

2021 ICIP Training Workshop

**Creative Ways to Develop a Cost
Estimate for Your Project**

Purpose of Training

- ▶ To aid communities in the preparation of the estimated costs for proposed projects listed on their Infrastructure Capital Improvement Plan (ICIP)
- ▶ Reference: *Cost Estimating Guide for Water, Wastewater, Roads and Buildings, For Use in Preparing the Local Infrastructure Capital Improvement Plan*, Developed for DFA Local Government Division by New Mexico Environmental Finance Center in June 2006 (link: <http://www.nncio.org/cms/kunde/rts/nncioorg/docs/688693061-07-24-2006-13-31-31e.pdf>)
- ▶ Link to US Inflation Calculator: <https://www.usinflationcalculator.com/>

Planning Sources for Project Cost Estimates

- ▶ Preliminary Engineering Reports
- ▶ Infrastructure Master Plans
- ▶ Asset Management Plans
- ▶ Comprehensive Transportation Plans
- ▶ Project Scoping Reports
- ▶ Rate Studies

Detailed Cost Estimating for Construction

- ▶ **Contractors / Professional Estimators**
 - ▶ Uses detailed plans, specifications and quantity schedules to determine the required amount and cost of labor, equipment, material, overhead and profit
- ▶ **Engineers**
 - ▶ Uses estimated quantities for each Bid Item and historical unit cost data from previous bids received on similar projects, and adjusts for current conditions

General Factors Influencing Construction Bids

- ▶ Applicable Standards
- ▶ Market Conditions
- ▶ Cost and Availability of Labor, Equipment and Materials
- ▶ Time of Year Bids are Solicited
- ▶ Time Allocated for Construction
- ▶ Size of Project
- ▶ Location of Project
- ▶ Risks Associated with Project

Intent of ICIP Cost Estimating Guide

- ▶ Provides simplified methods for estimating project costs.
- ▶ Provides magnitude of costs. Should not be used for funding applications.
- ▶ Is time sensitive.

Cost Estimating for Drinking Water Infrastructure

By

**Patricia Bolliger, PE
Stantec Consulting Services Inc.**

Drinking Water System Construction Cost Components

- Main components of providing drinking water to a community:
 - Removing water from the source (groundwater or surface water);
 - Treating the water;
 - Storing water for peak usage times and to fire flow and other emergencies; and
 - Distributing the water to the customers through underground pipes.
- Water source
 - Groundwater = well, pump, and chlorination process
 - Surface water = filtration treatment plant

Drinking Water System Basis of Cost Estimation

Basis of cost estimation

1. Groundwater system serving ≤ 300 households
2. Groundwater system serving > 300 households
3. Surface water treatment system

