total mgd	Total Inspirada EDUs	Total WH EDUs	TOTAL EDUs	Inspirada	WH	Total mgd
2016	2,000	769	2,769	2.30	0.86	3.17	2,000	769	2,769	2.30	0.86	3.17
2017	2,600	974	3,574	3.00	1.09	4.09	600	205	805	0.69	0.23	0.92
2018	3,212	1,200	4,412	3.70	1.35	5.05	612	226	838	0.71	0.25	0.96
2019	3,836	1,448	5,284	4.42	1.63	6.05	624	248	872	0.72	0.28	1.00
2020	4,836	1,721	6,557	5.57	1.93	7.50	1,000	273	1,273	1.15	0.31	1.46
2021	5,861	2,022	7,883	6.75	2.27	9.02	1,025	300	1,325	1.18	0.34	1.52
2022	6,912	2,352	9,264	7.96	2.64	10.60	1,051	330	1,381	1.21	0.37	1.58
2023	7,989	2,715	10,704	9.20	3.05	12.25	1,077	363	1,440	1.24	0.41	1.65
2024	9,093	3,115	12,208	10.47	3.50	13.97	1,104	400	1,504	1.27	0.45	1.72
2025	10,224	3,535	13,759	11.78	3.97	15.75	1,131	420	1,551	1.30	0.47	1.77
2026	11,384	3,975	15,359	13.11	4.47	17.58	1,160	441	1,600	1.34	0.50	1.83
2027	12,572	4,438	17,011	14.48	4.99	19.47	1,189	463	1,651	1.37	0.52	1.89
2028	13,500	4,924	18,424	15.55	5.53	21.08	928	486	1,414	1.07	0.55	1.61
2029	13,500	5,434	18,934	15.55	6.10	21.66	0	510	510	0.00	0.57	0.57
2030	13,500	5,970	19,470	15.55	6.71	22.26	0	536	536	0.00	0.60	0.60
2031	13,500	6,532	20,032	15.55	7.34	22.89	0	562	562	0.00	0.63	0.63
2032	13,500	7,123	20,623	15.55	8.00	23.55	0	591	591	0.00	0.66	0.66
2033	13,500	7,728	21,228	15.55	8.70	24.25	0	605	605	0.00	0.70	0.70
2034	13,500	8,379	21,879	15.55	9.43	24.98	0	651	651	0.00	0.73	0.73
2035	13,500	9,062	22,562	15.55	10.20	25.75	0	684	684	0.00	0.77	0.77
2036	13,500	9,780	23,280	15.55	11.00	26.55	0	718	718	0.00	0.81	0.81
2037	13,500	10,534	24,034	15.55	11.85	27.40	0	754	754	0.00	0.85	0.85
2038	13,500	11,326	24,826	15.55	12.74	28.29	0	791	791	0.00	0.89	0.89
2039	13,500	12,157	25,657	15.55	13.67	29.22	0	831	831	0.00	0.93	0.93
2040	13,500	13,029	26,529	15.55	14.65	30.20	0	873	873	0.00	0.98	0.98
2041	13,500	13,945	27,445	15.55	15.68	31.23	0	916	916	0.00	1.03	1.03
2042	13,500	14,907	28,407	15.55	16.76	32.31	0	962	962	0.00	1.08	1.08
2043	13,500	15,917	29,417	15.55	17.90	33.45	0	1,010	1,010	0.00	1.13	1.13

APPENDIX C – WEST HENDERSON WATER INFRASTRUCTURE PLANNING ASSUMPTIONS

The following assumptions were used in the West Henderson Water Infrastructure Phasing Strategy Update:

1. The land use assumptions and EDUs per acre were based on the City's land use plan and estimated EDU factors.
2. The maximum day demand for West Henderson was calculated using 0.78 gpm per EDU.
3. Interim demands for Phase 1 and Phase 2 were distributed evenly between Pressure Zones 2630 and 2760.
4. The "backbone" infrastructure installed in Phase 1 is sized for buildout conditions.
5. Storage capacity requirements for West Henderson are based on providing 35% of maximum day demands. Storage capacity requirements for added City water system reliability are based on providing 65% of maximum day demands. Therefore the total storage volume for new reservoirs serving West Henderson will provide volume equivalent to one day of maximum day demand.

