Public Works Committee

10:00 a.m., Monday, November 15, 2021
Council Chambers
1207 Palm Boulevard, Isle of Palms, South Carolina

Public Comment:
All citizens who wish to speak during the meeting must email their first and last name, address and topic to nicoled@iop.net no later than **3:00 p.m. the day before the meeting.** Citizens may also provide public comment here: https://www.iop.net/public-comment-form

Agenda

1. **Call to order -** and acknowledgement that the press and public have been duly notified of the meeting in accordance with the Freedom of Information Act.

2. **Approval of previous meeting's minutes –** October 6, 2021

3. **Citizens' Comments**

4. **Department Report –** Director Pitts and Assistant Director Asero

5. **Old Business**
    a. Update on Phase III Drainage Project, small internal projects and Waterway Boulevard path elevation project
    b. Update on improvements to golf cart path along Ocean Park Plaza

6. **New Business**
    a. Discussion and consideration of Ordinance 2021- 15 – An ordinance to temporarily suspend enforcement of Title 3, Chapter 4, Environmentally Acceptable Packaging and Products for businesses affected by global supply chain issues due to the COVID-19 pandemic
    b. Consideration of approval of a contract to Quality Enterprises in the amount of $2.27 million for the construction of Phase 3 Outfalls at 30th and 36th Avenue
    c. Discussion of alternatives to gravity sewer

7. **Miscellaneous Business**
    Next Meeting Date: _____, __________, January ___, 2022

8. **Executive Session –** If needed

9. **Adjournment**

PUBLIC WORKS COMMITTEE
4:30pm, Wednesday, October 6, 2021
1207 Palm Boulevard, Isle of Palms, SC
and broadcasted live on YouTube: https://www.youtube.com/user/cityofisleofpalms

MINUTES

1. **Call to order**

Present: Council members Streetman, Smith, and Ward

Staff Present: Administrator Fragoso, Director Pitts, Director Kerr, Asst. Director Asero

2. **Approval of previous meeting's minutes – September 1, 2021**

Council Member Streetman made a motion to approve the minutes of the September 1, 2021 meeting, and Council Member Ward seconded the motion. The motion passed unanimously.

3. **Citizens' Comments** -- none

4. **Department Reports – Director Pitts and Assistant Director Asero**

Director Pitts stated that garbage collection for August was average. September's collection was "a bit high" but expected. Yard debris collection for August was down from its 2020 total. He reported that Public Works is caught up on yard debris collection across the island. Vehicle maintenance costs were $5200 for August and $2800 in September.

Asst. Director Asero reported on a recent meeting with Eadies about "the 500-600' of the Forest Trail basin drainage that needs to be completed." He said they are down in the staffing numbers due to Covid and this project is labor intensive, requiring a full crew.

Ditch restructuring at Sparrow and Duck Lanes has been scheduled. Eadies was able to finish vegetation cleaning at 41st Avenue prior to the completion of the internal drainage project there.

The annual and 3-year testing for the underground storage tanks at Public Safety, Public Works, and the Marina has been completed. All of the bay lighting at Station 2 has been replaced. All new lighting is replaced with energy-saving LED lighting. The City's landscape contractor has removed dead wood from the trees over the playground at the Recreation Center.

Public Works has also been installing and replacing street signs in the rights of way. They installed an additional 50' of MobiMat at 42nd Avenue. The landscape contractor is going to lift the mat, regrade the area, and add another 50' to the MobiMat. They have begun working on rebuilding all the up lighting on the palms at Front Beach. Brush has been cleared from Waterway Boulevard and 20 yards of ROC was installed at the 53rd Avenue beach access.

The sinkhole repair at 41st Avenue is delayed but expected to be done soon.

Council Member Smith asked about having more cigarette receptacles placed on the street by the beach accesses.

5. Old Business

A. Update on Phase III Drainage Project, small internal projects, and Waterway Boulevard path elevation

Administrator Fragoso said the bid package for the 30th and 36th avenues outfalls is complete. Several interested parties attended the pre-bid meeting. Bids are due October 15 with the goal of a recommendation to the Ways & Means Committee in October.

She also reported that she has submitted a grant proposal to the CDBG-MIT Office of Resilience for funding for Phase III Drainage. They will also be submitting a grant application to FEMA that is due in November for additional funding for the 41st Avenue and Waterway Boulevard elevation project portion of the work. Awards for that grant will not be announced until next summer.

Director Kerr stated that 41st Avenue is not yet complete, and it remains closed due to rain delays. There have also been challenges with relocating the water lines.

B. Update and discussion of potential solutions to drainage ditch erosion issues

Director Kerr said the framework and documentation for this ditch erosion option is ready. He would like for there to be a gradual onset and use of the program to ensure that it works properly before notifying the public at large.

C. Update and discussion of golf cart path along Ocean Park Plaza

Administrator Fragoso said there is no update on this, and staff continues to look into it.

D. Discussion of litter-related ordinances, enforcement, and messaging

Council Member Smith said she would like to see more litter-related messaging at the beach access paths. Administrator Fragoso said 2 more signs have been ordered. There is $20,000 in FY22 for these purposes. They cost approximately $3,000 each to purchase and install. Council Member Smith would like to see this brought up to the Ways & Means Committee as the City has the funds to cover the expense to put signage at the 12 remaining beach access paths. She would also like to see what kind of messaging can be put up at the narrower beach paths. Council Member Ward said he is opposed to unbudgeted expenses.

Council Member Smith would like to see more enforcement and or education from Public Safety with regards to litter-related messaging.

E. Discussion of adding bins to share left-behind beach toys

Council Member Smith said she believes a good place for a bin for left-behind beach toys is in the 1100 block of Ocean Boulevard by the showers and suggested the restroom attendant could check on it.

Administrator Fragoso said that she would prefer the upkeep of this bin be the responsibility of volunteers as opposed to the part-time restroom attendant. She sees this as an opportunity for more community engagement. It was also suggested as something that the Environmental Advisory Committee or Beach Cleanup Crew could attend to.

6. New Business

7. Miscellaneous Business

The next meeting of the Public Works Committee will be Wednesday, November 3, 2021 at 4:30pm. Council Member Ward said he would prefer to have no meeting in December unless it is an emergency.

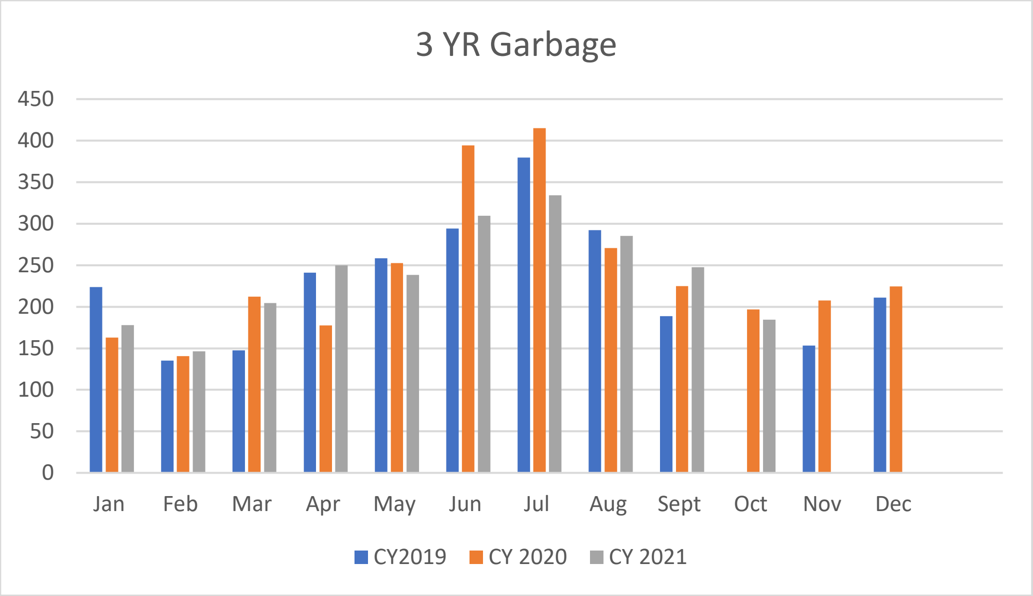
8. Adjournment

Council Member Streetman made a motion to adjourn, and Council Member Smith seconded the motion. The meeting was adjourned at 5:11pm.

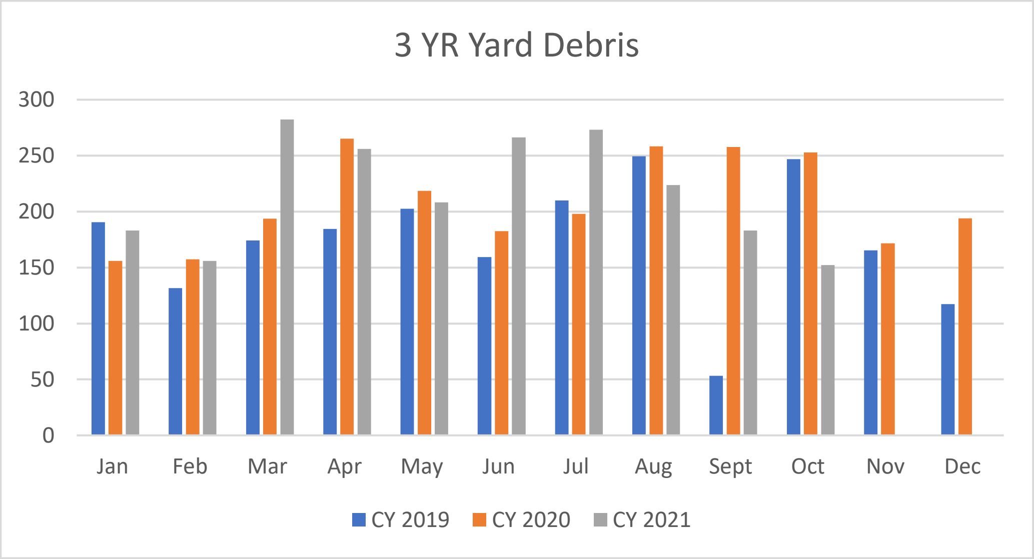
Respectfully submitted,

Nicole DeNeane
City Clerk

	CY2019	**CY 2020**	**CY 2021**
Column1			
Jan	223.61	162.77	177.84
Feb	135.17	140.66	146.48
Mar	147.4	212.04	204.6
Apr	241.17	177.52	249.86
May	258.45	252.56	238.23
Jun	294.31	394.38	309.71
Jul	379.48	415.12	334.17
Aug	292.36	270.71	285.21
Sept	188.86	224.87	247.76
Oct	Dorian	196.94	184.63
Nov	153.27	207.44	
Dec	211.04	224.45	



	CY 2019	**CY 2020**	**CY 2021**
Column1			
Jan	190.61	155.93	183.07
Feb	131.74	157.44	156.06
Mar	174.3	193.74	282.37
Apr	184.59	265.04	256.07
May	202.48	218.67	208.32
Jun	159.4	182.49	266.23
Jul	209.97	198.07	273.08
Aug	249.39	258.37	223.64
Sept	53.11	257.64	182.96
Oct	246.75	252.81	152.16
Nov	165.36	171.54	
Dec	117.26	194.08	



General duties

Sanitation:

27.14 tons of misc. debris in October

VEHICLE MAINTENANCE

Beginning Budget $90,000.00

Fund 10 GENERAL FUND

10/01/2021		10-4620.5017 VEHICLE MAINTENANCE		BEG. BALANCE 17,567.97
10/05/2021	AP INV	TARP FOR MACK FLATBED	179.00	17,746.97
10/06/2021	AP INV	HOSE AND CLAMP FOR PW 2	50.11	17,797.08
10/06/2021	AP INV	PW-24 2009 MACK - PM SERVICE, COOLANT	2,324.03	20,121.11
10/08/2021	AP INV	(2) HOSE REEL ASSEMBLY Hyd for PW 24	249.54	20,370.65
10/13/2021	AP INV	PW-28 2019 MACK - WATER PUMP REPLACEMENT	2,062.12	22,432.77
10/20/2021	AP INV	PW-27 SERVICE CALL (2) TIRES REPLACED	1,138.44	23,571.21
10/26/2021	AP INV	NEW PWD TRUCK #31 - 2022 MACK FLAT BED REG.	18.29	23,589.50
10/28/2021	AP INV	(2) COOLING HOSES pw 26	72.58	23,662.08
10/28/2021	AP INV	LOADER - SWAPPED THE SPARE LOADER TIRE	237.00	23,899.08
10/28/2021	AP INV	SPARE TIRE FOR LOADER	1,043.51	24,942.59
10/31/2021	10-4620.5017	END BALANCE	7,374.62	24,942.59

City of Isle of Palms, SC
Public Works Department
Robert Asero, Assistant Director of Storm Water and Facilities
Monthly Report: October 2021

Drainage

- Reviewing of Charleston County stormwater plans for new home construction.
- Eadies cleaning of 600 feet of Forest trail drainage ditch.
- Eadies cleaning of 23rd Ave ditch.
- Eadies cleaning of two sections of 24th Ave ditch.
- Clean up of drainage ditch on 45th Ave by DPW

Facilities

- Repair of access door lock at PSB.
- Completion of truck bay lighting at fire station 2
- Scheduled elevator service and repair.
- Pricing for seal coating and striping for city hall and public works parking lot.
- Scheduled repair of Veeder root fuel management system.

Front beach

- Weekly cleanup of parking lot / Front beach Ocean Blvd. trash and debris by public works.
  Ordering of supplies and managing cleaning crews for restrooms.
- Regrading and installation of Mobi mat at 46th Ave.
- Completion of the additional 50 ft of Mobi mat at 42nd Ave.
- Installation of electrical covers at front beach.
- Installation of 50 well lights into sidewalk at front beach.
- Assessment of beach paths.
- Estimate for palm tress behind the public restrooms.
- Scheduled line striping for front beach parking spaces.

Landscaping / Rights of way / Connector / Parks

- Removal of brush from multi use sidewalk on Waterway Blvd. by DPW.
- Clean up of the connector debris by public works and the sweeping contractor.
- Meeting with landscapers for front beach improvements.
- Installation of street signs.
- Clean up of Right of way on Marginal Rd.
- Clean up of Forest trail median.

Compactor / Dumpster

- Cleaned compactor pad and recycling area weekly.
- Removal of bulk items left by the PSB compactor weekly.
- Pressure washing of city trash compactor by public works.

Certifications, training and meetings

- Monthly UST testing of marina, public works and public safety building.
- On site meeting for the 41st Ave and Forest Trail. drainage projects.
- Meeting for new drainage master plan with Davis and Floyd.
- Meeting for safety lighting on public works vehicles.
- EOC meeting.

ORDINANCE 2021-15

AN ORDINANCE TO TEMPORARILY SUSPEND ENFORCEMENT OF TITLE 3, PUBLIC WORKS, CHAPTER 4, ENVIRONMENTALLY ACCEPTABLE PACKAGING AND PRODUCTS, OF THE CITY OF ISLE OF PALMS CODE OF ORDINANCES, FOR BUSINESSES AFFECTED BY GLOBAL SUPPLY CHAIN ISSUES DUE TO THE COVID-19 PANDEMIC.

BE IT ORDAINED AND ENACTED BY THE MAYOR AND COUNCIL MEMBERS OF THE CITY OF ISLE OF PALMS, SOUTH CAROLINA, IN CITY COUNCIL ASSEMBLED:

SECTION 1. That enforcement of Chapter 4, Environmentally Acceptable Packaging and Products, of Title 3, Public Works, of the City of Isle of Palms Code of Ordinances, is hereby temporarily suspended for a period of _____ months for businesses affected by global supply chain issues due to the Covid-19 pandemic.

SECTION 2. That should any part of this Ordinance be held invalid by a Court of competent jurisdiction, the remaining parts shall be severable therefrom and shall continue to be in full force and effect.

SECTION 3. That all ordinances or parts of ordinances conflicting with the provisions of this Ordinance are hereby repealed insofar as the same affect this Ordinance.

SECTION 4. That this Ordinance shall become effective immediately upon ratification and shall expire on ____________________, 20___.

PASSED AND APPROVED BY THE CITY COUNCIL FOR THE CITY OF ISLE OF PALMS, ON THE ______ DAY OF _________________, 2021.

____

Jimmy Carroll, Mayor

(Seal)

Attest:

____

Nicole DeNeane, City Clerk

First Reading:____________________________

Public Hearing:___________________________

Second Reading:__________________________

Ratification:______________________________

DOCUMENT 00313

BID FORM

PROJECT IDENTIFICATION: Phase 3 Drainage Improvements: Forest Trail and 30th Avenue Outfalls

CONTRACT IDENTIFICATION AND NUMBER:

THIS BID IS SUBMITTED TO: The City of Isle of Palms

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1. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Bid Price and within the Bid Times indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. BIDDER accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the day of Bid opening, or for such longer period of time BIDDER may agree to in writing upon request of OWNER.