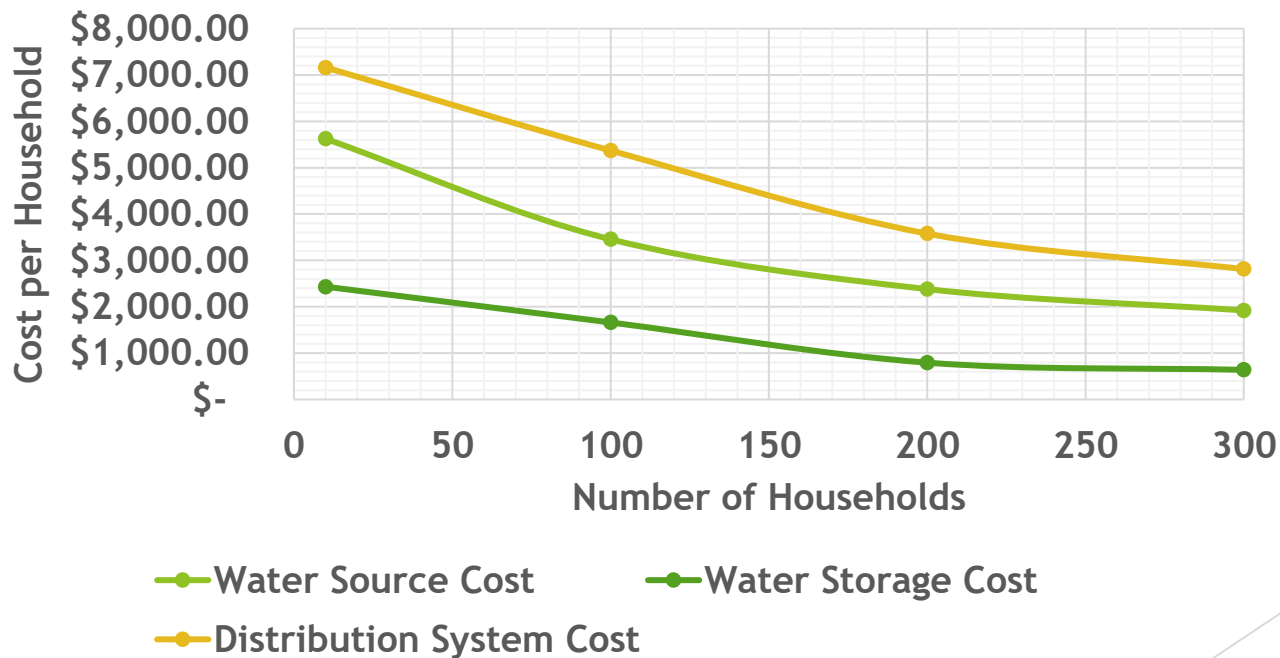
Groundwater System Serving ≤ 300 Households

- Based on number of households, not population.
- Cost per household is multiplied by the number of households to estimate:
 - Water source (well, pump, and chlorination);
 - Water storage tank; and
 - Water distribution system
- Cost Estimating Procedure
 1. Water Source Cost. Use graph on following slide to estimate cost per household. Multiply the cost per household by the number of households served.

$$\text{Cost per Household} \times \text{No. of Households} = \text{Water Source Cost}$$

Groundwater System Serving ≤ 300 Households

Estimating Average Cost of Construction of Small
Water Systems



Groundwater System Serving ≤ 300 Households

- Cost Estimating Procedure (cont'd)
 2. Water Storage Cost. Use same graph to determine cost per household. Multiply the cost per household by the number of households served.

$$\begin{array}{ccccc} \text{Cost per Household} & \times & \text{No. of Households} & = & \text{Water Storage Cost} \end{array}$$

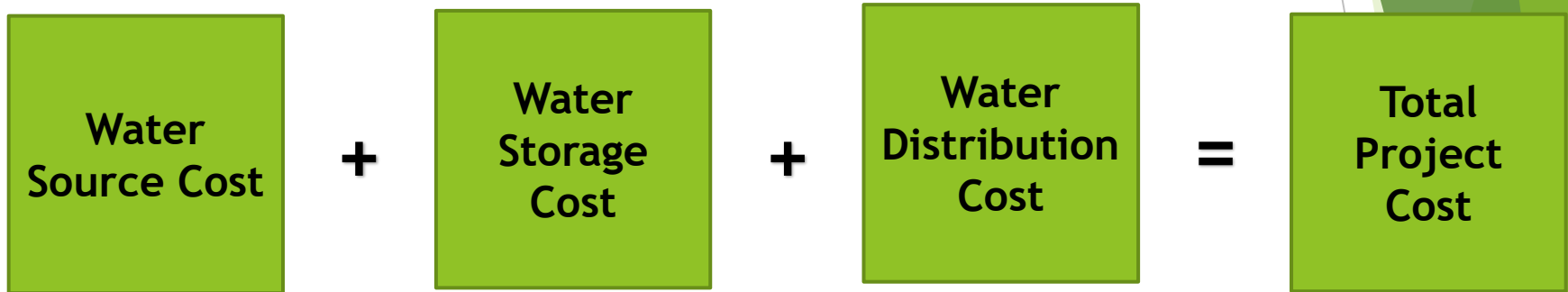
3. Water Distribution Cost. Use same graph to determine cost per household. Multiply the cost per household by the number of households served.

$$\begin{array}{ccccc} \text{Cost per Household} & \times & \text{No. of Households} & = & \text{Water Distribution Cost} \end{array}$$

Groundwater System Serving ≤ 300 Households

- Cost Estimating Procedure (cont'd)

4. Total Project Cost. Add Water Source Cost, Water Storage Cost, and Water Distribution Cost.



- Cost Estimate Assumptions:

- Water Distribution Cost includes PVC pipe and installation of meters.
- Cost includes engineering, engineering inspection, and construction.
- Cost does not include well drilling, pump and controls, well house, and chlorination equipment.