APPENDIX D – DETAILED COST ESTIMATES

carollo
Engineers...Working Wonders With Water®

PROJECT SUMMARY

Project:	**West Henderson PHASE 1**	**Estimate Class:**	**5**
Client:	**City of Henderson Water Infrastructure Update**	**CSM:**	**Freestone**
Location:	**Henderson, NV**	**PM:**	**Wesley**
Zip Code:	**89052**	**Date:**	**November 7, 2016**
Carollo Job	**10353A.00**	**By:**	**Wesley**
		Reviewed:	**EJM/LMF**

NO.	DESCRIPTION		TOTAL
1	Pipelines		
	16-Inch Pipelines (ft)	8,000	$1,408,000
	30-Inch Pipelines (ft)	23,486	$7,750,278
	36-Inch Pipelines (ft)	2,349	$930,153
	42-Inch Pipelines (ft)	4,411	$2,038,099
2	Reservoir Storage (MG)		
	R-35 (MG)	5.0	$5,500,000
	R-42 (MG)	5.0	$5,500,000
	R-43 (MG)	5.0	$5,500,000
	R-36A (MG)	5.0	$5,500,000
3	Pump Stations (MGD)		
	COH Bermuda (MGD)	20.0	$13,000,000
	P-42 (MGD)	5.0	$3,250,000
	P-35 (MGD)	5.0	$3,250,000
4	Land Acquisition		$1,500,000
	TOTAL DIRECT COST		**$55,126,529**
	Contingency	8.0%	$4,410,122
	Subtotal		**$59,536,652**
	General Contractor Overhead, Profit & Risk	10.0%	$5,953,665
	Subtotal		**$65,490,317**
	Escalation to Mid-Point	0.0%	$0
	Subtotal		**$65,490,317**
	Sales Tax (Based on 89052)	8.1%	$5,304,716
	Subtotal		**$70,795,033**
	Bid Market Allowance	5.0%	$3,539,752
	TOTAL ESTIMATED CONSTRUCTION COST		**$74,334,784**
	Engineering, Legal & Administration Fees	12.0%	$8,920,174
	Owner's Reserve for Change Orders	5.0%	$3,716,739
	TOTAL ESTIMATED PROJECT COST		**$86,971,697**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Engineers...Working Wonders With Water®

PROJECT SUMMARY

Project:	**West Henderson PHASE 2**	**Estimate Class:**	**5**
Client:	**City of Henderson Water Infrastucture Update**	**CSM:**	**Freestone**
Location:	**Henderson, NV**	**PM:**	**Wesley**
Zip Code:	**89052**	**Date:**	**November 7, 2016**
Carollo Job #:	**10353A.00**	**By:**	**Wesley**
		Reviewed:	**EJM/LMF**