3. In submitting this Bid, BIDDER represents, as more fully set forth in the Agreement, that:

   a. BIDDER has examined and carefully studied the Plans and Specifications for the work and contractual documents relative thereto, and has read all Technical Provisions, Supplementary Conditions, and General Conditions, furnished prior to the opening of Bids and can fulfill the requirements of the work to be performed.

   b. BIDDER further acknowledges hereby receipt of the following Addenda:

ADDENDUM NO.	DATE
1	11/5/21

   c. BIDDER has visited the site and become familiar with and is satisfied as to the general, local and site conditions possibly affecting cost, progress, performance and furnishing of the Work;

   d. BIDDER is familiar with and is satisfied as to all federal, state, and local Laws and Regulations possibly affecting cost, progress, performance and furnishing of the Work.

e. BIDDER has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structure at or contiguous to the site (except underground Facilities) have been identified in the Supplementary Conditions. BIDDER acknowledges such reports and drawings are not Contract Documents and may not be complete for BIDDER's purposes. BIDDER acknowledges OWNER and Engineer do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bidding Documents with respect to Underground Facilities at or contiguous to the site. BIDDER has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost progress, performance or furnishing of the work or which relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by BIDDER and safety precautions and programs incident thereto. BIDDER does not consider any additional examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance and furnishing of the Work in accordance with the times, price and other terms and conditions of the Bidding Documents.

f. BIDDER is aware of the general nature of Work to be performed by Owner and others at the site relating to Work for which this Bid is submitted as indicated in the Bidding Documents.

g. BIDDER has correlated the information known to BIDDER, information and observations obtained from visits to the site, reports and drawings identified in the Bidding Documents and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.

h. BIDDER has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies BIDDER has discovered in the Bidding Documents and the written resolution thereof by ENGINEER is acceptable to BIDDER. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work for which this Bid is submitted.

i. This bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.

4. BIDDER will complete the Work in accordance with the Contract Documents for the following price(s):

BID PROPOSAL

FOREST TRAIL OUTFALL

Item	Description	Quantity	Units	Unit Price	Total
1031000	Mobilization	1	LS	$ 147,718.00	$ 147,718.00
1050800	Construction Staking	1	EA	$ 8,400.00	$ 8,400.00
1071000	Traffic Control	1	LS	$ 20,597.00	$ 20,597.00
1090200	As-Built Construction Plans	1	LS	$ 14,400.00	$ 14,400.00
2015000	Selected Clearing and Grubbing	0.5	AC	$ 106,236.00	$ 53,118.00
2023000	Removal & Disposal of Existing Pavement	86	SY	$ 7.00	$ 602.00
2031000	Unclassified Excavation	400	CY	$ 16.25	$ 6,500.00
2106000	Selected Removal of Marked Trees	4	EA	$ 1,040.00	$ 4,160.00
3050110	Graded Aggregate Base Course (10" Uniform)	87	SY	$ 45.50	$ 3,958.50
4020320	Hot Mix Asphalt Intermediate Course Type B	7.2	TON	$ 1,095.00	$ 7,884.00
4030320	Hot Mix Asphalt Surface Course Type B	5.4	TON	$ 1,428.00	$ 7,711.20
2171074	4" Yellow Solid Lines (Pvt. Edge No Passing Zone) Thermo 90 MIL	56	LF	$ 12.00	$ 672.00
7141111	12" RC Pipe (Class III)	21	LF	$ 116.50	$ 2,446.50
7141119	54" RC Pipe (Class III)	213	LF	$ 419.25	$ 89,300.25
7192105	Manhole	2	EA	$ 5,733.00	$ 11,466.00
-	Head and Wingwall Structures	2	EA	$ 48,994.00	$ 97,988.00
7192282	Junction Box - With Grate Access	1	EA	$ 170,370.00	$ 170,370.00
-	In-Line Check Valve (54")	3	EA	$ 33,202.00	$ 99,606.00
-	In-Line Check Valve (12")	1	EA	$ 4,048.00	$ 4,048.00
-	Manually Operated Control Structures (Sluice Gates)	3	EA	$ 25,867.00	$ 77,601.00
-	Trash Rack	1	EA	$ 9,603.00	$ 9,603.00
-	Hand Railing	140	LF	$ 78.00	$ 10,920.00
6041020	Rip-Rap Class B	105	TON	$ 216.00	$ 22,680.00
8048205	Geotextile for Erosion Control Under Rip-Rap (Class 2) Type B	136	SY	$ 18.50	$ 2,516.00
8131000	Sodding	0.42	MSY	$ 14,678.00	$ 6,164.76
-	Geogrid Matting (Maintenance Access)	264	SY	$ 19.50	$ 5,148.00
-	12" 45 Degree Bend	4	EA	$ 369.00	$ 1,476.00
-	12" PVC Water Main	85	LF	$ 95.50	$ 8,117.50
-	12" Steel Casing	20	LF	$ 168.25	$ 3,365.00
-	Utility Coordination (Dry Utilities)	3	EA	$ 911.00	$ 2,733.00
-	Misc. Soil Erosion Control/Water Management	1	EA	$ 3,922.00	$ 3,922.00

Sub-Total, FOREST TRAIL OUTFALL $ 905,191.71

Item	Description	Quantity	Units	Unit Price	Total
30TH AVENUE OUTFALL					
1031000	Mobilization	1	LS	$233,496.00	$ 233,496.00
1050800	Construction Staking	1	LS	$8,400.00	$ 8,400.00
1071000	Traffic Control	1	LS	$23,947.00	$ 23,947.00
-	As-Built Construction Plans	1	LS	$14,400.00	$ 14,400.00
2015000	Selected Clearing and Grubbing	0.5	AC	$65,971.00	$ 32,985.50
2023000	Removal & Disposal of Existing Pavement	392	SY	$7.00	$ 2,744.00
2028100	Removal & Disposal of Existing Bridge	1	EA	$9,375.00	$ 9,375.00
2031000	Unclassified Excavation	379	CY	$20.50	$ 7,769.50
2033030	Controlled Fill - Borrow Material	422	CY	$37.00	$ 15,614.00
2106000	Selected Removal of Marked Trees	18	EA	$402.00	$ 7,236.00
3050110	Graded Aggregate Base Course (10" Uniform)	462	SY	$41.75	$ 19,288.50
4020320	Hot Mix Asphalt Intermediate Course Type B	52	TON	$234.25	$ 12,181.00
4030320	Hot Mix Asphalt Surface Course Type B	39	TON	$280.00	$ 10,920.00
6271010	4" White Solid Lines (Pvt. Edge Lines) Thermo 90 MIL	100	LF	$12.00	$ 1,200.00
6271025	24" White Solid Lines (Stop/Diagonal Lines) Thermo 125 MIL	14	LF	$36.00	$ 504.00
2171074	4" Yellow Solid Lines (Pvt. Edge No Passing Zone) Thermo 90 MIL	152	LF	$12.00	$ 1,824.00
7141114	24" RC Pipe (Class III)	23	LF	$134.50	$ 3,093.50
7141118	48" RC Pipe (Class III)	762	LF	$291.50	$ 222,123.00
7192020	Drop Inlet (24" x 36")	5	EA	$6,896.00	$ 34,480.00
7192105	Manhole	1	EA	$5,733.00	$ 5,733.00
7222802	8' x 4' PC Box Culvert	91	LF	$1,346.75	$ 122,554.25
7192282	Junction Box	1	EA	$19,762.00	$ 19,762.00
7016177	Headwall	1	EA	$18,032.00	$ 18,032.00
7192282	Junction Box (With Grate Access)	1	EA	$170,370.00	$ 170,370.00
-	In-Line Check Valve (48")	3	EA	$27,298.00	$ 81,894.00
-	In-Line Check Valve (12")	1	EA	$4,048.00	$ 4,048.00
-	Trash Rack	1	EA	$9,602.00	$ 9,602.00
-	Manually Operated Control Structures (Sluice Gates)	3	EA	$25,867.00	$ 77,601.00
-	Hand Railing	36	LF	$102.00	$ 3,672.00
8041020	Rip-Rap Class B	70	TON	$209.50	$ 14,665.00
8048205	Geotextile for Erosion Control Under Rip-Rap (Class 2) Type B	90	SY	$21.75	$ 1,957.50
8131000	Sodding	2.1	MSY	$7,478.00	$ 15,703.80
-	Geogrid Matting (Maintenance Access)	735	SY	$21.00	$ 15,435.00
-	8" Line Stop	2	EA	$22,554.00	$ 45,108.00
-	Air Release Valve	1	EA	$5,569.00	$ 5,569.00
-	8" Gate Valve	1	EA	$3,233.00	$ 3,233.00
-	12" Gate Valve	1	EA	$3,747.00	$ 3,747.00
-	6" 45 Degree Bend	4	EA	$369.00	$ 1,476.00
-	8" 45 Degree Bend	7	EA	$369.00	$ 2,583.00
-	12" 45 Degree Bend	3	EA	$369.00	$ 1,107.00
-	12" X 8" Tee	1	EA	$421.00	$ 421.00
-	8" PVC Force Main	52	LF	$583.25	$ 30,329.00
-	6" PVC Water Main	39	LF	$208.75	$ 8,141.25
-	8" PVC Water Main	53	LF	$164.25	$ 8,705.25
-	12" PVC Water Main	39	LF	$224.25	$ 8,745.75
-	18" Steel Casing	20	LF	$103.50	$ 2,070.00
-	24" Steel Casing	20	LF	$97.00	$ 1,940.00
-	Power Pole Relocation	1	EA	$3,846.00	$ 3,846.00
-	Water Line Relocation (Wild Dunes)	1	LS	$10,525.00	$ 10,525.00
-	Misc. Soil Erosion Control/Water Management	1	EA	$5,474.00	$ 5,474.00

Sub-Total, 30TH AVENUE OUTFALL	$ 1,365,630.80
GRAND TOTAL	$ 2,270,822.51

TOTAL BID FOR ALL ESTIMATED PRICES: Two Million Two Hundred Seventy Thousand Eight Hundred Twenty Two Dollars and Fifty One Cents
(Use words)

($ 2,270,822.51)
(Figures)

Unit Prices have been computed in accordance with paragraph 11.03.C of the General Conditions.

BIDDER acknowledges estimated quantities are not guaranteed and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Bid items will be based on actual quantities determined as provided, determined as provided in the Contract Documents.

5. BIDDER agrees the Work will be substantially complete within 270 calendar days after the date when the Contract Times commence to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within 300 calendar days after the date when the Contract Times commence to run.

6. BIDDER accepts provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within times specified in the Agreement.

7. The following documents are attached to and made a condition of this Bid:

    a. Required Bid Security in the form of 10 percent of the Bid Total Price.

    b. A tabulation of Subcontractors, Suppliers and other persons and organizations required to be identified in this Bid.

    c. Required BIDDER's Qualification Statement with supporting data.

8. The undersigned further agrees in case of failure on his/her part to execute the said contract and the Bond within 15 consecutive calendar days after written notice being given of the award of the contract, the check or bid bond accompanying this bid, and the monies payable thereon shall be paid into the funds of the Owner as liquidated damages for such failure, otherwise, the check or bid bond accompanying this proposal shall be returned to the undersigned.

9. Communications concerning this Bid shall be addressed to:

Quality Enterprises USA, Inc.
3494 Shearwater Street
Naples, Florida 34117-8414

Attn: Louis J. Gaudio, Vice President

10. Terms used in this Bid which are defined in the General Conditions or Instructions will have the meanings indicated in the General Conditions of Instructions.

SUBMITTED on November 10, 2021.

Quality Enterprises USA, Inc.
CONTRACTOR'S NAME

ADDRESS:

3494 Shearwater Street

Naples, Florida 34117-8414

BY:

Louis J. Gaudio, Vice President

State Utility Contractor License No. G97783 SC

Attest:

Allison B. Murrell, Chief Information Officer/
Assistant Secretary

3494 Shearwater Street
Naples, FL 34117-8414

Incorporated in the State of Virginia

PENAL SUM FORM

DOCUMENT 00411

BID BOND

BIDDER (Name and Address):

Quality Enterprises USA, Inc.
3494 Shearwater Street
Naples, FL 34117

SURETY (Name and Address of Principal Place of Business):

Fidelity and Deposit Company of Maryland
1299 Zurich Way
Schaumburg, IL 60196

OWNER (Name and Address):

The City of Isle of Palms
1207 Palm Boulevard
Isle of Palms, SC 29451

BID

BID DUE DATE: November 10, 2021

PROJECT (*Brief Description Including Location*): Phase 3 Drainage Improvements: Forest Trail and 30th Avenue Outfalls, Isle of Palms, South Carolina.

BOND

BOND NUMBER: Bid Bond DATE: November 10, 2021
(Not later than Bid Due Date)

PENAL SUM: -Ten-Percent-of-Amount-Bid---($10%-of-Bid)
(10% of Bid Sum)

IN WITNESS WHEREOF, Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER

Quality Enterprises USA, Inc. (Seal)
Bidder's Name and Corporate Seal

By:
Signature and Title

Attest:
Signature and Title

SURETY

Fidelity and Deposit Company of Maryland (Seal)
Surety's Name and Corporate Seal

By: Terri K Strawhand
Signature and Title Terri K. Strawhand Attorney-in-Fact
(Attach Power of Attorney)

Attest: Tammy A Ward
Signature and Title Tammy A. Ward Witness

Note: (1) Above addresses are to be used for giving required notice.
(2) Any singular reference to Bidder, Surety, Owner, or other party shall be considered plural where applicable.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents and Contract Documents.

3. This obligation shall be null and void if:

   3.1 Owner accepts Bidder's bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents and Contract Document, or

   3.2 All bids are rejected by Owner, or

   3.3 Owner fails to issue a notice of award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by bidder and, if applicable, consented to by Surety when required by paragraph 5 hereof.)

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of and any and all defenses based on arising out of any time extension to issue notice of award agreed to in writing by Owner and Bidder, provided that the time for issuing notice of award including extensions shall not in the aggregate exceed 120 days from Bid Due Date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in paragraph 4 above is received by Bidder and Surety, and in no case later than one year after Bid Due Date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notice required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier or by United States Registered or Certified Mail, return receipt requested, postage pre–paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent or representative who executed this Bond on behalf of Surety to execute, seal and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of the Bond conflicts with any applicable provision of any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "bid" as used herein includes a bid, offer or proposal as applicable.

Bond Number Bid Bond

Obligee The City of Isle of Palms

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by **Robert D. Murray, Vice President,** in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint Terri K. Strawhand, its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND,** this 19th day of June, A.D. 2019.

ATTEST:
ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: Robert D. Murray
Vice President

Dawn E Brown

By: Dawn E. Brown
Secretary

State of Maryland
County of Baltimore

On this 19th day of June, A.D. 2019, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Robert D. Murray, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Constance A. Dunn

Constance A. Dunn, Notary Public
My Commission Expires: July 9, 2023

SECTION 01135

BIDDER'S QUALIFICATIONS

Please answer all questions and have your statement notarized. If necessary, you may answer questions on separate sheets of paper and attach them to this statement. Other additional information your firm deems useful in the evaluation of your capabilities may also be included.

1. ORGANIZATION

Date of Response: November 10, 2021

Legal Name of Bidder: Quality Enterprises USA, Inc.

Street Address: 3494 Shearwater Street

City, State, Zip Code: Naples, Florida 34117-8414

Website: WWW.QEUSA.COM

Contact: Louis J. Gaudio Phone: 239-435-7200 Mobile: 239-207-0660

Email Address: LGAUDIO@QEUSA.COM

Is the address of the business listed above a: (Please circle one listed below)

[✓ Main Office] Regional Office Branch Office

When Organized: August 2, 1973

When and Where Incorporated: August 2, 1973 in Virginia

Licensed or Registered To Do Business in State of South Carolina: X Yes ______No

If No, In What (State) ______________Municipality does your Company Have A Business License?_

Business License Number for Said (State) ________________Municipality:____________________

Federal Employer I.D. Number: 54-0947002

If Partnership, list all partners and their addresses:

If there is no (State) South Carolina Partner, give name and address of agent for service of process in (State) South Carolina.

______________________ ____
______________________ ____
______________________ ____
______________________ ____

If an individual owner is not a (State) South Carolina resident, give name and address of agent for service of process in (State) South Carolina.

______________________ ____
______________________ ____
______________________ ____
______________________ ____

Is your company: (Please circle one listed below) **No**

MBE WBE DBE MBE/WBE/DBE Certified by:_______________________________________

Has your company or any of its principals ever petitioned for bankruptcy, failed in business, defaulted or been terminated on a contract awarded to you?

______ Yes __X__ No

Has your company ever been banned or otherwise precluded from pursuing public work or have ever been found to be non–responsive by a public agency?

______ Yes __X__ No

Has your company ever had a claim made against it for improper, delayed, or non–compliant work or failure to meet warranty obligations?