Groundwater System Serving > 300 Households

- Based on linear feet of pipe needed and depth of well to be drilled.
- Cost per household is multiplied by the number of households to estimate:
 - Water source (well, pump, and chlorination);
 - Water storage tank; and
 - Water distribution system
- Water Source Cost estimating procedure:
 1. Well Cost. Estimate the depth of well and corresponding diameter and cost per foot. Costs include drilling, casing, screen, pump test, and well development.

Diameter of Well (in)	Well < 500 ft (cost per ft)	Well = 500 ft (cost per ft)	Well > 500 ft (cost per ft)
6	\$170	\$150	N/A
8	N/A	\$185	\$170

Groundwater System Serving > 300 Households

- Cost estimating procedure (cont'd):
 2. Well Cost (cont'd). Multiply Depth of Well by Cost per Foot.

$$\begin{array}{|c|} \hline \text{Depth of Well} \\ \text{(ft)} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Cost per Foot} \\ \text{(\$/ft)} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Well Cost} \\ \hline \end{array}$$

3. Pump Cost. Estimate the cost of the pump using the below table.

Diameter of Well (in)	Cost for Well < 500 ft	Cost for Well = 500 ft	Cost for Well > 500 ft
6	\$4,220	\$8,330	N/A
8	N/A	\$8,330	\$16,900 - \$41,800

Groundwater System Serving > 300 Households

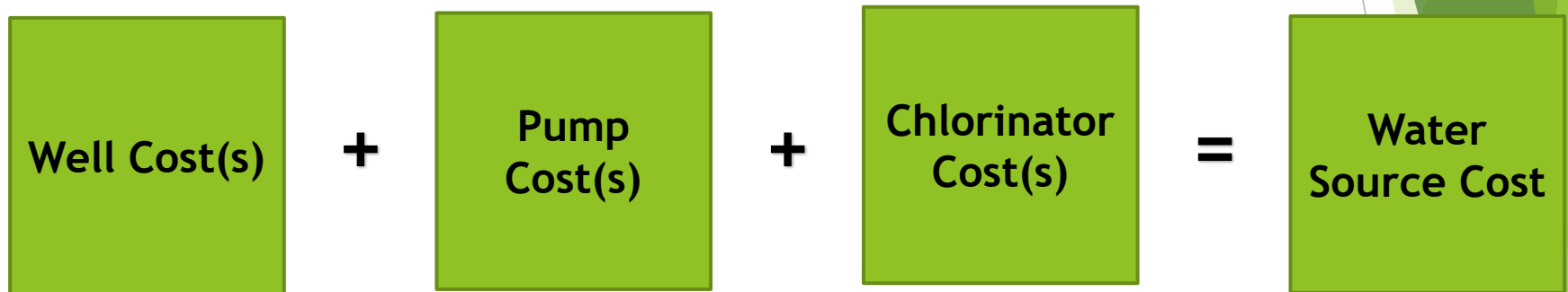
- Cost estimating procedure (cont'd):
 4. Chlorinator Cost. Estimate the Cost of Chlorinator using the following table.

Chlorinator	Cost
Small Well (300-500 households or 110-180 gpm)	\$515 - \$840
Medium Well (500-700 households or 180-225 gpm)	\$840 - \$1,335
Large Well (700-900 households or 255-330 gpm)	\$1,335 - \$2,025

- Multiple pumps and wells. It is a good idea to have redundant wells and pumps within a system to plan for problems with pump, wells, or supply quantity. The same procedure may be followed for multiple wells.