NO.	DESCRIPTION		TOTAL
1	Pipelines		
	16-Inch Pipelines (ft)	-	$0
	30-Inch Pipelines (ft)	-	$0
	36-Inch Pipelines (ft)	-	$0
	42-Inch Pipelines (ft) - West Henderson	15,700	$4,144,800
	42-Inch Pipelines (ft) - System Reliability	15,700	$3,108,600
2	Reservoir Storage (MG)		
	R-35 (MG) - Expansion	5.0	$5,500,000
	R-42 (MG) - Expansion	5.0	$5,500,000
	R-43 (MG) - Expansion	5.0	$5,500,000
	R-36A (MG) - Expansion	5.0	$5,500,000
3	Pump Stations (MGD)		
	Horizon Ridge for West Henderson Portion (MGD)	20.0	$13,000,000
	Horizon Ridge for System Reliability (MGD)	15.0	$9,750,000
	P-42 (MGD) - Expansion	5.0	$3,250,000
	P-35 (MGD) - Expansion	5.0	$3,250,000
	P-35 (MGD) - for System Reliability	15.0	$9,750,000
4	Land Acquisition		$750,000
	TOTAL DIRECT COST		**$69,003,400**
	Contingency	8.0%	$5,520,272
	Subtotal		**$74,523,672**
	General Contractor Overhead, Profit & Risk	10.0%	$7,452,367
	Subtotal		**$81,976,039**
	Escalation to Mid-Point	0.0%	$0
	Subtotal		**$81,976,039**
	Sales Tax (Based on 89052)	8.1%	$6,640,059
	Subtotal		**$88,616,098**
	Bid Market Allowance	5.0%	$4,430,805
	TOTAL ESTIMATED CONSTRUCTION COST		**$93,046,903**
	Engineering, Legal & Administration Fees	12.0%	$11,165,628
	Owner's Reserve for Change Orders	5.0%	$4,652,345
	TOTAL ESTIMATED PROJECT COST		**$108,864,877**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

PHASE I - West Henderson Backbone Water Infrastructure - 20 MGD Total w/ Cost Delineation By Pressure Zone (Developer Participation)									
				2630 Pressure Zone Cost			2760 Pressure Zone Cost		
Phase 1 Infrastructure	Size	Unit	Cost	Cost ($)	EDUs	Cost per EDU ($)	Cost ($)	EDUs	Cost per EDU ($)
Pump Stations:									
COH Bermuda PS - Construction cost	20.0	MGD	$17,529,712	-	-	-	-	-	-
COH Bermuda PS - Eng, Admin (12%) + C.O. (5%)			$2,980,051	-	-	-	-	-	-
COH Bermuda PS - Project cost			**$20,509,763**	**$10,254,882**	**8,903**	**$1,152**	**$10,254,882**	**8,903**	**$1,152**
P35 + P42 - Construction cost	10.0	MGD	$8,764,856	-	-	-	-	-	-
P35 + P42 - Eng, Admin (12%) + C.O. (5%)			$1,490,026	-	-	-	-	-	-
P35 + P42 - Project cost			**$10,254,882**	**$0**	**0**	**$0**	**$10,254,882**	**8,903**	**$1,152**
Reservoirs:									
R35 + R42 - Construction cost[(1)]	3.5	MG	$5,191,492	-	-	-	-	-	-
R35 + R42 - Eng, Admin (12%) + C.O. (5%)			$882,554	-	-	-	-	-	-
R35 + R42 - Project cost			**$6,074,045**	**$6,074,045**	**8,903**	**$682**	**$0**	**$0**	**$0**
R36A + R43 - Construction cost[(1)]	3.5	MG	$5,191,492	-	-	-	-	-	-
R36A + R43 - Eng, Admin (12%) + C.O. (5%)			$882,554	-	-	-	-	-	-
R36A + R43 - Project cost			**$6,074,045**	**$0**	**0**	**$0**	**$6,074,045**	**8,903**	**$682**
Pipelines:									
16-inch diameter line (P35-toR36)	8,000	LF	$1,408,000	$0	-	-	$1,408,000	17,806	-
30-inch diameter line (BPS-to-R35)	8,416	LF	$2,777,363	$1,388,681	17,806	-	$1,388,681	17,806	-
30-inch diameter line (BPS-to-R42)	15,069	LF	$4,972,915	$2,486,458	17,806	-	$2,486,458	17,806	-
36-in diameter line (P42-to-R43)	2,349	LF	$930,153	$0	-	-	$930,153	17,806	-
42-inch diameter line (P42-to-R43)	4,411	LF	$2,038,099	$0	-	-	$2,038,099	17,806	-
Total Pipeline Direct Cost			$12,126,529	$3,875,139	-	-	$8,251,391	-	-
Total Pipelines - Construction Cost			$16,351,890	$5,225,390	-	-	$11,126,500	-	-
Total Pipelines - Eng, Admin (12%) + C.O. (5%)			$2,779,821	$888,316	-	-	$1,891,505	-	-
Total Pipelines - Project cost			**$19,131,711**	**$6,113,706**	**17,806**	**$343**	**$13,018,005**	**17,806**	**$731**
Land:									
Land Acquisition - Construction Cost	2	LS	$2,022,659	-	-	-	-	-	-
Land Acquisition - Eng, Admin (12%) + C.O. (5%)			$343,852	-	-	-	-	-	-
Land Acquisition - Project cost			**$2,366,511**	**$1,183,256**	**17,806**	**$66**	**$1,183,256**	**17,806**	**$66**
TOTAL COST - DEVELOPER PARTICIPATION			**$64,410,958**	**$23,625,889**	**-**	**-**	**$40,785,069**	**-**	**-**