______ Yes __X__ No

Is your company or any of its owners, officers, or major shareholders currently involved in any arbitration or litigation?

______ Yes __X__ No

Does your company have any outstanding judgments or claims against it?

______ Yes __X__ No

Is your company currently involved or has been involved in the last 3 years with any litigation?

______ Yes __X__ No

Has your organization ever failed to complete any work awarded to it?

______ Yes __X__ No

If yes to any of the above questions, please explain:

Please list any litigation brought against your company in the past five (5) years asserting that you failed to make payments to anyone.

None

Has your company ever had a contract terminated for any reason?

____ Yes X No

If Yes, please explain:

List the geographical areas in which you work: Alabama, Florida, Georgia, Louisina, Mississippi, North Carolina, South Carolina, Virginia

List the areas of work that you normally perform with your own forces: Underground Utilities, Horizontal Directional Drills and Lift Stations, Earthwork, Storm Drainage, Petroleum Work, Mechanical Dredging, Roadway Construction, Concrete Sidewalks & Curbs, Pile Driving Bridge and Aviation Construction

What percentage of the Company's work is normally subcontracted? 5 %

What is the largest contract your company has completed?

Amount $ 35,568,000 Year 2013

Project Name / Scope / Contact Information

* IDIQ Storm Drainage Reduction Projects Along Coastal Mississippi

* Dredging of Canals, Beach Renourishment, Gabion Baskets & Plantings

US Army Corp - Nathan Lovelace, 251-802-2010

Should the work require compliance with the (State) South Carolina State Construction Licensing Board Rules and Regulations, the Contractor and any Subcontractor shall list the appropriate License number(s):

Main Contractor's License Number: G97783

Subcontractor #1 License Number: 98632

Subcontractor #1 Name: Eadies Construction Inc.

Subcontractor #2 License Number: COA 1509 and 1066640

Subcontractor #2 Name: Whitaker Lab & Engineering

Subcontractor #3 License Number: N/A

Subcontractor #3 Name:

(List additional if appropriate)

Year Firm Established:

2. EXPERIENCE

How many years have you been engaged in the contracting business under your present firm or trade name? 27

List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration or license numbers, if applicable.
South Carolina - Building -BD5, Asphalt Paving - AP5, Concrete Paving - CP5, Bridges - BR5,
Grading - GD5, Highway Incidential - HI5, Highway - HY5, Marine - MR5, Water & Sewer Lines - WL5

Current Employment (Numbers of Employees): Total: 175

Management: 15
Clerical: 5
Professional:
Technical: 7
Skilled Labor: 111
Common Labor: 37

Total Value of Projects Completed (last five years): $ 226,551,587

A. Contracts On Hand

Project Name and Location	Owner Name Address Phone No.	Project Description	Bid $	Actual $	Anticipated Completion Date
Ben Sawyer ICW Watermain Mt. Pleasant, SC	Charleston Water Sys 103 St Phillips St Charleston, SC 843-727-6800	Installation of 5300 LF of 18" Watermain by directional drill & open cut, elect.	$7,405,755.00	On Budget	December 2021
PS007 Forcemain Monks Corner, SC	Berkeley County 212 Oakley Plantation Monks Corner, SC 843-719-2316	Installation of 10,000 LF of 18" Forcemain by open cut and directional drill	$2,541,548.00	On Budget	March 2022
DB Veterans Mem Blvd Naples, Florida	Collier County 2885 S Horseshoe Dr Naples Fl 239-252-5844	Construction of new 4 lane roadway with storm piping, signalization and landscaping	$10,065,000.00	On Budget	September 2022
DB Whippoorwill Rd Naples, Fl	Collier County 2885 S Horseshoe Dr Naples Fl 239-252-5844	Construction of new roadway with 4 roudabouts, storm piping and signalization	$4,720,450.00	On Budget	November 2022
East Naples Dredge Naples, Fl	City of Naples 295 Riverside Circ Naples, Fl 239-213-5003	Removal of rock and sediment from various canals	$3,245,000.00	On Budget	September 2022

B. Selected Similar Construction Project Examples

At Least Five (5) Projects Similar in Nature:

Project Name and Location	Owner Name Address Phone No.	Project Description	Bid $	Actual $	Completion Date
Smokehouse Bridge Marco Island, Fl	City of Marco Island 50 Bald Eagle Dr Marco Island, Fl 239-825-9554	Replacement of 2 pile supported bridges and associated roadway	$8,625,327.00	$8,692,839.00	March 2017
Hope Hospice Ft Myers, Fl	Center for Hope 9470 Healthcare Park Ft Myers, Fl 239-489-9140	Development of 50 Ac site, incl all utilities, roadway, lighting and landscaping	$9,700,000.00	$9,998,717.00	April 2020
West Harns Marsh Ph III Lehigh Acres, Fl	Lehigh Acres MSID 601 E County Lane Lehigh Acres, Fl 239-292-7491	Installation of storm pipe culverts, headwalls, weir gates & pedestrian bridge	$2,300,500.00	$2,300,500.00	March 2021
DB I75 Utility Relocation Naples, Fl	Collier County 3339 Tamiami Tr E Naples, Fl 239-315-2181	Installation of over 20,000 ft of watermain by open cut and directional drill	$12,515,323.00	$12,418,400.00	September 2021
DB Logan-Immokalee Forcemain Naples, Fl	Collier County 3339 Tamiami Tr E Naples, Fl 239-877-8338	Installation of over 21,000 lf of 24" HDPE forcemain by open cut and directional drill	$9,858,072.00	$9,838,072.00	June 2021

Has your company or your proposed subcontractors ever completed projects that included the following:

[List] Yes____No____

[List] Yes____No____

[List] Yes____No____

[List] Yes____No____

[List] Yes____No____

C. Safety Issues Disclosure:

Contractor's Experience Modification Rate (EMR):
List Safety Issues for Last Five Years:

2021 - 1.18
2020 - 1.53
2019 - 1.38
2018 - .99
2017 - .73

In 2019 there was a fatal accident on a QE project and it was determined by OSHA that QE was not at fault and no citation was issued.

List Major Equipment Proposed To Be Used For This Project:

Description	Make/Model	Owned by Bidder or Sub?	Year Purchased
See Attached		Yes ___ No ___	
		Yes ___ No ___	
		Yes ___ No ___	
		Yes ___ No ___	
		Yes ___ No ___	
		Yes ___ No ___	
		Yes ___ No ___	
		Yes ___ No ___	
		Yes ___ No ___	

D. Proposed Superintendent for this Project:

Name: Wesley Shipp

Address: 500 Preserve Avenue East, Port Royal, SC 29935

E. Select Project Experience of the Superintendent:

Project Name and Location	Owner Name Address Phone No.	Project Description	Bid $	Actual $	Completion Date
Ben Sawyer ICW Watermain Mt. Pleasant, SC	Charleston Water Sys 103 St Phillips St Charleston, SC 843-727-6800	Installation of 5300 LF of 18" Watermain by directional drill & open cut, elect.	$7,405,755.00	On Budget	December 2021
Walterboro Airport Comprehensive Airfield Drainage Walterboro, SC	Walterboro Airport 537 Aviation Way, Walterboro, SC 843-549-2549	Clearing, earthwork, storm pipe installation and pavement repairs	$3,358,210.00	$3,514,482.00	October 2020
Rhiner Dr Roadway Rehab Hilton Head Island, SC	Town of Hilton Head One Town Center Ct Hilton Head, SC 843-341-4600	Rehab of roadway - earthwork, storm piping and paving	$293,858.00	$293,858.00	January 2018
West Harns Marsh Ph III Lehigh Acres, Fl	Lehigh Acres MSID 601 E County Lane Lehigh Acres, Fl 239-292-7491	Installation of storm pipe culverts, headwalls, weir gates & pedestrian bridge	$2,300,500.00	$2,300,500.00	March 2021
Hope Hospice Ft Myers, Fl	Center for Hope 9470 Healthcare Park Ft Myers, Fl 239-489-9140	Development of 50 Ac site, incl all utilities, roadway, lighting and landscaping	$9,700,000.00	$9,998,717.00	April 2020

3. REFERENCES

Name of your Bank: Old Point National Bank

Address: 1812 Granby Street, Norfolk, VA 23517

Phone: 757-325-6177 Contact Person: Mike Galvin

Amount of line of credit: $3,000,000 Amount Available: $3,000,000

Bonding Company: Fidelity and Deposit Company of Maryland

Address: 1299 Zurich Way, 5th Floor, Schaumburg, IL 60196

Contact Person: Larry White Phone: 847-605-6000

Bonding Company's Rating: A+

Bonding Capacity: Per Job $ 75,000,000 Aggregate $ 150,000,000

Date of Last Bond: October 11, 2021 Bond Amount $ 1,707,271.13

Bond Rate: 1.5% Remaining Bonding Capacity $ 94,000,000

Please list the persons or entities that provide indemnification to your Surety:
Quality Enterprises USA, Inc. and Quality Environment Company, Inc.

List three of your major suppliers:

A. Company: Ferguson Waterworks
Address: 17323 Jean Street, Fort Myers, FL
Phone: 239-850-3553 Fax:
Contact: Tyler Evenson

B. Company: Core & Main
Address: 4750 Laredo Avenue, Fort Myers, FL
Phone: 239-590-5655 Fax:
Contact: Greg Stacy

C. Company: Fortiline
Address: 4810 Laredo Avenue, Ft. Myers, FL
Phone: 859-321-2804 Fax:
Contact: Aaron Manning

List three Contractors/Owners you do business with:

A. Company: Charleston Water Systems
Address: 103 St. Phillips St., Charleston, SC
Phone: 843-727-6800 Fax:
Contact: James Wilson

B. Company: Collier County
Address: 3339 Tamiami Trail East, Naples, FL 34112
Phone: 239-315-2181 Fax:
Contact: Shon Fandrich

C. Company: Grady Minor
Address: 3800 Via Del Rey, Bonita Springs, FL
Phone: 239-947-1144 Fax:
Contact: Justin Frederiksen

4. SIGNATURE

The Undersigned certifies under oath that the information provided herein is true and sufficiently complete so as not to be misleading. The undersigned also recognizes that the Owner is relying on the accuracy of the information and the responses in deciding the demonstrated competence and qualifications for the type of required work.

The foregoing statement of qualifications is submitted under oath:

Respectfully submitted:

Company Name: Quality Enterprises USA, Inc.

Street Address: 3494 Shearwater Street

City, State, Zip: Naples, Florida 34117-8414

By (Signed):

By (Typed): Louis J. Gaudio

Title: Vice President

Attach satisfactory evidence of the authority of the officer, or officers, signing on behalf of a corporation.

SWORN to before me this

10th Day of November, 20 21

(SEAL)

Notary Public for State of Florida

My Commission Expires: 2/11/22

MARCIE L. COHEN
MY COMMISSION # GG 152066
EXPIRES: February 11, 2022
Bonded Thru Notary Public Underwriters

Attest:

Allison B. Murrell, Chief Information Officer/
Assistant Secretary

Incorporated in the State of Virginia

UNANIMOUS WRITTEN CONSENT IN LIEU OF THE 2021 ANNUAL MEETING OF THE BOARD OF DIRECTORS OF QUALITY ENTERPRISES USA, INC.

The undersigned, being all the directors of Quality Enterprises USA, Inc. (the "Corporation"), pursuant to Virginia Code Section 13.1-685, hereby approve and consent to the following actions in lieu of the Annual Meeting of the Board of Directors:

WAIVER OF NOTICE: Execution of this Written Consent will constitute full waiver of notice of the Annual Meeting of the Board of Directors of the Corporation for the year 2021.

ELECTION OF OFFICERS: The following persons are elected to the offices following their names to serve until the expiration of their terms at the next annual meeting of the Board of Directors, or until their successors shall be duly elected and qualified:

Howard J. Murrell, Jr.	President
Louis J. Gaudio	Vice President
Allison B. Murrell	Chief Information Officer/Asst Secretary
Rachel S. Murrell	Director of Risk Management
Howard J. Murrell, III	Construction Technology Manager
Stacey L. Murrell	Secretary

WHEREAS, the Directors believe it is in the best interest of the Company to grant, without limitation, signing authority and the authority to conduct business on behalf of the Company to each of the following Officers:

Howard J. Murrell, Jr., President

WHEREAS, the Directors believe it is in the best interest of the Company to grant authority to enter into and sign contracts on behalf of the Company to each of the following Officers:

Louis J. Gaudio	Vice President
Allison B. Murrell	Chief Information Officer/Asst Secretary
Rachel S. Murrell	Director of Risk Management
Howard J. Murrell, III	Construction Technology Manager
Stacey L. Murrell	Secretary

RATIFICATION: All acts taken on behalf of the Corporation by the Corporation's officers since the last meeting of the Board of Directors are hereby ratified and approved.

MINUTES: This Unanimous Consent shall be filed with and become a part of the Minutes of the Corporation.

Effective date: January 1, 2021

1/1/21
Date signed

Howard J. Murrell, Jr.

QUALITY
ENTERPRISES

Subcontractors:

Quality Control- Whitaker Lab & Engineering 2500 Tremont Road, Savannah, Georgia 31405 License# COA1509 or 1066640

Established in 1970 by Joe Whitaker, Whitaker Laboratory's early days focused primarily on testing asphalt on state highways and city streets as Savannah expanded to the suburbs.

Utilities-Eadies Construction Inc, 1513 SC-61, Ridgeville, SC 29472 License #98632

In 1989 Keith Eadie started Eadie's Construction to specialize in Industrial / Municipal Drain & Vacuum work. As the work and need grew so did the company. In 1996 Keith added a new utility construction and repair division. Then in 1998 Eadie's Construction became Eadie's Construction Company, Inc.

Suppliers:

Pipe material supplier- Fortiline Waterworks, 4301 Arco Lane, North Charleston, SC 29418

Fortiline's Municipal Group strives to be the most trusted vendor to any Federal, State or Local agency customer by providing unparalleled knowledge, superior service and a wide array of products.

Storm Structure supplier- Knight's Precast, P.O. Box 3408, Summerville, SC 29484

Knight's Precast is certified by SCDOT, GDOT and our quality control team is certified by the American Concrete Institute. Our Summerville, SC plant recently celebrated its 10th consecutive year as an NCPA certified plant, while our Richmond Hill, GA plant was NPCA certified for its first year.