Groundwater System Serving > 300 Households

- Cost estimating procedure (cont'd):
 5. Subtotal Cost for Water Source. Sum of Well Cost(s), Pump Cost(s), and Chlorinator Cost(s).



Groundwater System Serving > 300 Households

- Water Storage Cost estimating procedure:
 1. Consider factors affecting tank cost. Size, type of tank, construction conditions.
 2. Determine storage needed.
 - a) If replacing tank with sufficient size, estimate same size tank.
 - b) Approx. recommended total storage capacity = two-day use + fire flow storage (based on number of households served and assuming an average of 3.5 persons per household).
 - c) If adding storage, the new tank size = total storage capacity - existing tank size.

Number of Households	Minimum Recommended Storage Volume (gallons)
300	260,000
400	330,000
500	400,000
600	470,000

Groundwater System Serving > 300 Households

- Water Storage Cost estimating procedure (cont'd):
 3. Determine cost per gallon based on size of tank.

Size of Tank (gallons)	Cost Range (\$/gallon)
Less than 50,000	\$1.26 - \$1.68
50,000 - 75,000	\$0.68 - \$1.26
75,000 - 300,000	\$0.58 - \$0.68
300,000 - 500,000	\$0.50 - \$0.58
500,000 - 100,000	\$0.40 - \$0.50

4. Multiply Storage Volume by Cost per Gallon to determine Total Tank Cost.

$$\begin{array}{|c|} \hline \text{Storage Volume} \\ \text{(gallons)} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Cost per Gallon} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Total Tank Cost} \\ \hline \end{array}$$

Groundwater System Serving > 300 Households

- Use 6- to 8-inch pipe for general estimate.
- Cost includes cost of standard construction, pipe materials, and labor.
- Rocky conditions = significantly higher cost
- Estimate length of distribution pipe needed (Google Earth, GPS unity, or car odometer). One (1) mile = 5,280 feet
- Water Distribution Cost estimating procedure:
 1. Estimate cost per linear foot using following table.

Pipe Diameter	Cost per Linear Foot	Notes
4-inch	\$44	Maximum flow of 225 gpm
6-inch	\$48	Minimum needed for fire flow
8-inch	\$53	Maximum flow of 1,000 gpm
10-inch	\$61	Maximum flow of 1,500 gpm

Groundwater System

Serving > 300 Households

- Water Distribution Cost estimating procedure (cont'd):
 2. Multiply the Linear Feet of Distribution Pipe by the Cost per Linear Foot to obtain the Water Distribution Cost.

$$\begin{array}{|c|} \hline \text{Linear Feet of} \\ \text{Distribution} \\ \text{Pipe} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Cost per Linear} \\ \text{Foot} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Water} \\ \text{Distribution} \\ \text{Cost} \\ \hline \end{array}$$

- Estimate Total Project Cost by adding the Water Source Cost, Water Storage Cost, and Water Distribution Cost.

$$\begin{array}{|c|} \hline \text{Water} \\ \text{Source Cost} \\ \hline \end{array} + \begin{array}{|c|} \hline \text{Water} \\ \text{Storage} \\ \text{Cost} \\ \hline \end{array} + \begin{array}{|c|} \hline \text{Water} \\ \text{Distribution} \\ \text{Cost} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Total} \\ \text{Project} \\ \text{Cost} \\ \hline \end{array}$$