EDU Rate - Phase 1	8903	$1,834	$2,986
EDU Rate - Phase 1 and 2	17806	$410	$798
Total Assessment		**$2,244**	**$3,783**

West Henderson Backbone Water Infrastructure - 20 MGD Total w/ Cost Delineation By Pressure Zone (City Participation)			
Phase 1 Infrastructure	Size	Unit	Cost
Reservoirs:			
R35 + R42 - Construction cost[(1)]	6.5	MG	$9,641,342
R35 + R42 - Eng, Admin (12%) + C.O. (5%)			$1,639,028
R35 + R42 - Project cost			**$11,280,370**
R36A + R43 - Construction cost[(1)]	6.5	MG	$9,641,342
R36A + R43 - Eng, Admin (12%) + C.O. (5%)			$1,639,028
R36A + R43 - Project cost			**$11,280,370**
TOTAL COST CITY PARTICIPATION			**$22,560,740**

Notes:

(1) City is agreeable to pay for the "oversizing costs" associated with the increased volume for West Henderson reservoirs (for system reliability). Oversizing amount is equal to the difference between the current reservoir sizing criteria of 2x Operational Storage (i.e. (PHD - MDD) x 6-hours) and the new proposed criteria for West Henderson of one MDD.

- MDD = Maximum Day Demand; PHD = Peak Hour Demand
- Operational Storage = 2 x ((PHD - MDD) x 6-hours) = 2 x ((1.7 MDD - 1.0 MDD) x 6-hours) = 2 x (0.7MDD x 0.25) = 2 x 0.175 MDD = 0.35 MDD
- Difference = 1.0 MDD - 0.35 MDD = 0.65 MDD

Ph I Cost Est - Developer Contribution 10-31-16	**$64,410,958**
Ph I Cost Est - City Contribution 10-31-16	**$22,560,740**
TOTAL PROJECT COST - PHASE 1	**$86,971,697**