QE Heavy Equipment List

Equipment Code	Description	Make	Model	Year
01-022	Volvo ECR58D Excavator	Volvo	ECR58D	2014
01-023	Volvo ECR88D Excavator	Volvo	ECR88D	2013
01-025	Volvo ECR58D Excavator	Volvo	ECR58D	2014
01-026	CAT 336EL Excavator	CAT	CAT336EL	2014
01-029	Volvo ECR58D Compact Excavator	Volvo	ECR58D	2014
01-030	CAT 349FL Hydraulic Excavator	CAT	349FL	2014
01-033	CAT 321DLCR Hydraulic Excavator	CAT	321DLCR	2014
01-035	CAT 335FLCR Hydraulic Excavator	CAT	335FLCR	2015
01-036	Volvo ECR88D Excavator	Volvo	ECR88D	2014
01-037	Volvo ECR58D Excavator	Volvo	ECR58D	2015
01-038	Kubota KX057 Excavator	Kubota	KX057-4R3A	2015
01-039	Volvo ECR235EL Crawler Excavator	Volvo	ECR235EL	2015
01-040	CAT 326FL Super Long Reach Excavator	CAT	CAT326FL	2015
01-041	Volvo ECR88D Excavator	Volvo	ECR88D	2016
01-042	CAT 315FLCR Excavator	CAT	315FLCR	2017
01-043	Volvo ECR88D Excavator	Volvo	ECR88D	2016
01-044	Volvo ECR88D Excavator	Volvo	ECR88D	2016
01-045	CAT 336FL Excavator	CAT	CAT 336FL	2018
01-046	CAT 335FLCR Hydraulic Excavator	CAT	CAT 335FLCR	2018
01-047	CAT 335FLCR Hydraulic Excavator	CAT	CAT 335FLCR	2018
01-048	CAT 325FLCR Track Excavator	CAT	CAT 325FLCR	2018
01-049	CAT 323 Hydraulic Excavator	CAT	CAT 323	2018
01-050	CAT 335FLCR Compact Excavator	CAT	CAT 335FLCR	2018
01-051	Kubota KX080 Excavator	Kubota	KX080-4SR3	2018
01-052	Kubota KX080 Excavator	Kubota	KX080-4SR3	2018
01-053	CAT 330F Hydraulic Excavator	CAT	330F	2019
01-054	CAT 335FLCR Excavator	CAT	335FLCR	2019
01-055	Kubota KX080 Excavator	Kubota	KX080-4SR3A	2019
01-056	CAT 323 Hydraulic Excavator	CAT	323-07	2019
01-057	CAT 336 Hydraulic Excavator	CAT	336-07	2019
01-058	CAT 308 Hydraulic Excavator	CAT	CAT 308E2CRSB	2019
01-059	CAT 336 Hydraulic Excavator	CAT	336-07A	2020
01-060	CAT 320 Excavator	CAT	320	2019
01-061	CAT 320 Excavator	CAT	320	2019
01-062	CAT 320 Excavator	CAT	320	2020
01-063	CAT 320 Excavator	CAT	320	2020
01-064	CAT 352 Excavator	CAT	352	2020
01-065	CAT 320 Excavator	CAT	320	2020
01-066	CAT 395 Excavator	CAT	395-07	2021
01-067	CAT 395 Excavator	CAT	395	2021
01-068	CAT 335 Excavator	CAT	335-07	2021
02-007	JD4120 Farm Tractor	John Deere	JD4120	2012
02-016	Volvo L70E Loader	Volvo	L70E	2006
02-017	CAT 930 Loader	CAT	930K	2013

QE Heavy Equipment List

02-018	Volvo L70 Loader	Volvo	L70G	2013
02-020	Volvo L30GS Loader	Volvo	L30GS	2014
02-021	Volvo L70G Wheel Loader	Volvo	L70G	2014
02-025	Volvo L30GS Loader	Volvo	L30GS	2014
02-026	CAT 938 Loader	CAT	938	2014
02-028	CAT 938K Wheel Loader	CAT	938K	2014
02-029	CAT 938K Wheel Loader	CAT	938K	2014
02-031	Volvo L120H Wheel Loader	Volvo	L120H	2014
02-032	CAT 938K Wheel Loader	CAT	938K	2015
02-033	Volvo L30GS Loader	Volvo	L30GS	2017
02-034	Volvo L30GS Loader	Volvo	L30GS	2017
02-035	CAT 980M Wheel Loader	CAT	980M	2018
02-036	CAT 938M Wheel Loader	CAT	938M	2018
02-037	CAT 938M Wheel Loader	CAT	938M	2018
02-038	Volvo L30GS Wheel Loader	Volvo	L30GS	2018
02-039	Volvo L30GS Wheel Loader	Volvo	L30GS	2018
02-040	CAT 962M Wheel Loader	CAT	962M	2019
02-041	CAT 962M Wheel Loader	CAT	962M	2019
02-042	CAT 982M Wheel Loader	CAT	982M	2018
02-043	Kubota SVL95 Skid Steer	Kubota	SVL95-2SHFC	2018
02-045	CAT 950GC Wheel Loader	CAT	950GC	2019
02-046	Kubota SVL95 Skid Steer	Kubota	SVL95-2SHFC	2019
02-047	Kubota SVL95 Skid Steer	Kubota	SVL95-2SHFC	2019
02-048	CAT 918 Wheel Loader	CAT	918 M	2018
02-049	Kubota SVL95 Skid Steer	Kubota	SVL95-2SHFC	2020
02-050	Kubota SVL95 Skid Steer	Kubota	SVL95-2SHFC	2020
02-051	CAT 908M Wheel Loader	CAT	908M	2019
02-052	CAT 908M Wheel Loader	CAT	908M	2019
03-005	CAT D6NLGP Dozer	CAT	D6NLGP	2016
03-006	CAT D6KLGP Dozer	CAT	D6KLGP	2017
03-007	CAT D6NLGP Dozer	CAT	D6NLGP	2018
03-008	CAT D6-20XEVP Dozer	CAT	D6-20XEVP	2021
04-003	CAT 12M3 Motor Grader	CAT	12M3	2015
04-004	CAT 160 Motor Grader	CAT	160-15AWD	2021
04-005	CAT 160 Motor Grader	CAT	160-15AWD	2021
05-002	Bomag Vibratory Roller	Bomag	BW213-D	2005
05-008	Hypac 9 Wheel Roller	Hypac	C-530AH	2002
05-009	Bomag 138 Roller	Bomag	138	2014
05-010	Bomag 211D Roller	Bomag	211D	2014
05-011	CAT CS54B Vibratory Compactor Roller	CAT	CS54B	2016
05-012	CAT CS54B Vibratory Compactor Roller	CAT	CS54B	2016
05-013	CAT CB22B Asphalt Compactor Roller	CAT	CB22B	2017
05-014	CAT CB22B Asphalt Compactor Roller	CAT	CB22B	2017
05-015	CAT CW34 Pneumatic Tire Compactor	CAT	CW34	2018
05-016	CAT CB13 Double Drum Asphalt Roller	CAT	CB13	2018
05-017	CAT CB10 Asphalt Compactor	CAT	CB10	2018

QE Heavy Equipment List

05-018	HAMM Tandem Roller	Linder	HAMM	2018
05-019	HAMM H13i VIO Roller	Hamm	H13i VIO	2018
05-020	HAMM GRW 180 Pneumatic Roller	Hamm	GRW 180	2018
05-021	HAMM HD120 iVO Roller	Hamm	HD120 iVO	2016
06-002	Manitowoc Crawler Crane	Manitowac	999	2009
06-003	Mantis Crawler Crane	Mantis	GTC1200	2015
06-050	Ice Vibratory Hammer Power Unit	ICE	44B	2014
07-001	CAT 745 Articulated Off Road Truck	CAT	745	2019
07-002	CAT Hydrema 912FHM Off-Road Dump Truck	CAT	912FHM	2019
07-003	CAT 745 Articulated Off Road Truck	CAT	745	2020
07-004	CAT Hydrema 912HM Articulated Truck	CAT	912HM	2021
07-005	CAT 745 Articulated Off Road Truck	CAT	745-04	2021
08-001	Ditch Witch JT100 Drill	Ditch Witch	JT100	2016
08-002	American Auger DD-440T Track-Mounted Directional Drill	American Auger	DD-440T	2018
08-003	American Auger DD-440T	American Auger	DD-440T	2020
08-004	American Auger DD1100RS	American Auger	DD1100RS	2019
09-001	Grundoram Pipe Ramming System	Grundoram	Pipe Ramming	2016
09-002	618 Fusing Machine	McElroy	618	2016
09-003	Grundomat Piercing Tool	Grundomat	Piercing Tool	2017
09-004	12"-36" T900 Fusing Machine	McElroy	T900 (AT9028001)	2018
09-005	McElroy T1200 Fusing Machine 16"-48"	McElroy	T1200	2020
12-003	Toro 36" Walk-Behind Broom	Toro	Walk-Behind Broom	2014
12-004	Broce CT350 Broom Tractor	Broce	CT350	2015
12-005	Massey Ferguson Broom	Ferguson	4608	2015
12-006	Massey Ferguson Broom Tractor	Ferguson	MF4607M	2015
13-001	Skyjack Scissor Lift	Skyjack	SJ3220	1997
13-003	JLG 80' Manlift	JLG	800AJ	2006
13-004	JLG 40-46' Manlift	JLG	E400AJP Narrow	2020
20-007	Doosan 185 Air Compressor	Doosan	CL185WKUB-EX-T2	2013
21-001	CAT 25 Forklift	CAT	GC25	1997
21-003	CAT 50 Forklift	CAT	P5000D	2004
21-005	CAT 560 Telehandler Forklift	CAT	TH5560B	2004
21-007	CAT 1255D Telehandler	CAT	TL 1255D	2021
22-001	4000 Watt Towable Light Tower	Wacker Neuson	MLTDA7	2005
22-003	4000 Watt Towable Light Tower	Wacker Neuson	LTN6K	2014
22-004	4000 Watt Towable Light Tower	Wacker Neuson	LTN6K	2014
22-005	4000 Watt Towable Light Tower	Wacker Neuson	LTV6K	2017
22-006	4000 Watt Towable Light Tower	Wacker Neuson	LTV6K	2017
22-007	Allmand Night-Lite PRO Portable Light Tower	Allmand	PRO	2020
22-008	Allmand Night-Lite PRO Portable Light Tower	Allmand	PRO	2020
22-009	Allmand Night-Lite PRO Portable Light Tower	Allmand	PRO	2020
24-005	Lincoln Vantage 400 Welding Machine	Lincoln	K2410-3	2010
24-009	Lincoln Vantage 600 Welding Machine	Lincoln	VANTAGE 600	2012
24-010	Lincoln Vantage 600 Welding Machine	Lincoln	VANTAGE 600	2012

QE Heavy Equipment List

24-011	Lincoln Vantage 300 Welding Machine	Lincoln	VANTAGE 300	2012
24-012	Miller 252 Welder	Miller	MILLERMATIC 252	2017
24-013	Miller 400 Welder	Miller		2021
24-014	Miller 400 Welder	Miller		2021
25-001	Holland Hydraulic Submersible Pump	Holland	1104-11-1051	2004
25-002	Holland Hydraulic Submersible Pump	Holland	08-1104-44-1069	2005
25-004	Godwin 12" Dri Prime Diesel Pump	Godwin	CD300M	2010
25-006	Thompson 8" Well Point Pump	Thompson	801-C/ V.1138 TYPE	2006
25-007	Thompson 8" Well Point Pump	Thompson	801-C/ V.1112 TYPE	2006
25-008	Thompson 8" Well Point Pump	Thompson	801-C/ V.1143 TYPE	2006
25-010	Skid-Mounted Power Pack Unit	D&D Machine&Hydraul	800D	2014
25-011	Thompson Hydraulic Pump	Thompson	Hydraulic Pump	2014
25-012	Thompson Hydraulic Pump	Thompson	Hydraulic Pump	2014
25-014	Thompson 6" Hydraulic Submersible Pump	Thompson	32HPU	2016
25-015	Thompson 6" Hydraulic Submersible Pump	Thompson	32HPU	2016
25-016	Godwin 6" Dri-Prime Diesel Pump	Godwin	CD150M	2017
25-017	Godwin 6" Dri-Prime Diesel Pump	Godwin	CD150M	2017
25-018	Godwin Pump	Godwin	CD100M	2014
25-019	P-750 Mud Pump	American Auger	P-750	2018
25-020	Godwin 6" Dri-Prime Diesel	Godwin	CD150S	2020
25-021	Godwin 6" Dri-Prime Diesel	Godwin	CD150S	2020
25-022	MAC Pump PPSI 400	MAC	PPSI 400	2021
25-023	MAC Pump PPSI 400	MAC	PPSI 400	2021
25-024	MAC Pump PPSI 400	MAC	PPSI 400	2021
33-003	Gravely 250 Z-Turn Lawn Mower	Gravely	260	2014
33-004	Kubota Utility Vehicle	Kubota	RTV-X1140WL-H	2020
33-005	Kubota Utility Vehicle	Kubota	RTV-X1120WL-H	2021
33-006	Kubota Utility Vehicle RTV	Kubota	RTVX1140WLH	2021
33-009	Gravely Z-Turn Lawn Mower	Gravely	PRO TURN 252	2012
34-029	Tommy Silt Fence Machine	Tommy	N/A	
35-005	Curb-Tec Concrete Curb Machine	Curb-Tec	CT3000C	2004
35-006	MQ Super Screed	MQ	WRS-3200	2007
35-007	Gomaco Work Bridge Machine	Gomaco	4000 Series/ Spaint	2006
35-008	MQ 8HP Concrete Finisher	MQ	B-4-8H	
35-009	MQ 8HP Concrete Finisher	MQ	B-4-8H	
35-010	Multi Quip Finishing Machine	Multiquip	BA4-8H	2006
35-011	Terramite Roller Finisher - No Drum	Terramite	SCREED	
35-013	Concrete Vibre Strike Tool	Lindley	LINDLEY MFG	
35-016	Powerscreen MGLEX1 Handyscreen	Powerscreen	MGLEX1	2014
35-017	Terex-Bidwell 4800 Bridge Deck Paver	Terex-Bidwell	4800	2015
35-018	Metso LT1213 Lokotrack Crusher	Metso	LT1213	2018
35-019	Metso Lokotrack Mobile Screener	Metso	ST3.8	2018
35-020	Metso LT1213S Lokotrack Crusher	Metso	LT1213s	2018
35-021	Sandvik Screener	Sandvik	QE441	2018
35-022	Powerscreen M85 Stacker/Conveyor - 65'	Powerscreen	M85	2010

QUALITY ENTERPRISES

QE Heavy Equipment List

35-023	McCloskey ST80T Track Stacker/Conveyor - 80'	McCloskey	ST80T	2019
35-024	Sandvik Screener	Sandvik	QA441	2019
35-025	Powerscreen MGLEX1 Screen	Powerscreen	MGLEX1	2016
35-026	Superior 36"x18' Coarse Material Washer	Mellott	Superior Washer	2019
35-027	Fastway 210 Portable Silo	Fastway	210	2019
35-028	Kleemann KT80 80' Stacker	Kleemann	KT80	2019
35-029	Holcombe Silo	Holcombe	350BBL	
38-001	Blaw-Knox Hot Tack Wagon	Blaw-Knox	HT-540	2002
38-003	Wirtgen W150 Milling Machine	Wirtgen	W150	2012
38-004	CAT 1055F Asphalt Paver	CAT	AP1055F	2018
38-005	Weiler E2850A Shuttle Buggy	Weiler	E2850A	2018
38-006	Weiler P385B Asphalt Paver	Weiler	P385B	2019
38-007	Wirtgen W200i Milling Machine	Wirtgen	W200i	2018
38-008	Weiler P385B Asphalt Paver	Weiler	P385 B	2019
38-009	Wirtgen WR 200XLi Soil Stabilizer	Wirtgen	WR 200 XLi	2020
39-008	Hopper Barge	Hopper	Barge	2014
39-009	Hopper Barge	Hopper	Barge	2014
40-005	Oquawka Flat Bottom Boat	Oquawka	1660	2009
40-007	Premier Pontoor Boat	Premier	VA-7911BA	2003
40-008	Tracker Boat	Tracker	Boat	2015
40-009	PUSH BOAT	Madison Boat & Barge	PUSH BOAT	2019
40-010	Barge	Madison Boat & Barge	SECTIONAL BARGE	2020
51-001	Md4-3000 Drone	Microsdrones	MDR-3000	2021
51-002	Mavic 2 Pro Drone	Mavic		2021
90-004	Chevrolet 2500 LT	Chevrolet	Suburban 4X4	2002
90-006	Ford Explorer	FORD	Explorer	2002
90-027	GMC 2500 Crewcab	GMC	2500 Sierra 4X4	2008
90-029	GMC 2500 Crewcab	GMC	2500 Sierra 4X4	2008
90-031	Mercedes Sprinter Van	Mercedes	2500	2010
90-033	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2014
90-034	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2014
90-035	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2014
90-036	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2014
90-040	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2014
90-043	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2015
90-046	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2015
90-049	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2016
90-050	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2016
90-051	Dodge Ram 1500	Dodge	1500 SLT Crewcab	2016
90-052	Dodge Ram Promaster 2500	Dodge	2500 High Roof 136WB	2016
90-053	Dodge Ram Promaster 2500	Dodge	2500 High Roof 136WB	2016
90-054	Ford F250 Pickup	Ford	F-250	2017

QUALITY
ENTERPRISES

QE Heavy Equipment List

90-055	Honda Ridgeline	Honda	Ridgeline	2018
90-056	Honda Ridgeline	Honda	Ridgeline	2018
90-057	Honda Ridgeline	Honda	Ridgeline	2018
90-058	Honda Ridgeline	Honda	Ridgeline RTL-T	2019
90-059	Honda Ridgeline	Honda	Ridgeline	2019
90-060	Honda Ridgeline	Honda	Ridgeline	2019
90-061	Camera Truck Mercedes Sprinter Van	Mercedes	Sprinter Van	2019
90-062	Mercedes Sprinter Van	Mercedes	Sprinter Van	2020
90-063	Honda Ridgeline	Honda	Ridgeline	2021
91-003	Dodge Ram 3500 Crewcab	Dodge	Dually	2014
91-019	Dodge Ram 5500	Dodge	Utility Body w/ Lift	2014
91-020	Dodge Ram 5500	Dodge	Utility Body w/ Lift	2014
91-021	Dodge Ram 5500	Dodge	Utility Body w/ Lift	2015
91-022	Dodge Ram 3500	Dodge	Utility Body	2015
91-023	Isuzu NPR XD	Isuzu	Flatbed Concrete	2015
91-024	Dodge Ram 5500	Dodge	Flat Bed	2016
91-025	Dodge Ram 3500	Dodge	Utility Body 4x4	2016
91-026	Dodge Ram 3500	Dodge	Utility Body w/ Lift	2016
91-027	Dodge Ram 5500	Dodge	Utility Body w/ Lift	2016
91-031	Dodge Ram 5500	Dodge	Utility Body w/ Lift	2016
91-032	Dodge Ram 5500	Dodge	4X4	2016
91-033	Dodge Ram 5500	Dodge	Utility Body w/ Lift	2017
91-034	Dodge Ram 5500	Dodge	Utility Body w/ Lift	2017
91-035	Dodge Ram 5500	Dodge	4x4	2017
91-036	Dodge Ram 5500	Dodge	Flat Bed	2017
91-037	Dodge Ram 5500	Dodge	Utility Body	2018
91-038	Dodge Ram 5500	Dodge	Utility Body	2018
91-039	Dodge Ram 5500	Dodge	Utility Body	2018
91-040	Dodge Ram 5500	Dodge	Utility Body	2018
91-041	Dodge Ram 3500	Dodge	Utility Body	2018
91-042	Dodge Ram 3500	Dodge	Utility Body	2018
91-043	Dodge Ram 3500	Dodge	3500	2019
91-044	Dodge Ram 3500	Dodge	3500	2019
91-045	Dodge Ram 3500	Dodge	3500	2019
91-046	Dodge Ram 3500	Dodge	3500 CREW	2019
91-047	Dodge Ram 3500	Dodge	3500 CREW	2019
91-048	Dodge Ram 5500	Dodge	5500	2019
91-049	Dodge Ram 5500 Grout Truck	Dodge	5500	2021
92-004	Ford F-750 Water Truck	Ford	F-750	2007
92-006	Ford F-750 Water Truck	Ford	F-750	2007
92-008	Ford F-750 Water Truck	Ford	F-750	2007
92-009	Ford F-750 Water Truck	Ford	F-750	2007
92-010	Sterling Acterra Water Truck	Sterling	Water Truck	2008
92-011	Kenworth T370 Truck	Kenworth	Mechanic Truck	2016
92-012	Kenworth T370 Lube Truck	Kenworth	Fuel & Lube Truck	2018
92-013	Ford F-650 Truck	Ford	F-650	2017