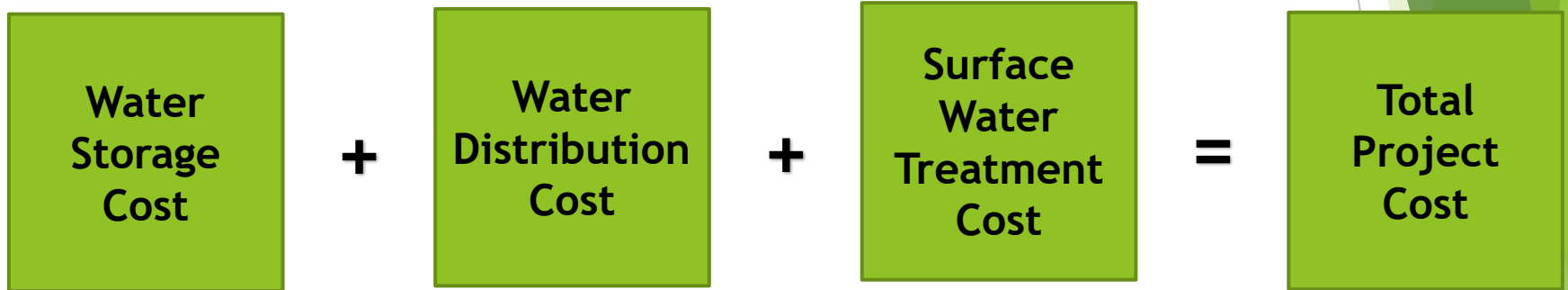
Surface Water Treatment System

- Costs for storage and distribution systems can be estimated using the previous groundwater system methods (depending on number of households).
- This method estimates construction costs for a new water treatment facility and does not include operations and maintenance costs.
- Rule of thumb = 3.5 persons per household and 100 gallons per capita per day.
- Estimate cost of surface water treatment system using the following table:

No. of Households	Size of Surface Water Treatment Facility	Cost per Gallon of Water
Greater than 3,000	1,000,000 gallons or more per day	\$2.10
2,000 - 3,000	750,000 gallons or more per day	\$2.62
1,500 - 2,000	500,000 gallons or more per day	\$3.34
Less than 1,500	Less than 500,000 gallons per day	\$4.31 - \$5.02

Surface Water Treatment System

- Estimate Total Project Cost by adding Water Storage Cost, Water Distribution Cost, and Surface Water Treatment System Cost.



Cost Estimating for Wastewater Infrastructure

By

Patricia Bolliger, PE
Stantec Consulting Services Inc.

Wastewater Infrastructure Construction Cost Components

- Main components of a wastewater collection and treatment system/facility:
 - Collection system;
 - Treatment system/facility; and
 - Effluent disposal.
- Collection system conveys wastewater generated at households to the treatment system/facility.

Wastewater Infrastructure Construction Cost Components

- Considerations for choosing a treatment system/facility:
 - Quality/quantity of flow
 - Characteristics of raw influent wastewater
 - Quality/quantity of effluent desired
 - Type of discharge (surface water, groundwater, irrigation, etc.)
 - Permit conditions
 - Acceptable degree of O&M
 - Quality/quantity of land available
 - Physical characteristics of the area (soil, groundwater, bedrock, topography, etc.)

Wastewater Infrastructure Construction Cost Components

- Considerations for choosing a method for effluent discharge:
 - Discharge to nearby surface water, need EPA NPDES permit.
 - Discharge to groundwater (irrigation, infiltration, injection, etc.), need an NMED Groundwater Discharge permit
 - Discharge by evaporation, very land intensive.

Wastewater Infrastructure Construction Cost Estimate

- Basis of cost estimate
 - For collection and treatment only, not for discharge (too variable)
 - Does not include ROW, land acquisition, or O&M
 - New construction, not upgrade or expansion
 - Flowrate of 100 gpcd and 3.5 persons per household are assumed.
 - Does not include extreme conditions, such as dewatering, bedrock, etc.
- Collection System Construction Estimated Costs

Collection System Construction Estimated Costs**Gravity Collection System**

Classification	No. of Households	Cost per Household	Subtotal
Rural (3 - 5 acres per household)		\$34,483	
Semi-Rural (1 - 3 acres per household)		\$24,782	
Semi-Urban (0.5 - 1.0 acre per household)		\$16,456	
Urban (Less than 0.5 acre per household)		\$8,768	

Vacuum Collection System

Classification	No. of Households	Cost per Household	Subtotal
Rural (3 - 5 acres per household)		\$20,598	
Semi-Rural (1 - 3 acres per household)		\$16,046	
Semi-Urban (0.5 - 1.0 acre per household)		\$11,784	
Urban (Less than 0.5 acre per household)		\$8,528	