PHASE 2 - West Henderson Backbone Water Infrastructure - 20 MGD Total w/ Cost Delineation By Pressure Zone									
				2630 Pressure Zone Cost			2760 Pressure Zone Cost		
Phase 2 Infrastructure	Size	Unit	Cost	Cost ($)	EDUs	Cost per EDU ($)	Cost ($)	EDUs	Cost per EDU ($)
Pump Stations:									
COH Horizon Ridge PS - Construction cost	20.0	MGD	$17,529,712	-	-	-	-	-	-
COH HR PS - Eng, Admin (12%) + C.O. (5%)			$2,980,051	-	-	-	-	-	-
COH Horizon Ridge PS - Project cost			**$20,509,763**	**$10,254,882**	**8,903**	**$1,152**	**$10,254,882**	**8,903**	**$1,152**
P35 + P42 - Construction cost (EXPANSION)	10.0	MGD	$8,764,856	-	-	-	-	-	-
P35 + P42 - Eng, Admin (12%) + C.O. (5%)			$1,490,026	-	-	-	-	-	-
P35 + P42 - Project cost			**$10,254,882**	**$0**	**0**	**$0**	**$10,254,882**	**8,903**	**$1,152**
Reservoirs:									
R35 + R42 - Construction cost (EXPANSION)	3.5	MG	$5,191,492	-	-	-	-	-	-
R35 + R42 - Eng, Admin (12%) + C.O. (5%)			$882,554	-	-	-	-	-	-
R35 + R42 - Project cost			**$6,074,045**	**$6,074,045**	**8,903**	**$682**	**$0**	**$0**	**$0**
R36A + R43 - Construction cost (EXPANSION)	3.5	MG	$5,191,492	-	-	-	-	-	-
R36A + R43 - Eng, Admin (12%) + C.O. (5%)			$882,554	-	-	-	-	-	-
R36A + R43 - Project cost			**$6,074,045**	**$0**	**0**	**$0**	**$6,074,045**	**8,903**	**$682**
Pipelines:									
16-inch diameter line (P35-toR36)	0	LF	$0	$0	-	-	$0	-	-
30-inch diameter line (BPS-to-R35)	0	LF	$0	$0	-	-	$0	-	-
30-inch diameter line (BPS-to-R42)	0	LF	$0	$0	-	-	$0	-	-
36-in diameter line (P42-to-R43)	0	LF	$0	$0	-	-	$0	-	-
42-inch diameter line (P42-to-R43)	15,700	LF	$4,144,800	$2,072,400	-	-	$2,072,400	-	-
Total Pipeline Direct Cost			$4,144,800	$2,072,400	-	-	$2,072,400	-	-
Total Pipelines - Construction Cost			$5,589,012	$2,794,506	-	-	$2,794,506	-	-
Total Pipelines - Eng, Admin (12%) + C.O. (5%)			$950,132	$475,066	-	-	$475,066	-	-
Total Pipelines - Project cost			**$6,539,144**	**$3,269,572**	**8,903**	**$367**	**$3,269,572**	**8,903**	**$367**
Land:									
Land Acquisition - Construction Cost	1	LS	$1,011,330	-	-	-	-	-	-
Land Acquisition - Eng, Admin (12%) + C.O. (5%)			$171,926	-	-	-	-	-	-
Land Acquisition - Project cost			**$1,183,256**	**$591,628**	**8,903**	**$66**	**$591,628**	**8,903**	**$66**
TOTAL COST - DEVELOPER PARTICIPATION			**$50,635,135**	**$20,190,127**	**-**	**-**	**$30,445,008**	**-**	**-**

EDU Rate - Phase 1 (Prop. of pipelines & land)	8903	$410	$798
EDU Rate - Phase 2	8903	$2,268	$3,420
Total Assessment		**$2,678**	**$4,217**

West Henderson Backbone Water Infrastructure - City Participation (System Reliability)			
Phase 2 Infrastructure	Size	Unit	Cost
Pump Stations:			
COH Horizon Ridge PS - Construction cost	15.0	MGD	$13,147,284
COH HR PS - Eng, Admin (12%) + C.O. (5%)			$2,235,038
COH Horizon Ridge PS - Project cost			**$15,382,322**
P35A	15.0	MGD	$13,147,284
P35 + P42 - Eng, Admin (12%) + C.O. (5%)			$2,235,038
P35A			**$15,382,322**
Reservoirs:			
R35 + R42 - Construction cost (EXPANSION)	6.5	MG	$9,641,342
R35 + R42 - Eng, Admin (12%) + C.O. (5%)			$1,639,028
R35 + R42 - Project cost			**$11,280,370**
R36A + R43 - Construction cost (EXPANSION)	6.5	MG	$9,641,342
R36A + R43 - Eng, Admin (12%) + C.O. (5%)			$1,639,028
R36A + R43 - Project cost			**$11,280,370**
Pipelines:			
42-inch diameter line (P42-to-R43)	15,700	LF	$3,108,600
Total Pipeline Direct Cost			$3,108,600
Total Pipelines - Construction Cost			$4,191,759
Total Pipelines - Eng, Admin (12%) + C.O. (5%)			$712,599
Total Pipelines - Project cost			**$4,904,358**
TOTAL COST CITY PARTICIPATION			**$58,229,742**