QE Heavy Equipment List

92-014	Kenworth T370 Etnyre Centennial Tack Truck	Kenworth	Etnyre Centennial	2018
92-015	Kenworth T370 Mechanics Truck	Kenworth	T370	2019
92-017	Kenworth T370 Maintainer Mechanics Truck	Kenworth	T370	2020
92-018	Kenworth T370 SWP Fuel & Lube Truck	Kenworth	T370	2020
92-019	Kenworth Water Truck	Kenworth / Curry	T880	2022
92-020	Kenworth T370 Mini Dump Truck	Kenworth	T370	2022
92-021	Peterbilt Elgin Crosswind Sweeper	Peterbilt	J1	2020
93-004	Mack Tractor	Mack	CHU613	2008
93-010	Mack Service Fuel Truck	Mack	CV713 Granite	2006
93-011	Kenworth T880 Tractor	Kenworth	T880	2016
93-012	Kenworth T880 Dump Truck	Kenworth	T880	2016
93-013	Kenworth T880 Dump Truck	Kenworth	T880	2016
93-014	Kenworth T880 Dump Truck	Kenworth	T880	2016
93-015	Kenworth T470 Boom Truck	Kenworth	T470	2013
93-016	Vactor Vacuum Truck	Kenworth	T880	2017
93-017	Kenworth T880 Dump Truck	Kenworth	T880	2018
93-018	Kenworth T880 Dump Truck	Kenworth	T880	2018
93-019	Kenworth T880 Tractor	Kenworth	T880	2018
93-020	Kenworth T880 Tractor	Kenworth	T880	2020
93-021	Kenworth T880 Dump Truck	Kenworth	T880	2020
93-022	Kenworth T880 Dump Truck	Kenworth	T880	2020
93-023	Kenworth T880 Tractor	Kenworth	T880	2020
93-024	Kenworth Concrete Mixer Truck	Kenworth / Holcombe	T880	2020
93-025	Kenworth Concrete Mixer Truck	Kenworth / Holcombe	T880	2020
93-026	Kenworth T880 Tractor	Kenworth	T880	2020
93-027	Kenworth Concrete Mixer Truck	Kenworth / Holcombe	T880	2022
93-028	Kenworth Concrete Mixer Truck	Kenworth / Holcombe	T880	2022
93-029	Vactor Vacuum Truck	Kenworth	T880	2022
95-012	Wells Cargo Trailer	Wells	MC162-7 ME	2009
95-021	Performance Utility Trailer	Performance	6X12 PUT612E	2003
95-023	Etnyre Lowboy Trailer	Etnyre	PRTN55TD3	2005
95-023A	Nitrogen Stinger	Nitrogen		2016
95-027	Texas Pride Dump Trailer	Texas Pride	DT71414KBP	2013
95-028	Texas Pride Dump Trailer	Texas Pride	DT71414KBP	2013
95-032	Texas Pride Trailer	Texas Pride	Bumper Pull Dump Trl	2014
95-033	Texas Pride Trailer	Texas Pride	Goose Neck Dump Trl	2014
95-034	20' Connex Box	Connex Box	20'	2014
95-037	20' Connex Box	Connex Box	20'	2014
95-038	20' Connex Box	Connex Box	20'	2014
95-039	20' Connex Box	Connex Box	20'	2014

QE Heavy Equipment List

95-040	20' Connex Box	Connex Box	20'	2014
95-042	20' Connex Box	Connex Box	20'	2014
95-043	20' Connex Box	Connex Box	20'	2014
95-044	20' Connex Box	Connex Box	20'	2014
95-045	20' Connex Box	Connex Box	20'	2014
95-046	20' Connex Box	Connex Box	20'	2014
95-047	20' Connex Box	Connex Box	20'	2014
95-048	800 Gallon Wylie Water Wagon	Wylie	EXP-800-S	2015
95-050	Doonan Trailer	Doonan	50' x 102'	2006
95-051	Landoll Trailer	Landoll	440A-53	2016
95-052	20' Connex Box	Connex Box	20'	2016
95-053	20' Connex Box	Connex Box	20'	2016
95-054	20' Connex Box	Connex Box	20'	2016
95-055	20' Connex Box	Connex Box	20'	2016
95-057	Bloomer Gooseneck Trailer	Bloomer	BSTKGS2O7	2016
95-058	Eager Beaver Trailer	Eager Beaver		2017
95-059	20' Connex Box	Connex Box	20'	2016
95-060	20' Connex Box	Connex Box	20'	2016
95-061	20' Connex Box	Connex Box	20'	2016
95-062	20' Connex Box	Connex Box	20'	2016
95-063	20' Connex Box	Connex Box	20'	2016
95-064	20' Connex Box	Connex Box	20'	2016
95-065	20' Connex Box	Connex Box	20'	2016
95-066	20' Connex Box	Connex Box	20'	2016
95-067	Elgin/Ameritrail Mud Recycling Trailer	Ameritrail	GN27-30EHJ	2017
95-068	Big Tex 20' Dump Trailer	Big Tex	20'	2018
95-069	Big Tex 18' Dump Trailer	Big Tex	18'	2017
95-070	Big Tex 20' Dump Trailer	Big Tex	20'	2018
95-071	Fontaine Step Deck Trailer	Fontaine	50'	2019
95-072	Fontaine Step Deck Trailer	Fontaine	50'	2019
95-073	Fontaine Step Deck Trailer	Fontaine	50'	2019
95-074	Fontaine Step Deck Trailer	Fontaine	50'	2019
95-075	Fontaine Step Deck Trailer	Fontaine	50'	2019
95-076	Fontaine Step Deck Trailer	Fontaine	50'	2019
95-077	Trail King Lowboy Trailer	Trail King	50'	2019
95-077A	Trail King Jeep Trailer	Trail King	Jeep	2019
95-077B	Trail King Booster Trailer	Trail King	Booster	2019
95-077C	Trail King Pin on Axle Trailer	Trail King	Pin On Axle	2019
95-078	American Auger MCD-1000 Drilling Fluid Cleaning System	American Auger	MCD-1000	2018
95-079	Dragon 130BBL Tanker Trailer	Dragon Products, LLC	130BBL	2019
95-080	Dragon 130BBL Tanker Trailer	Dragon Products, LLC	130BBL	2019
95-081	Trail King Lowboy Trailer	Trail King	TK110HDG	2018
95-081A	Trail King Pin on Axle Trailer	Trail King	Pin on Axle	2018

QUALITY ENTERPRISES

QE Heavy Equipment List

95-083	Fontaine Step Deck Trailer	Fontaine	50'	2020
95-084	Fontaine Step Deck Trailer	Fontaine	50'	2020
95-085	Fontaine Step Deck Trailer	Fontaine	50'	2020
95-086	Big Tex Covered Wagon Trailer for Line Striping	Big Tex Covered Wagon	CWG85X18TA	2019
95-087	Aldura Aluminum Pneumatic DryBulk Trailer	Aldura	Pneumatic	2020
95-088	Aldura Aluminum Pneumatic DryBulk Trailer	Aldura	Pneumatic	2019
95-089	Fontaine Step Deck Trailer	Fontaine	50'	2020
95-090	Fontaine Step Deck Trailer	Fontaine	50'	2020
95-091	Fontaine Step Deck Trailer	Fontaine	50'	2020
95-092	Fontaine Step Deck Trailer	Fontaine	50'	2020
95-093	Fontaine Step Deck Trailer	Fontaine	50'	2020
95-094	Fontaine Step Deck Trailer	Fontaine	50'	2020
95-095	Dragon 130BBL Tanker Trailer	Dragon Products, LLC	130BBL SD Vac	2020
95-096	Dragon 130BBL Tanker Trailer	Dragon Products, LLC	130BBL SD Vac	2020
95-097	American Auger M-500PD Mud Cleaning Unit	American Auger	M-500PD	2020
95-098	PL6000 Receiving Trailer for Buoyancy Pipe	Spool Trailer	PL6000	2020
95-099	Econoline 31' Tiltbed Trailer	Econoline	DG1031TE	2020
95-100	Econoline 31' Tiltbed Trailer	Econoline	DG1031TE	2020

***** CHECK LICENSE CARD, CERTIFICATE, CLASSIFICATION(S), AND CONTRACT LIMIT FOR ACCURACY *****

LICENSE RENEWALS - YOUR LICENSES EXPIRES ON 10/31/2022. Renewal Information will be sent to the email address on file approximately 3-4 months prior to the expiration date and available on the Board's website at: https://llr.sc.gov/clb. Contact the board if you do not receive a renewal notice at that time.

THIS IS A 2-PART POCKETCARD! FOLD CARD - DO NOT CUT OR TEAR CARD IN HALF!

BOTH PARTS OF THIS POCKETCARD MUST BE PRESENTED TO CONDUCT BUSINESS AT ALL TIMES!

LICENSE NUMBER: G97783 CCB 1058549

South Carolina Department of Labor, Licensing and Regulation
Contractor's Licensing Board
GENERAL CONTRACTOR
QUALITY ENTERPRISES USA INC
3494 SHEARWATER STREET
NAPLES FL 34117-8414

is certified to practice in the following classification(s) and *Group Limit:
Building-BD5, Asphalt Paving-AP5, Concrete Paving-CP5, Bridges-BR5, Grading-GD5, Highway Incidental-HI5, Highway-HY5, Marine-MR5, Water & Sewer Lines-WL5

LICENSE NUMBER: G97783 CCB 1058549

Qualifying Party(s)** (Primary QP displays "PQ"): **HOWARD J MURRELL JR (CQG.5887 PQ)

*** Group Limitations - $Amount Per Job:**
Group #1 - $50,000 **Group #3 - $500,000**
Group #2 - $200,000 **Group #4 - $1,500,000**
Group #5 - $Unlimited

Initial License Date: 07/30/1999
EXPIRATION DATE: 10/31/2022

Additional information about General Contractor Classification Abbreviations and Group Bid/Job Limitations is available on the SC Contractor's Licensing Board website: https://llr.sc.gov/clb

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SOUTH CAROLINA DEPARTMENT OF LABOR, LICENSING AND REGULATION CCB 1058549

CONTRACTOR'S LICENSING BOARD

Hereby Certifies:

QUALITY ENTERPRISES USA INC
3494 SHEARWATER STREET
NAPLES FL 34117-8414

Having given satisfactory evidence of the necessary qualifications required by laws of the State of South Carolina and is duly qualified and entitled to practice as a:

GENERAL CONTRACTOR

for the Classification(s) and Group Limitation* shown below:

Building-BD5, Asphalt Paving-AP5, Concrete Paving-CP5, Bridges-BR5, Grading-GD5, Highway Incidental-HI5, Highway-HY5, Marine-MR5, Water & Sewer Lines-WL5

LICENSE NUMBER:..........G97783
Expiration Date: 10/31/2022
Initial License Date: 07/30/1999

*** Group Limitations - $Amount Per Job:**
Group #1 - $50,000 **Group #3 - $500,000**
Group #2 - $200,000 **Group #4 - $1,500,000**
Group #5 - $Unlimited

Administrator

Qualifying Party(s) (Primary QP displays "PQ"): HOWARD J MURRELL JR (CQG.5887 PQ)

It is at the discretion of the licensee to designate whomever they elect to pull permits and conduct business for this license.

United States
Environmental Protection
Agency

Wastewater Technology Fact Sheet

Sewers, Pressure

DESCRIPTION

Conventional Wastewater Collection System

Conventional wastewater collection systems transport sewage from homes or other sources by gravity flow through buried piping systems to a central treatment facility. These systems are usually reliable and consume no power. However, the slope requirements to maintain adequate flow by gravity may require deep excavations in hilly or flat terrain, as well as the addition of sewage pump stations, which can significantly increase the cost of conventional collection systems. Manholes and other sewer appurtenances also add substantial costs to conventional collection systems.

Alternative

Alternative wastewater collection systems can be cost effective for homes in areas where traditional collection systems are too expensive to install and operate. Pressure sewers are used in sparsely populated or suburban areas in which conventional collection systems would be expensive. These systems generally use smaller diameter pipes with a slight slope or follow the surface contour of the land, reducing excavation and construction costs.

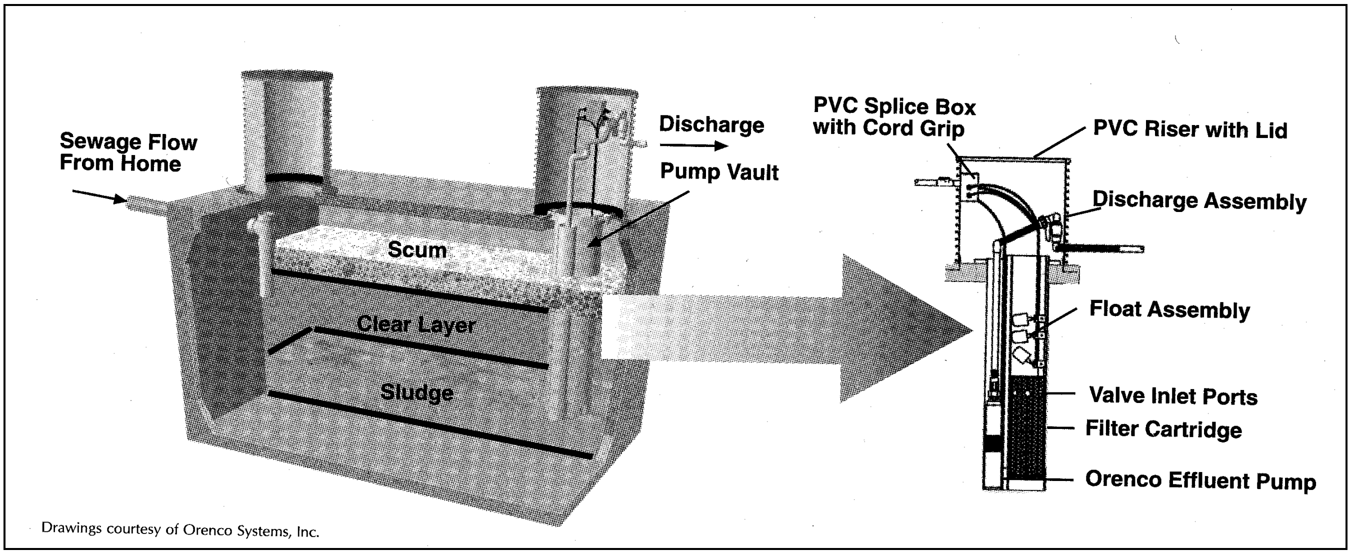
Pressure sewers differ from conventional gravity collection systems because they break down large solids in the pumping station before they are transported through the collection system. Their watertight design and the absence of manholes eliminates extraneous flows into the system. Thus, alternative sewer systems may be preferred in areas that have high groundwater that could seep into the sewer, increasing the amount of wastewater to be treated. They also protect groundwater sources by keeping wastewater in the sewer. The disadvantages of alternative sewage systems include increased energy demands, higher maintenance requirements, and greater on-lot costs. In areas with varying terrain and population density, it may prove beneficial to install a combination of sewer types.

This fact sheet discusses a sewer system that uses pressure to deliver sewage to a treatment system. Systems that use vacuum to deliver sewage to a treatment system are discussed in the *Vacuum Sewers* Fact Sheet, while gravity flow sewers are discussed in the *Small Diameter Sewers* Fact Sheet.