Small Diameter Gravity Collection System

Classification	No. of Households	Cost per Household	Subtotal
Rural (3 - 5 acres per household)		\$19,859	
Semi-Rural (1 - 3 acres per household)		\$24,782	
Semi-Urban (0.5 - 1.0 acre per household)		\$16,456	
Urban (Less than 0.5 acre per household)		\$8,768	

Grinder Pump Collection System

Classification	No. of Households	Cost per Household	Subtotal
Rural (3 - 5 acres per household)		\$24,593	
Semi-Rural (1 - 3 acres per household)		\$24,593	
Semi-Urban (0.5 - 1.0 acre per household)		\$16,380	
Urban (Less than 0.5 acre per household)		\$13,345	

Septic Tank Effluent Pump Collection System

Classification	No. of Households	Cost per Household	Subtotal
Rural (3 - 5 acres per household)		\$26,130	
Semi-Rural (1 - 3 acres per household)		\$21,888	
Semi-Urban (0.5 - 1.0 acre per household)		\$17,916	
Urban (Less than 0.5 acre per household)		\$14,884	

Wastewater Infrastructure Construction Cost Estimate

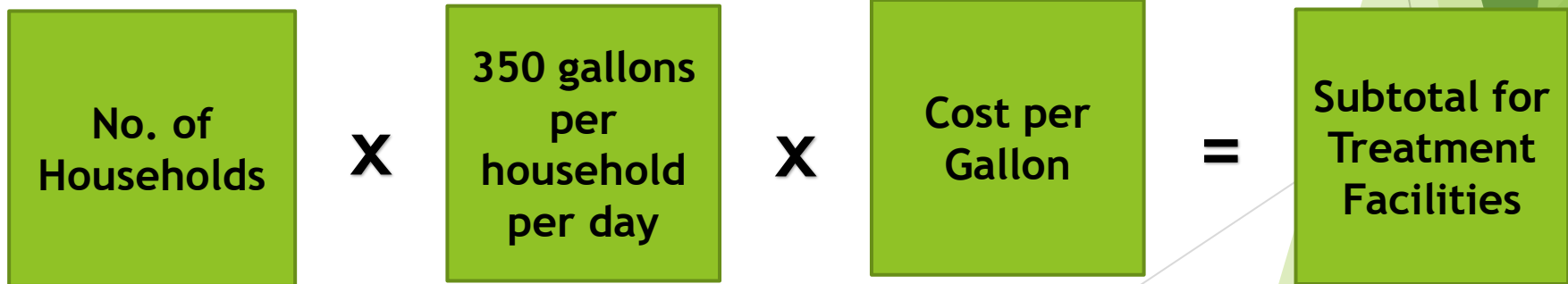
- Pump Station Construction Estimated Costs

Pump Station Construction Estimated Costs			
Classification	No. of Households	Cost per Household	Subtotal
Fewer than 100 households		\$2,365	
100 to 500 households		\$1,089	
More than 500 households		\$426	

Wastewater Infrastructure Construction Cost Estimate

- Wastewater Treatment Facility Estimated Costs

No. of Households	Size of Wastewater Treatment Facility	Range of Cost per Gallon of Wastewater Treated
≤ 3,000	≤ 1,000,000 gallons per day	\$8.36 - \$13.35
> 3,000	> 1,000,000 gallons per day	\$13.35 - \$16.73



Cost Estimating for Roadways and Streets Infrastructure

By

**Jerry B. Paz, PE
Molzen Corbin & Associates
Board Member - ACEC-NM**

Primary Roadway Specific Construction Cost Components

- ▶ Earthwork - Cutting, Filling, Shaping
- ▶ Surfacing - Subgrade Prep, Base, Surface
- ▶ Drainage - Roadway, Cross Drainage
- ▶ Structures - Bridges, Retaining Walls
- ▶ Traffic - Signing, Striping, Signals, MOT
- ▶ Utilities - Adjustment of Existing Utilities
- ▶ Landscaping / Aesthetic Enhancements
- ▶ Other - Mobilization, Testing, Staking, etc.