Notes:

(1) City is agreeable to pay for the "oversizing costs" associated with the increased volume for West Henderson reservoirs (for system reliability). Oversizing amount is equal to the difference between the current reservoir sizing criteria of 2x Operational Storage (i.e. (PHD - MDD) x 6-hours) and the new proposed criteria for West Henderson of one MDD.

- MDD = Maximum Day Demand; PHD = Peak Hour Demand
- Operational Storage = 2 x ((PHD - MDD) x 6-hours) = 2 x ((1.7 MDD - 1.0 MDD) x 6-hours) = 2 x (0.7MDD x 0.25) = 2 x 0.175 MDD = 0.35 MDD
- Difference = 1.0 MDD - 0.35 MDD = 0.65 MDD

	City Contribution	Developer Contribution	Total Project Cost
Phase 1 Cost Est (10-31-16)	**$22,560,740**	**$64,410,958**	**$86,971,697**
Phase 2 Cost Est (10-31-16)	**$58,229,742**	**$50,635,135**	**$108,864,877**
TOTAL COST CONTRIBUTION	**$80,790,482**	**$115,046,093**	**$195,836,574**

APPENDIX E – WEST HENDERSON FINANCIAL ANALYSIS

CITY OF HENDERSON
240 Water Street
P. O. Box 95050
Henderson, NV 89009

November 10, 2016

Lisa M. Freestone, P.E., Vice President
Carollo Engineers, Inc.
376 East Warm Springs Road, Suite 250
Las Vegas, Nevada 89119

Subject: West Henderson Water Infrastructure Phasing Strategy Update
2630 and 2760 PZ Rate Adjustments

Dear Ms. Freestone:

As we've discussed to date, we have utilized the phase 1 water backbone infrastructure costs reflected in the subject draft report, dated August 2016, and based on that information, we have added a 1.5% inflation factor to those costs. This additional inflation factor is necessary in order to account for the projected timeframes when it is anticipated the City will be constructing the associated infrastructure. Additionally, we have also added financing costs, based upon a 2% financing charge.

Taking into account the above additional considerations, please see the adjusted rates, on a $/EDU basis, for the 2630 and 2760 pressure zones.

Phase 1 Cost per EDU ($/EDU) - 2630 and 2760 PZs West Henderson Water Infrastructure Phasing Strategy Update City of Henderson Nevada						
Phase 1	Equivalent Dwelling Unit (EDU)	Total Cost based on 2016 Dollars	Total Cost based on 2016 Dollars Inflated to Construction Timeframe	Inflated Construction Cost per EDU	Financing Cost per EDU	Total Inflated Construction Cost plus Financing Cost per EDU
Zone 2630	8,903	$ 16,328,928	$ 18,928,675	$ 2,126	$ 467	$ 2,593
Zone 2630	17,806	$ 7,296,962	$ 8,076,125	$ 454	$ 104	$ 558
Total - 2630 PZ		**$ 23,625,890**	**$ 27,004,800**	**$ 2,580**	**$ 571**	**$ 3,151**
Zone 2760	8,903	$ 26,583,810	$ 30,680,706	$ 3,446	$ 761	$ 4,207
Zone 2760	17,806	$ 14,201,261	$ 15,726,039	$ 883	$ 203	$ 1,086
Total - 2760 PZ		**$ 40,785,071**	**$ 46,406,745**	**$ 4,329**	**$ 964**	**$ 5,293**

Please don't hesitate in calling me if you have any questions.

Sincerely,

Kyle R. Okamura, P.E.
Deputy Director – Utility Planning & Business Operations

KO:an