Pressure Sewers

Pressure sewers are particularly adaptable for rural or semi-rural communities where public contact with effluent from failing drain fields presents a substantial health concern. Since the mains for pressure sewers are, by design, watertight, the pipe connections ensure minimal leakage of sewage. This can be an important consideration in areas subject to groundwater contamination. Two major types of pressure sewer systems are the **septic tank effluent pump (STEP)** system and the **grinder pump (GP)**. Neither requires any modification to plumbing inside the house.

In STEP systems, wastewater flows into a conventional septic tank to capture solids. The liquid effluent flows to a holding tank containing a pump and control devices. The effluent is then pumped and transferred for treatment. Retrofitting existing septic tanks in areas served by septic tank/drain field systems would seem to present an opportunity for cost savings, but a large number (often a majority) must be replaced or expanded over the life of the system because of insufficient capacity, deterioration of concrete tanks, or leaks. In a GP system, sewage flows to a vault where a grinder pump grinds the solids and discharges the sewage into a pressurized pipe system. GP systems do not require a septic tank but may require more horsepower than STEP systems because of the grinding action. A GP system can result in significant capital cost



Source: C. Falvey, 2001.

FIGURE 1 TYPICAL SEPTIC TANK EFFLUENT PUMP

savings for new areas that have no septic tanks or in older areas where many tanks must be replaced or repaired. Figure 1 shows a typical septic tank effluent pump, while Figure 2 shows a typical grinder pump used in residential wastewater treatment.

The choice between GP and STEP systems depends on three main factors, as described below:

Cost: On-lot facilities, including pumps and tanks, will account for more than 75 percent of total costs, and may run as high as 90 percent. Thus, there is a strong motivation to use a system with the least expensive on-lot facilities. STEP systems may lower on-lot costs because they allow some gravity service connections due to the continued use of a septic tank. In addition, a grinder pump must be more rugged than a STEP pump to handle the added task of grinding, and, consequently, it is more expensive. If many septic tanks must be replaced, costs will be significantly higher for a STEP system than a GP system.

Downstream Treatment: GP systems produce a higher TSS that may not be acceptable at a downstream treatment facility.

Low Flow Conditions: STEP systems will better tolerate low flow conditions that occur in areas with highly fluctuating seasonal occupancy and those with slow build out from a small initial population to the ultimate design population. Thus, STEP systems may be better choices in these areas than GP systems.

APPLICABILITY

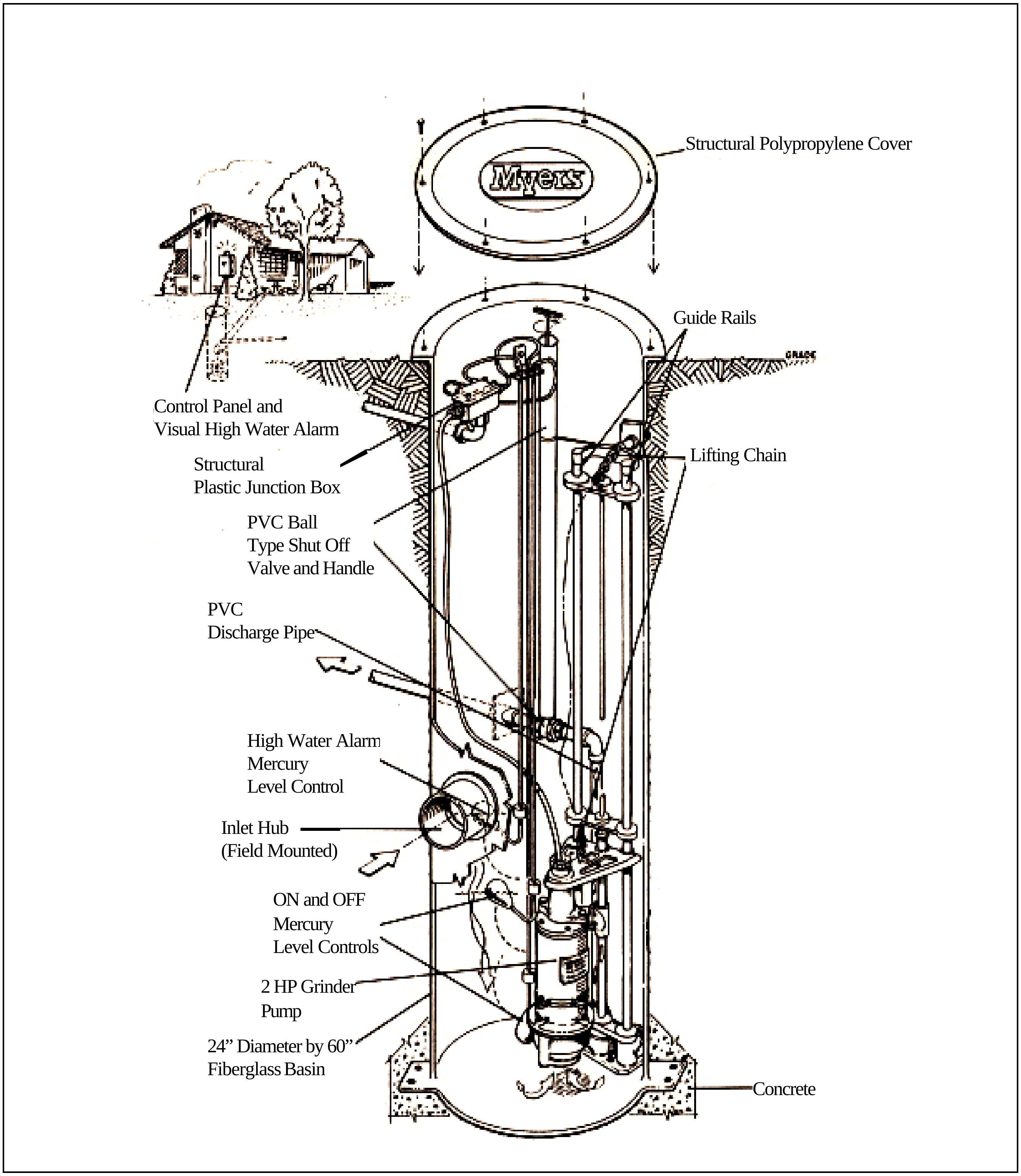
Pressure sewer systems are most cost effective where housing density is low, where the terrain has undulations with relatively high relief, and where the system outfall must be at the same or a higher elevation than most or all of the service area. They can also be effective where flat terrain is combined with high ground water or bedrock, making deep cuts and/or multiple lift stations excessively expensive. They can be cost effective even in densely populated areas where difficult construction or right of way conditions exist, or where the terrain will not accommodate gravity sewers.

Since pressure systems do not have the large excess capacity typical of conventional gravity sewers, they must be designed with a balanced approach, keeping future growth and internal hydraulic performance in mind.

ADVANTAGES AND DISADVANTAGES

Advantages

Pressure sewer systems that connect several residences to a “cluster” pump station can be less expensive than



Source: F.E. Meyers Company, 2000.

FIGURE 2 TYPICAL GRINDER PUMP

conventional gravity systems. On-property facilities represent a major portion of the capital cost of the entire system and are shared in a cluster arrangement. This can be an economic advantage since on-property components are not required until a house is constructed and are borne by the homeowner. Low front-end investment makes the present-value cost of the entire system lower than that of conventional gravity sewerage, especially in new development areas where homes are built over many years.

Because wastewater is pumped under pressure, gravity flow is not necessary and the strict alignment and slope restrictions for conventional gravity sewers can be relaxed. Network layout does not depend on ground contours: pipes can be laid in any location and extensions can be made in the street right-of-way at a relatively small cost without damage to existing structures.

Other advantages of pressure sewers include:

> Material and trenching costs are significantly lower because pipe size and depth requirements are reduced.
>
> Low-cost clean outs and valve assemblies are used rather than manholes and may be spaced further apart than manholes in a conventional system.
>
> Infiltration is reduced, resulting in reductions in pipe size.
>
> The user pays for the electricity to operate the pump unit. The resulting increase in electric bills is small and may replace municipality or community bills for central pumping eliminated by the pressure system.
>
> Final treatment may be substantially reduced in hydraulic and organic loading in STEP systems. Hydraulic loadings are also reduced for GP systems.
>
> Because sewage is transported under pressure, more flexibility is allowed in siting final treatment facilities and may help reduce the length of outfall lines or treatment plant construction costs.

Disadvantages

> Requires much institutional involvement because the pressure system has many mechanical components throughout the service area.
>
> The operation and maintenance (O&M) cost for a pressure system is often higher than a conventional gravity system due to the high number of pumps in use. However, lift stations in a conventional gravity sewer can reverse this situation.
>
> Annual preventive maintenance calls are usually scheduled for GP components of pressure sewers. STEP systems also require pump-out of septic tanks at two to three year intervals.
>
> Public education is necessary so the user knows how to deal with emergencies and how to avoid blockages or other maintenance problems.
>
> The number of pumps that can share the same downstream force main is limited.
>
> Power outages can result in overflows if standby generators are not available.
>
> Life cycle replacement costs are expected to be higher because pressure sewers have a lower life expectancy than conventional systems.

Odors and corrosion are potential problems because the wastewater in the collection sewers is usually septic. Proper ventilation and odor control must be provided in the design and non-corrosive components should be used. Air release valves are often vented to soil beds to minimize odor problems and special discharge and treatment designs are required to avoid terminal discharge problems.

DESIGN CRITERIA

Many different design flows can be used in pressure systems. When positive displacement GP units are used, the design flow is obtained by multiplying the pump discharge by the maximum number of pumps expected to be operating simultaneously. When centrifugal pumps are used, the equation used is $Q= 20 + 0.5D$, where Q is the flow in gpm and D is the number of homes served. The operation of the system under various assumed conditions should be simulated by computer to check design adequacy. No allowances for infiltration and inflow are required. No minimum velocity is generally used in design, but GP systems must attain three to five feet per second at least once per day. A Hazen-Williams coefficient, (C) = 130 to 140, is suggested for hydraulic analysis. Pressure mains generally use 50 mm (2 inch) or larger PVC pipe (SDR 21) and rubber-ring joints or solvent welding to assemble the pipe joints. High-density polyethylene (HDPE) pipe with fused joints is widely used in Canada. Electrical requirements, especially for GP systems, may necessitate rewiring and electrical service upgrading in the service area. Pipes are generally buried to at least the winter frost penetration depth; in far northern sites insulated and heat-traced pipes are generally buried at a minimal depth. GP and STEP pumps are sized to accommodate the hydraulic grade requirements of the system. Discharge points must use drop inlets to minimize odors and corrosion. Air release valves are placed at high points in the sewer and often are vented to soil beds. Both STEP and GP systems can be assumed to be anaerobic and potentially odorous if subjected to turbulence (stripping of gases such as H_2S).

PERFORMANCE

STEP

When properly installed, septic tanks typically remove about 50 percent of BOD, 75 percent of suspended solids, virtually all grit, and about 90 percent of grease, reducing the likelihood of clogging. Also, wastewater reaching the treatment plant will be weaker than raw sewage. Typical average values of BOD and TSS are 110 mg/L and 50 mg/L, respectively. On the other hand, septic tank effluent has virtually zero dissolved oxygen.

Primary sedimentation is not required to treat septic tank effluent. The effluent responds well to aerobic treatment, but odor control at the headworks of the treatment plant should receive extra attention.

The small community of High Island, Texas, was concerned that septic tank failures were damaging a local area frequented by migratory birds. Funds and materials were secured from the EPA, several state agencies, and the Audubon Society to replace the undersized septic tanks with larger ones equipped with STEP units and low pressure sewerage ultimately discharging to a constructed wetland. This system is expected to achieve an effluent quality of less than 20 mg/L each of BOD and TSS, less than 8 mg/L ammonia, and greater than 4 mg/L dissolved oxygen (Jensen 1999).

In 1996, the village of Browns, Illinois, replaced a failing septic tank system with a STEP system discharging to low pressure sewers and ultimately to a recirculating gravel filter. Cost was a major concern to the residents of the village, who were used to average monthly sewer bills of $20. Conditions in the village were poor for conventional sewer systems, making them prohibitively expensive. An alternative low pressure-STEP system averaged only $19.38 per month per resident, and eliminated the public health hazard caused by the failed septic tanks (ICAA, 2000).

GP Treatment

The wastewater reaching the treatment plant will typically be stronger than that from conventional systems because infiltration is not possible. Typical design average concentrations of both BOD and TSS are 350 mg/L (WPCF, 1986).

GP/low pressure sewer systems have replaced failing septic tanks in Lake Worth, Texas (Head, et. al., 2000); Beach Drive in Kitsap County, Washington (Mayhew and Fitzwater, 1999); and Cuyler, New York (Earle, 1998). Each of these communities chose alternative systems over conventional systems based on lower costs and better suitability to local soil conditions.

OPERATION AND MAINTENANCE

Routine operation and maintenance requirements for both STEP and GP systems are minimal. Small systems that serve 300 or fewer homes do not usually require a full-time staff. Service can be performed by personnel from the municipal public works or highway department. Most system maintenance activities involve responding to homeowner service calls usually for electrical control problems or pump blockages. STEP systems also require pumping every two to three years.

TABLE 1 RELATIVE CHARACTERISTICS OF ALTERNATIVE SEWERS

Sewer Type	Slope Requirement	Construction Cost in Rocky, High Groundwater Sites	Operation and Maintenance Requirements	Ideal Power Requirements
Conventional	Downhill	High	Moderate	None*
Pressure				
STEP	None	Low	Moderate-high	Low
GP	None	Low	Moderate-high	Moderate

* Power may be required for lift stations
Source: Small Flows Clearinghouse, 1992.

The inherent septic nature of wastewater in pressure sewers requires that system personnel take appropriate safety precautions when performing maintenance to minimize exposure to toxic gases, such as hydrogen sulfide, which may be present in the sewer lines, pump vaults, or septic tanks. Odor problems may develop in pressure sewer systems because of improper house venting. The addition of strong oxidizing agents, such as chlorine or hydrogen peroxide, may be necessary to control odor where venting is not the cause of the problem.

Generally, it is in the best interest of the municipality and the homeowners to have the municipality or sewer utility be responsible for maintaining all system components. General easement agreements are needed to permit access to on-site components, such as septic tanks, STEP units, or GP units on private property.

COSTS

Pressure sewers are generally more cost-effective than conventional gravity sewers in rural areas because capital costs for pressure sewers are generally lower than for gravity sewers. While capital cost savings of 90 percent have been achieved, no universal statement of savings is possible because each site and system is unique. Table 1 presents a generic comparison of common characteristics of sanitary sewer systems that should be considered in the initial decision-making process on whether to use pressure sewer systems or conventional gravity sewer systems.

Table 2 presents data from recent evaluations of the costs of pressure sewer mains and appurtenances (essentially the same for GP and STEP), including items specific to each type of pressure sewer. Purchasing pumping stations in volume may reduce costs by up to 50 percent. The linear cost of mains can vary by a factor of two to three, depending on the type of trenching equipment and local costs of high-quality backfill and pipe. The local geology and utility systems will impact the installation cost of either system.

The homeowner is responsible for energy costs, which will vary from $1.00 to $2.50/month for GP systems, depending on the horsepower of the unit. STEP units generally cost less than $1.00/month.

Preventive maintenance should be performed annually for each unit, with monthly maintenance of other mechanical components. STEP systems require periodic pumping of septic tanks. Total O&M costs average $100-200 per year per unit, and include costs for troubleshooting, inspection of new installations, and responding to problems.

Mean time between service calls (MTBSC) data vary greatly, but values of 4 to 10 years for both GP and STEP units are reasonable estimates for quality installations.

TABLE 2 AVERAGE INSTALLED UNIT COSTS FOR PRESSURE SEWER MAINS & APPURTENANCES

Item	Unit Cost ($)
2 inch mains	9.40/LF
3 inch mains	10.00/LF
4 inch mains	11.30/LF
6 inch mains	15.80/LF
8 inch mains	17.60/LF
Extra for mains in asphalt concrete pavement	6.30/LF
2 inch isolation valves	315/each
3 inch isolation valves	345/each
4 inch isolation valves	440/each
6 inch isolation valves	500/each
8 inch isolation valves	720/each
Individual Grinder pump	1,505/each
Single (simplex) package pump system	5,140/each
package installation	625 - 1,880/each
Automatic air release stations	1,255/each

Source: U.S. EPA, 1991.

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Other Related Fact Sheets

Other EPA Fact Sheets can be found at the following web address:

http://www.epa.gov/owm/mtb/mtbfact.htm

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EPA 832-F-02-006
September 2002

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CASE STUDY

An Affordable Wastewater Collection Solution for Municipalities and Communities

VERO BEACH, FLORIDA

Problem Along the Indian River Lagoon adjacent to Vero Beach, Florida, both residents and government officials were becoming increasingly concerned about excessive nutrient loads and pollution. About 1,500 homes in Vero Beach had septic systems, many of which were antiquated and failing. Experts believed that the failing onsite systems were a major contributor to the environmental degradation of the lagoon, loss of sea grass habitat, and the unexplained deaths of manatees and dolphins.