Factors Affecting Roadway Specific Construction Costs

- ▶ Terrain and Geographic Features
- ▶ Project Type - Rehabilitation, Reconstruction or New Construction
- ▶ Traffic Load / Roadway Function - Local, Collector, Arterial
- ▶ Urbanization - Curb & Gutter, Sidewalks
- ▶ Drainage Features
- ▶ Utilities Affecting Project
- ▶ Enhancements / Constraints - Safety, Environmental, Aesthetic, etc.

2021 Average Cost for Earthwork

Costs per Mile

Roadway Type	Driving Lanes	Road Top Width	Significant Cuts and Fills along Mainline	Major Widening in Mountain to Hilly Terrain	Widening in Flat to Moderate Terrain	Blading and Shaping Only
Local Streets	2 DL	24-28 ft	\$350,000	\$175,000	\$100,000	\$40,000
Collector	2 DL	36-40 ft	\$575,000	\$285,000	\$160,000	\$50,000
Collector	2 DL & CTL	52-56 ft	\$750,000	\$375,000	\$200,000	\$65,000
Collector	4 DL & CTL	72-76 ft	\$1,000,000	\$500,000	\$250,000	\$95,000

2021 Average Per Mile Costs for Roadway Surfacing

(For Urban Sections Includes curb & gutter)

Roadway Type	Driving Lanes	Roadway Top Width	New Surfacing Constr. Hot Mix Asphalt (HMA)	Process Existing Surfacing and Overlay w/ Hot Mix Asphalt	Mill and Process Existing Surfacing & Overlay w/ Hot Mix Asphalt	New Surfacing Constr. Double Penetr.
Local Streets	2 DL	24-28 ft	\$635,000	\$425,000	\$600,000	\$350,000
Collector	2 DL	36-40 ft	\$850,000	\$765,000	\$735,000	
Collector	2 DL & CTL	52-56 ft	\$1,150,000	\$1,020,000	\$950,000	
Collector	4 DL & CTL	72-76 ft	\$1,720,000	\$1,440,000	\$1,400,000	

2021 Average Per Mile Costs for Roadway Urbanization

Item		Cost/Mile
Curb and Gutter w/ Drive-pads and ADA Compliant Corners	New Construction - Both Sides of Roadway	\$350,000
Sidewalk	New Construction - Both Sides of Roadway	\$375,000
Raised Median Incl Curb & Gutter and Median Pavement	New Construction	\$540,000
Raised Median Incl Curb & Gutter, No Median Pavement	New Construction	\$190,000
ADA Compliant Corners and Drive-Pads	Street Rehabilitation	\$125,000

2021 Average Costs for Drainage Improvements

Structure	Unit	Unit Costs
Bridge/CBC (Large Drainage)	Surface Area	\$300/SF
Storm Drain System	Per Center Line Mi	\$2,400,000/Mi
Cross Drainage	24" CMP & End Treatment	\$130/LF
	36" CMP & End Treatment	\$200/LF
	48" CMP & End Treatment	\$225/LF
	60" CMP & End Treatment	\$260/LF

Other Construction Costs

Items		Add % to Total Cost for Earthwork, Surfacing, Urbanization and Drainage
Mobilization		10%
Traffic	Signing, Striping, Management of Traffic	7.5%
Other	Quality Assurance, Utility Adjustments, Construction Staking, Demolition	7.5%
Signalization		\$300,000/Signal

Example of Cost Estimate for 0.5 Mi of Local Street, Urbanized with 1- 60” CMP

Description	Unit	Unit Cost	Amount
Earthwork - Widening (flat to moderate) ½ Mi	Mi	\$100,000	\$50,000
Surfacing - New Surfacing ½ Mi	Mi	\$635,000	\$317,500
Urbanization - New Constr. w/ Curb & Gutter, ADA Compliant Drive-pads and Corners - ½ Mi	Mi	\$350,000	\$175,000
Drainage - 80 LF of 60” CMP & End Treatments	LF	\$260	\$20,800
Subtotal			\$562,500
Mobilization, Traffic and Other Costs	%	25% of Subtotal	\$140,625
Subtotal			\$703,125
Gross Receipts Tax and Contingencies	%	28% of Above	\$196,875
Construction Cost			\$900,000
Engineering and other Professional Costs	%	22% of Constr.	\$198,000
Total Project Costs			\$1,098,000