Solution The City of Vero Beach installed an Orenco Effluent Sewer consisting of directionally drilled, small-diameter mainlines and individual Orenco STEP (Septic Tank Effluent Pump) packages. Primary-treated effluent from each residential or multi-family property is ultimately conveyed to the city's existing centralized wastewater treatment plant.

Seeking an Affordable Technology

Vero Beach (population 15,220 in 2010) is a small but densely populated city adjacent to the Indian River Lagoon on Florida's east coast. Many of the city's approximately 1,500 on-site septic tanks and drainfields were failing, and the excess nitrogen, phosphorus, and bacteria were considered a primary contributor to the pollution of the watershed.

Due to financial constraints, sewering small cities like Vero Beach has long been an extreme challenge. For decades, engineers have encountered difficulties identifying affordable and viable wastewater solutions

Concerned about nutrient runoff to the adjacent lagoon, the City of Vero Beach installed an Orenco Effluent Sewer, a much less-expensive and less-intrusive option than extending the city's gravity sewer.

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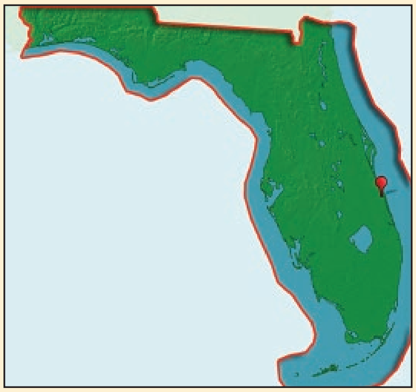
Municipal and Community Market

Project Overview

VERO BEACH, FLORIDA



Design Parameters
- Approx. 1,500 homes at full build-out

Installation Date
- First on-lot STEP packages were installed in April 2015

Total Project Cost*
- Approx. $11,000,000 at full build-out (includes engineering, legal, administrative, and construction costs)

Cost of Installing Mainlines and Service Laterals
- Mainlines: approx. $885,000
- Service laterals: approx. $750,000

Funding Sources
- St. Johns River Water Management District: $292,050 grant for mainlines; $247,500 grant for service laterals
- Remaining amount paid by homeowners, less any credits:
  - ~ STEP Up and Save Credit: $2,290 offered by the city to property owners who sign up within twelve months of sewer availability notification
  - ~ Wastewater Utility Extension Credit: $1,100 offered by the city to property owners who pay in full for their STEP package at the time they submit their sewer application

Ongoing installation costs have been used to estimate total cost at project's end.

"Project Overview" continued on back.

for these communities. Even during the construction grant era following the passage of the Clean Water Act in 1972 (when grants dwarfed loans), state and federal agencies struggled to identify and implement cost-effective solutions for small communities.

For many years, Vero Beach and various independent consultants searched for an affordable technology to eliminate the impact caused by residents' failing septic systems. Immediately following the damage caused by hurricanes in 2004, approximately 60 homes with failing systems voluntarily connected to the city's existing gravity sewer system. The construction impact was extensive and required digging up narrow residential streets for installation of the gravity sewer collection lines and ancillary equipment. The expansion was expensive but was funded through an assessment process that ranged from $6,200 to $19,400 per connection, depending on the area served.

In 2007, the city was offered a $1.5 million grant from the State of Florida to expand the sewer system to more homes on the barrier island. The grant required 60% support from affected homeowners but ultimately failed, with only 14% voting in favor of the proposal. Even with the grant subsidies, opponents cited concerns about the overall affordability of the proposed gravity sewer extension. Social impact was also an issue, as many residents feared the sewer installation would damage their large live oak trees.

A Solution with Low Capital Costs

Based on his experience with low-pressure effluent sewer systems used in the nearby City of Palm Bay, Robert J. Bolton, P.E., Director of Water and Sewer for Vero Beach, began thoroughly investigating alternative sewer systems. After months of comprehensive research and evaluation, Bolton concluded that an Orenco Effluent Sewer system, also known as a STEP (Septic Tank Effluent Pump) system, was the most cost-effective solution for the city. He estimated the cost of an Orenco Effluent Sewer to be approximately $11 million. In comparison, an expansion of the city's gravity sewer system was expected to cost about $22.5 million.

The dramatically lower cost of an Orenco Effluent Sewer is largely attributed to its use of small-diameter mainlines laid at a constant depth to follow the contour of the land. Such mainlines are less time-consuming to install and minimize the construction impact of the system. Comparatively, a gravity sewer system typically involves tearing up roads to install 8-inch (200-mm) diameter sewer mains in conjunction with manholes and service laterals to property lines. Bolton estimated a six- to nine-month construction period to extend the gravity sewer, versus just weeks for an effluent sewer system.

Further extending gravity sewer was too expensive and disruptive due to the small lots and mature trees common throughout Vero Beach.

Bolton also calculated each option's "availability cost," which he defined as the cost of making sewer available to all residents by installing just the mainlines and components (excluding the on-lot portion of the system). By his estimates, the availability cost of an effluent sewer would be about $885,000, or less than $600 per lot. In contrast, he estimated the availability cost of further expanding the city's gravity sewer system to be approximately $18,000,000, or $12,000 per lot.

Encouraged by the prospect of lower capital costs, minimal construction disruption, and the ability to reassure residents that their live oak trees would be unaffected, Vero Beach chose to install an Orenco Effluent Sewer.

Continued on next page

For constructing the mainlines and service laterals, the St. Johns River Water Management District, a branch of the State of Florida Department of Environmental Protection, issued two grants totaling approximately $540,000. In a news release issued by the district, Vero Beach's Vice Mayor at the time, Jay Kramer, said, "The STEP System really saved us; we can now be environmentally active while keeping the costs down for the community."[1]

Incentives for Residents

Because of the Orenco Effluent Sewer's much lower availability cost, residents of Vero Beach aren't required to connect to the low-pressure sewer mains. Conversely, gravity sewers almost always require mandatory connections, due to the municipality's need for cash flow to retire the debt associated with the much higher cost of conveyance infrastructure.

To encourage residents to connect, the city developed a "STEP Up and Save" incentive program. The first incentive is the "STEP Up and Save Credit" of $2,290, which offsets the wastewater impact fee that is normally charged to new sewer customers. This credit is available to property owners who sign up within twelve months of notification. The second incentive is the $1,100 "Wastewater Utility Extension Credit," available to homeowners who pay in full for their STEP package at the time of application. Residents do have the option of receiving the STEP Up and Save Credit while financing the equipment cost for ten years at no interest; however, they do not receive the Wastewater Utility Extension Credit with this option.

The first 2-inch (50-mm) collection lines and on-lot STEP packages were installed in the spring of 2015. A total of 1,500 residences are expected to opt in before the project is complete. The majority of homes will have a new, watertight 1,000-gallon (3,800-L) tank and STEP package installed at an estimated cost of $7,000 (installation plus materials) per connection. However, if a home was recently constructed and the city deems the existing septic tank to be watertight and structurally sound, the tank will be retained and the cost of construction will be reduced to about $5,600. In this case, the on-lot component design includes a simple, 100-gallon (380-L) pump chamber installed immediately following the existing tank (see photo at right). Once connected to the Orenco Effluent Sewer system, primary-treated effluent from each

The total cost of installing an Orenco Effluent Sewer in Vero Beach was estimated to be half the cost of expanding the city's gravity sewer.

The city owns and operates the entire effluent sewer infrastructure, including the on-lot tank and pump package at each home.

Continued on next page

Connecting an estimated 1,500 residences to the city's new Orenco Effluent Sewer should dramatically improve water quality in the lagoon.

home's on-lot STEP package is pumped to the city's central wastewater treatment facility.

George McCullers is with Reliable Septic, the company that has installed most of the STEP packages. As quoted by VeroNews.com, McCullers says, "Dollar for dollar, this is the best system out there, and that is coming from the guy who puts them in the ground." McCullers says it takes about two days to do the job, including a cleanup that makes the surrounding landscaping appear undisturbed.[2]

Every five years, the city requires a licensed septic tank technician to inspect the septic tank and drainfield on properties that are not connected to the system. The technician then submits a report to the city. If any critical part of the on-site septic system is determined to be deficient, the homeowner is required to connect to the city's effluent sewer system.

Operation and Maintenance Advantages

During his initial research, Bolton determined that an effluent sewer system could save the city millions in up-front capital costs. However, he needed to ensure that the components were sustainable and would not result in excessive maintenance costs. While contacting other cities that had installed Orenco Effluent Sewer systems, he found that they were able to maintain their systems with minimal staffing and negligible maintenance issues. "At this point, I determined that Orenco products led the industry," says Bolton.

While consideration of capital costs is important, most sewage collection systems require greater fiscal resources for lifetime operation, maintenance, and repair than will be spent on the initial capital investment. Unfortunately, despite the major savings on capital costs associated with Orenco Effluent Sewers, it is still a common misconception that they are more expensive than gravity sewers over the full life cycle of the system.[3] This mistaken belief stems from a lack of information about long-term effluent sewer operation and maintenance (O&M) costs, as well as a tendency to underestimate the O&M costs of gravity sewer, including biosolids management, daily staffing needs, and electricity.

The City of Vero Beach maintains 123 miles (198 km) of gravity sewer lines, 48 miles (77 km) of force mains associated with the gravity sewer, 118 electrical panels, 236 lift station pumps, and 2,660 manholes. Based on a 75-year term, Bolton's projected O&M costs for extending conventional gravity sewer to the city's unsewered areas was $12.42/month per EDU. Estimated O&M costs for the Orenco Effluent Sewer were comparable at $13.18/month per EDU, dispelling the myth that an effluent sewer is much more expensive to operate and maintain than a gravity sewer.

The city owns and operates the entire effluent sewer infrastructure, including the on-lot tank and pump package at each home. Monthly costs for residents include a basic fee of $19.89/month per EDU, plus a usage charge of $3.59 per 1000 gallons (3,800 L).

Continued on next page

However, the usage fee only applies to the first 10,000 gallons (38,000 L), so the maximum monthly charge is $55.79. The city has taken the approach that the health of the Indian River Lagoon is a quality-of-life issue, and that the cost of converting septic systems to STEP packages should be shared by all residents.

"The Orenco product line is awesome," says Bolton, "Everything has been high quality. Before we decided to go with an effluent sewer, I did my research and spoke with other cities that had used this technology. The feedback was very positive. The support I've received from Orenco every time I've had a question has also been fabulous."

Minimal Construction Impact

According to Bolton, the installation time required for an effluent sewer system is less than a quarter of that required for a conventional gravity sewer. Directional boring (generally not possible for gravity sewer installations) was used in Vero Beach to minimize the impact of construction on both the public and the environment. This less-intrusive construction method reduces a number of unfavorable by-products of the construction process, including adverse environmental impacts, permitting concerns, problems with handling and disposing of excavated soils and groundwater, the number and cost of utility conflicts and resulting relocations, and the high costs of surface restoration.[4]

Orenco Effluent Sewers' affordability stems primarily from their use of small-diameter mainlines, which can be installed with minimal disturbance to neighborhoods.

Each home connected to the system has an Orenco STEP package, including a 1,000-gal (3.8-m^3) watertight tank and an energy-efficient, low-horsepower pump that conveys effluent to the treatment plant.

Even though records of existing utilities are more accurate today than ever before, communities are still littered with unmarked and hidden electrical, gas, and telephone utilities. Gravity sewers, due to their larger construction zone and amount of excavated material, have a greater propensity for encountering existing utilities. The slope requirements of gravity sewers also make it challenging and costly to avoid existing utilities. The costs associated with existing utility conflicts include additional design costs, repair costs for inadvertently damaged utilities, and loss of production time while making the repairs. Conversely, effluent sewer mains can be easily re-routed to avoid existing utilities.

When constructing a gravity sewer in an existing, active street, prolonged and inconvenient traffic delays are likely to occur. This is not the case with effluent sewer, for which mainlines can typically be installed along the side of the road with light-duty equipment. Due to gravity sewer's larger construction footprint, road and landscape restoration costs are also more expensive when compared to those associated with effluent sewer. With regards to gravity sewer, "Depending upon soil conditions, either a portion of the roadway or the entire roadway may be removed during the trenching operation. In some cases, where only a portion of the roadway is removed for sanitary [gravity] sewer installation, the

Continued on next page

remainder of the roadway is effectively destroyed due to the heavy construction traffic that must use it to complete the project.”[5]

Trenchless construction is a less-intrusive method for installing new pipes while reducing negative environmental impacts and disruption to residents.

In Vero Beach, the minimal construction impact of the new Orenco Effluent Sewer was appreciated, especially considering that a significant percentage of the city’s residential lots are located on narrow streets and contain large homes surrounded by mature and established live oak trees. In fact, a substantial number of homes that are expected to connect to the system are located on lots of 0.3 acres (.12 ha) or less. Table 1 shows lot size data for the Bethel Creek area, which is representative of the city.

Cleaning Up the Lagoon

At full build-out, with an estimated 1,500 residences connected to the city’s new effluent sewer, water quality in the Indian River Lagoon is expected to improve considerably. In its news release, the water management district reported that “the STEP project will divert septic system effluent … preventing up to 40,500 pounds [18,370 kg] of nutrients per year from entering the groundwater.” In addition, the replacement of failed septic systems will result in fewer pollutants ending up in the lagoon. Local officials are confident this will be a boon to the dolphins, manatees, and other wild creatures that make their home in these vital waters.

Municipal and Community Market

User Charges
- Base monthly rate: $19.89/Equivalent Dwelling Unit (EDU) per month
- Usage charge: $3.59/1000 gallons (3,800 L) up to 10,000 gallons (38,000 L)

Collection System
- Approx. 1,500 connections
- Approx. 93,000 linear ft (28,346 linear m) of 2-in. (50-mm) diameter collection lines at full build-out
- 1,000-gallon (3,800-L) tanks
- Orenco S1-Series control panels with elapsed time meters, cycle counters, and manual transfer switches

Treatment
- Existing centralized treatment plant owned by the city

Engineer
- Robert J. Bolton, P.E., Director of Water and Sewer, City of Vero Beach

Operation and Maintenance
- City of Vero Beach

Table 1. Vero Beach Parcel Statistics (Bethel Creek Area)

Lot Size (acres)	# of Homes
0.00 - 0.15	4
0.16 - 0.2	3
0.2 - 0.3	82
0.3 - 0.4	38
0.4 - 0.5	18
> 0.5	12

For more information about Orenco Effluent Sewers and AdvanTex® Treatment Systems, contact Orenco Systems®, Inc., at 800-348-9843.

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[1] St. Johns River Water Management District, “District partners with Vero Beach to improve lagoon water quality” (news release, Palatka, Florida, February 13, 2015).

[2] Steven Thomas, “Innovative Sewer System Will Help Lagoon,” VeroNews.com, December 10, 2015, http://www.veronews.com/32963_features/innovative-sewer-system-will-help-lagoon/article_c7696ae8-9e9b-11e5-91ab-cb169dc09af1.html.

[3] Bill Cagle, Terry Cargil, and Roger Dickinson, “20-Year Life Cycle Analysis of an Effluent Sewer (STEP) System” (paper presented at the Water Environment Federation Technical Exhibition and Conference, Chicago, Illinois, October 8, 2013), 17-18.

[4] Paul Bizier, ed., Gravity Sanitary Sewer Design and Construction (Reston, Virginia: American Society of Civil Engineers, 2007), 395-396.

[5] Bizier, Gravity Sanitary Sewer Design and Construction, 369.

Data used by Orenco to derive the representations and conclusions contained within this case study were current as of November, 2015.

DRAFT

ALTERNATIVE CONVEYANCE SYSTEMS

SMALL DIAMETER GRAVITY SEWERS

Prepared for
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Environmental Protection Agency
Municipal Wastewater Branch
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August 1990

CHAPTER 1

OVERVIEW OF ALTERNATIVE CONVEYANCE SYSTEMS

INTRODUCTION

Small Diameter Gravity Sewers

Description

Small diameter gravity sewers (SDGS) are rapidly gaining popularity in unsewered areas because of their low construction costs. Unlike conventional sewers, primary treatment is provided at each connection and only the settled wastewater is collected. Grit, grease and other troublesome solids which might cause obstructions in the collector mains are separated from the waste flow and retained in interceptor tanks installed upstream of each connection (Figure 1.1). With the solids removed, the collector mains need not be designed to carry solids as conventional sewers must be. Large diameter pipes designed with straight alignment and uniform gradients to maintain self-cleansing velocities are not necessary. Instead, the collector mains may be smaller in diameter, laid with variable or inflective gradients and have fewer manholes. Construction costs are reduced because SDGS may be laid to follow the topography more closely than conventional sewers and routed around most obstacles within their path without installing manholes. The interceptor tanks are an integral part of the system. They are typically located on private property, but usually owned by the utility districts so that regular pumping to remove the accumulated solids for safe disposal is ensured.