Cost Estimating for Buildings

By

**Jerry B. Paz, PE
Molzen Corbin & Associates
Board Member - ACEC-NM**

Primary Building Construction Components

- ▶ Civil- Site, Parking Lot
- ▶ Structural - Foundation, Str Framework
Mechanical - Plumbing, HVAC
- ▶ Electrical - Wiring, Lighting
- ▶ Fire Suppression - Sprinkler, Alarms
- ▶ Architectural - Thermal/Moisture
Interior/Exterior Finishes
- ▶ Landscaping

Factors Affecting Building Specific Costs

- ▶ Site Terrain and Availability of Utilities
- ▶ Soil Conditions
- ▶ Structural Complexity
- ▶ Exterior and Interior Finish Levels
- ▶ General Building Construction Type
- ▶ Heating, Venting, Cooling System Level

Cost for Administration Buildings

Population to be Served	Range of Typical Building Size	2021 Typical Cost Per Square Foot (SF)
Under 5,000	2,000 to 5,000 SF	\$205
5,000 to 10,000	5,000 to 6,500 SF	\$190
Over 10,000	6,500 to 8,000 SF	\$180

Costs for Community Centers

Population to be Served	Range of Typical Building Size	Typical Costs per Square Foot (SF)
Under 8,000	10,000 to 20,000 SF	\$165
Over 8,000	20,000 to 30,000 SF	\$145

Costs for Fire Stations

Population to be Served	Typical Building Size	Typical Cost per Square Feet (SF)
Under 2,000	2,000 SF	\$235
2,000 to 5,000	4,000 SF	\$200
5,000 to 10,000	6,000 SF	\$175
Over 10,000	8,000 SF	\$165

Costs for Libraries

Population to be Served	Typical Building Size	Typical Cost per Square Feet (SF)
Under 2,000	2,000 to 2,500 SF	\$270
2,000 to 5,000	2,500 to 3,500 SF	\$270
5,000 to 10,000	3,500 to 7,000 SF	\$270
Over 10,000	7,000 SF to 10,000 SF	\$245

Costs for Maintenance Buildings

Population to be Served	Typical Building Size	Typical Cost per Square Feet (SF)
Under 5,000	10,000 SF	\$145
5,000 to 10,000	20,000 SF	\$120
Over 10,000	30,000 SF	\$105

Cost for Site Work

- ▶ Dependent on number of parking spaces required. Use 1 Park/300 SF of Building Space.
- ▶ Cost includes grading and shaping, subgrade prep, base course, hot mix asphalt, curb and front sidewalk.
- ▶ For construction cost use **\$2,500 per Parking Space** (300 SF of Building space for site costs).

Example of Cost Estimate for New Library- 6,000 SF

Description	Unit	Unit Costs	Amount
Building	6000 SF	\$270/SF	\$1,620,000
Site Work	20 Parking Spaces	\$2,500/Parking Space	\$50,000
Sub-Total			\$1,670,000
GRT		8% of above	\$133,600
Sub-Total			\$1,803,600
Architectural / Engineering		15% of above	\$270,540
Total			\$2,074,140

US LABOR & MATERIAL COST ESCALATION

(AUGUST 2020 TO AUGUST 2021)

Labor (Through May, 2021)	16%
PVC Pipe	40%
Gas Prices	43%
Concrete	157%
Rolled Steel	326%



Patricia Bolliger, P.E.
Stantec Consulting Services Inc.
Direct: 575 587-3745
Mobile: 505 252-1168
patricia.bolliger@stantec.com

Jerry B. Paz, P.E., M.ASCE, ENV SP
MOLZEN CORBIN
575 644-3517 Cell
jpaz@molzencorbin.com