Small diameter gravity sewers (SDGS) were first constructed in Australia in the 1960's. They were used to provide a more cost effective solution than conventional gravity sewers to correct problems with failing septic tank systems in densely developed urban fringe areas. The SDGS were designed to collect the effluent from existing septic tanks. Since the tanks would remove the suspended solids that might settle or otherwise cause obstructions in the mains, smaller collector mains 100 mm (4 in) in diameter, laid on a uniform gradient sufficient to maintain only a 0.45 m/s (1.5 ft/s) flow velocity were permitted. This alternative proved to reduce construction costs by 30 to 65%. Routine maintenance also proved to be low in cost. As a result, by 1986 over 80 systems had been constructed with up to 4,000 connections per scheme (Laver, 1975; South Australia Health Commission, 1986; Tucker, 1989).

In the United States, small diameter gravity sewers were not introduced until the mid-1970's (Otis, 1986). The first systems, located in Mt. Andrew, Alabama and Westboro, Wisconsin, were small demonstration systems with 13 and 90 connections respectively. The Mt. Andrew system was constructed as a variable grade system with sections of sewer depressed below the static hydraulic grade line (Simmons,et al.,1982). The Westboro system was designed with uniform gradients using the more conservative Australian guidelines (Otis, 1978). The Westboro system proved to be 30% less costly than conventional sewers.

As knowledge of the success of these systems spread, SDGS began to gain acceptance and by the mid-1980's, over 100 systems had been constructed (US EPA, 1986). The designs of most of the systems constructed prior to

1990 followed the Australian guidelines, but as experience has been gained, engineers are finding that the guidelines can be relaxed without sacrificing performance or increasing maintenance costs. Variable grade systems in which the sewers are allowed to operate in a surcharged condition are becoming more common. Minimum flow velocities are no longer considered as a design criterion. Instead, the design is based on the system's capacity to carry the expected peak flows without raising the hydraulic grade line above the interceptor outlet inverts for extended periods of time. Inflective gradients are allowed such that sections of the mains are depressed below the static hydraulic grade line. Despite these significant changes from the Australian guidelines, operation and maintenance costs have not increased.

Small diameter gravity sewer systems consist of: a) house connections; b) interceptor tanks; c) service laterals; d) collector mains; e) cleanouts, manholes and vents; and f) lift stations.

a) **House Connections** are made at the inlet to the interceptor tank. All household wastewaters enter the system at this point.

b) **Interceptor Tanks** are buried, vented, watertight tanks with baffled inlets and outlets. They are designed to remove both floating and settleable solids from the waste stream through quiescent settling over a period of 12 to 24 hours. Ample volume is also provided for storage of the solids which must be periodically removed through an access port. Typically, a single-chamber septic tank, which is vented through the house plumbing stack vent, is used as an interceptor tank.

c) **Service Laterals** connect the interceptor tank with the collector main. Typically, they are 75-100 mm (3-4 in) in diameter, but should be no larger than the collector main to which they are connected, They may include a check valve or other backflow prevention device near the connection to the main.

c) **Collector Mains** are small diameter plastic pipes with typical minimum diameters of 75 to 100 mm (3-4 in), although 30 mm (1.25 in) pipe has been used successfully. The mains are trenched into the ground at a depth sufficient to collect the settled wastewater from most connections by gravity. Unlike conventional gravity sewers, small diameter gravity sewers are not necessarily laid on an uniform gradient with straight alignment between cleanouts or manholes. In places, the mains may be depressed below the hydraulic grade line. Also, the alignment may be curvilinear between manholes and cleanouts to avoid obstacles in the path of the sewers.

d) **Cleanouts, Manholes and Vents** provide access to the collector mains for inspection and maintenance. In most circumstances, cleanouts are preferable to manholes because they are less costly and can be more tightly sealed to eliminate most infiltration and grit which commonly enter through manholes. Vents are necessary to maintain free-flowing conditions in the mains. Vents in the household plumbing are sufficient except where depressed sewer sections exist. In such cases, air release valves or ventilated cleanouts are necessary at the high points of the main.

e) **Lift Stations** are necessary where elevation differences do not permit gravity flow. Either STEP units (See Pressure Sewer Systems) or mainline lift stations may be used. STEP units are small lift stations installed to pump wastewater from one or a small cluster of connections to the collector main, while a mainline lift station is used to service all connections in a larger drainage basin.

Although the term "small diameter gravity sewers" has become commonly accepted, it is not an accurate description of the system, since the mains need not be small in diameter (the size is determined by hydraulic considerations) nor are they "sewers" in the sense that they carry sewage solids. The most significant feature of small diameter sewers is that primary pretreatment is provided in interceptor tanks upstream of each connection. With the settleable solids removed, it is not necessary to design the collector mains to maintain minimum self-cleansing velocities. Without the requirement for minimum velocities, the pipe gradients may be reduced and, as a result, the depths of excavation. The need for manholes at all junctions, changes in grade and alignment, and at regular intervals is eliminated. The interceptor tank also attenuates the wastewater flow rate from each connection which reduces the peak to average flow ratio allowing reductions in the sewer diameter. Yet, except for the need to evacuate the accumulated solids in the interceptor tanks periodically, SDGS operate similarly to conventional sewers.

Application

Small diameter gravity sewers have potential for wide application. They are a viable alternative to conventional sewers in many situations, but are particularly well-suited for low-density residential and commercial developments such as small communities and residential fringe developments of larger urban areas. Because of their smaller size, reduced gradients and fewer manholes, they can have a distinct cost advantage over conventional gravity sewers where adverse soil or rock conditions create excavation problems or where restoration costs in developed areas can be excessive. In new developments, construction of the sewers can be deferred until the number of homes built warrant their installation. In the interim, septic tank systems or holding tanks can be used. When the sewers are constructed, the tanks can be converted for use as interceptor tanks. However, SDGS usually are not well suited in high density developments because of the cost of installing and maintaining the interceptor tanks.

Extent of Use in the U.S.

The use of small diameter gravity sewers has been rapidly increasing in the U.S. They have been referred to by different names including variable grade sewers (VGS), small bore sewers (SBS), septic tank effluent drains (STED) and common effluent drains (CED). They are all similar in design except that CED typically are designed to have uniform gradients with a minimum flow velocity of 0.3 m/s (1 fps). The others do not require uniform gradients, but will allow inflective gradients where sections of the sewer are depressed below the hydraulic grade line. Minimum flow velocities may not be required.

The use of small diameter gravity sewers has been largely limited to existing rural communities. The first SDGS system was installed in 1977 and by the early 1990's over 200 systems were operating. Increasingly, they are been used for residential fringe developments and new subdivision and resort developments where the topography is favorable. Frequently, the systems built are hybrid gravity and pressure systems.

Experience with the sewers has been excellent. The sewers have proved to be trouble-free with low maintenance requirements. As a result, confidence with the systems has grown and the designs have become less conservative.

Myths Versus Reality

Deterrents to the use of small diameter gravity sewers have come from both the engineering/regulatory community and the potential users themselves. Engineers and regulatory agencies have been reluctant to promote SDGS because of the concern over long-term performance. The concern has been over whether the sewers could handle the flows without backups or obstructions occurring. This concern is fading as experience shows the sewers to be relatively trouble-free.

Potential users have discouraged their use because of the conception that SDGS are a "second-rate" system. Typical concerns are for odors and whether the system can be expanded to accommodate growth. However, where SDGS have been installed, users have found them to perform no differently than conventional sewers. With proper planning, expansion can be accommodated and with proper design, odors problems are avoided.

Construction of SDGS may not be the lower in cost than conventional sewers in all unsewered developments. The cost of installing interceptor tanks is a significant cost. Usually existing septic tanks cannot be used as interceptor tanks because they are not watertight and cannot be inspected and repaired cost effectively. As in any project, all reasonable alternatives should be evaluated before design commences.

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CHAPTER 3:

SMALL DIAMETER GRAVITY SEWERS

INTRODUCTION

Small diameter gravity sewers are a system of interceptor tanks and small diameter collection mains. The interceptor tanks, located upstream of each connection and usually on the property served, remove grease and settleable solids from the raw wastewater. The settled wastewater is discharged from each tank via gravity or by pump (STEP unit) into the gravity collector mains usually located in the public right-of-way. The mains transport the tank effluents to the treatment facility.

Because the interceptor tanks remove the troublesome solids from the waste stream, the collector mains need not be designed to carry solids. This reduces the gradients needed and, as a result, the depths of excavation. The need for manholes at all junctions, changes in grade and alignment, and at regular intervals is eliminated resulting in further potential cost savings. The sewer diameter can also be reduced because the interceptor tank attenuates the wastewater flow to reduce the peak to average flow ratio. Yet, except for the need to evacuate the accumulated solids from the interceptor tanks periodically, SDGS operate similarly to conventional sewers.

The compatibility of septic tank effluent pumping (STEP) systems with SDGS allows an efficient low-cost hybrid collection alternative in many unsewered developments. A hybrid design can often eliminate or minimize the need for lift stations to reduce both capital, operation and maintenance costs. It is cautioned that grinder pump (GP) systems are not compatible with SDGS because the waste solids and grease are not removed from the waste stream before discharge to the collector main.

DESCRIPTION OF SYSTEM COMPONENTS

Typical small diameter gravity sewer systems consist of: building sewers, interceptor tanks, service laterals, collector mains, cleanouts, manholes and vents, and lift stations (See Figure 3.1). Other appurtenaces may be added as necessary

Building Sewers

All wastewaters enter the small diameter gravity sewer system through the building sewer. It conveys the raw wastewaters from the building to the inlet of the interceptor tank. Typically it is a 100-150 mm (4-6 in) diameter pipe laid at a prescribed slope, usually no less than 1%, made of cast iron, vitrified clay, acrylonitrile butadiene styrene (ABS) or polyvinyl chloride (PVC).

Interceptor Tanks

Interceptor tanks perform three important functions: 1) removal of settleable and floatable solids from the raw wastewater, 2) storage of the removed solids and, 3) flow attenuation. The tanks are designed for hydraulic retention times of 12 to 24 hours when two-thirds full of solids to permit liquid-solid separation via sedimentation and flotation. Outlet baffles on the tanks prevent floating solids from leaving the tank. The tank has sufficient volume to store the solids until which time they can removed, typically on 1 to 10 year cycles for residential connections and semi-annually or annually for commercial connections with food service. Anaerobic digestion does take place within the tank which reduces the volume of accumulated sludge and prolongs the storage time. The interceptor tanks also provide some surge storage which can attenuate peak flows entering the interceptor tank by more than 60% (Baumann, et al., 1978; Otis, 1986).

Septic tanks are typically used as interceptor tanks (Figure 3.2). Pre-cast reinforced concrete and coated steel tanks are usually available locally in a variety of sizes. Fiberglass (fiber reinforced plastic, FRP) and high density polyethylene tanks (HDPE) are also available regionally. Pre-cast concrete tanks are most commonly used in SDGS systems, but polyethylene and fiberglass tanks are gaining in popularity because they are more watertight and lighter in weight for easier installation. However, FRP and HDPE tanks require more care in proper bedding and anti-flotation devices where high ground water occurs.

Service Laterals

Service laterals connect the interceptor tank to the collection main. The laterals are usually plastic pipe no larger in diameter than the collector main. They are not necessarily laid on a uniform grade nor with a straight alignment (Figure 3.3).

Optional lateral appurtenances include check valves, "p"-traps or "running" traps and corporation stops. Most existing SDGS systems do not include these options, but check valves are being used more frequently to prevent backups into low-lying connections during peak flows. "P"-traps have been retro-fitted on connections where odors issuing from the house plumbing vent stack have been a problem. Corporation stops are used primarily on "stub outs" reserved for future connections.

Collector Mains

Collector mains convey the settled wastewater to either a lift station, manhole of a conventional gravity sewer system or directly to a treatment plant. Plastic pipe, with solvent weld or rubber gasket joints is used almost exclusively. Flexible, high density polyethylene pipe with heat fused joints has also been used successfully.

Manholes and Cleanouts

Manholes and cleanouts provide access to the collector main for maintenance. Since hydraulic flushing is sufficient to clean the mains, the use of manholes is usually limited. Common practice is to use manholes only at major junctions because they can be a significant source of infiltration, inflow and sediment. Cleanouts are typically used at upstream termini, minor main junctions, changes in pipe size or alignment, high points, and at intervals of 120 to 300 m (400-1000 ft).

Air Release Valves and Vents

Vents are necessary to maintain free-flowing conditions in the mains. In SDGS systems installed with continuously negative gradients, the individual house connections will provide adequate venting if the sewer lateral is not trapped. In systems where inflective gradients are allowed, the high points in the mains must be vented. Air release or a combination of air release/vacuum valves are commonly used in combination with a cleanout (Figure 3.4). Individual connections located at a summit can also serve as a vent if the service is not trapped or has a check valve.

Lift Stations

Lift stations may be used at individual connections which are too low in elevation to drain by gravity into the collector. They are also used on the collector mains to lift the wastewater from one drainage basin to another. Individual or STEP lift stations are usually simple reinforced concrete or fiberglass wet wells following the interceptor tank with low head, low capacity submersible pumps operated by mercury float switches (Figure 3.5). In a few systems where the static lift is great, high head, high capacity turbine pumps have been used successfully. This is only possible if the wastewater affluent is screened prior to pumping to eliminate any solids that might clog the turbines. Mainline lift stations are similar in design to the "residential" lift stations, but because of corrosion problems which commonly occur in the wet well, the construction of dry wells is becoming more common to reduce corrosion problems and to facilitate maintenance.

SYSTEM DESIGN CONSIDERATIONS

Hydraulic Design

A small diameter gravity sewer system conveys settled wastewater to the selected outlet by utilizing the difference in elevation between its upstream connections and its downstream terminus. It must be set deep enough to receive flows from the majority of the service connections and have sufficient capacity to carry the expected peak flows. Therefore, design decisions regarding its location, depth, size and gradient must be carefully made to hold the hydraulic losses within the limits of available energy. Where the differences in elevation are insufficient to permit gravity flow from an individual connection, energy must be added to the system by a lift pump (See Pressure Sewer Section). The number and location of individual lift stations or STEP units generally is determined from the comparisons of their costs of construction, operation and maintenance with the cost of construction and maintenance of deeper and/or larger diameter (smaller headloss) sewers. The hybridization of SDGS with STEP is quite common.

Design Flow Estimates

The hydraulic design of sewer mains is based on the estimated flows which the sewer must carry. Since wastewater flows vary throughout the day, the sewer main must be designed to carry the expected prolonged peak flows, typically the peak hour flow. Conventional sewer design assumes 380 L/d (100 g/d) per capita times a typical peaking factor of 4 for collector mains. This estimate includes allowances for commercial flows and infiltration. However, experience with SDGS has shown that these design flow estimates exceed actual flows because most SDGS serve residential areas where daily per capita flows are less than 380L/d (100 g/d) per capita the peak to average flow ratio is also less than 4 because the interceptor tanks attenuate peak flows markedly.

Measured average daily wastewater flow per capita is approximately 170 L/d (45 g/d) (Anderson and Watson, 1967; Bennett and Linstedt, 1975; Siegrist, et al., 1976). However, in small communities and residential developments where little commercial or industrial activity exists, average per capita wastewater flows in sewers may be as much as 25% less (Otis, 1978). Household wastewater flow can vary considerably between homes but it is usually less than 227 L/d (60 g/d) and seldom exceeds 284 L/d (75 g/d) U.S. EPA, 1980). Typically, 190 L/d (50 g/d) is assumed for per capita wastewater flows in residential areas. Commercial and industrial flows are estimated individually using established criteria (U.S. EPA, 1980).

The collector mains are sized to carry the daily peak flows rather than the average flows. In residential dwellings, the rate of wastewater discharged from the building depends on the water use appliances and fixtures used. Instantaneous peak flows are typically 0.3 to 0.6 L/s (5 -10 g/m) (U.S. EPA, 1980). Maximum hourly flows of 380 L/h (100 g/h) may occur (Watson, et al., 1967; Jones, 1974). However, the interceptor tank in SDGS systems attenuates these peaks dramatically. Monitoring of individual interceptor tanks showed that outlet flows seldom exceeded 0.06 L/s (1 g/m) and most peaks ranged between 0.03 and 0.06 L/s (0.5-0.9 g/m) over 30 to 60 minutes periods. There were long periods of zero flow (Otis, 1986). The degree of attenuation depends on the design of the interceptor tank and /or its outlet (see below).

In addition to wastewater flows, allowance must be made for potential clear water infiltration/inflow. A common source of infiltration in SDGS systems is the building sewer and interceptor tank. In SDGS systems in which the existing septic tanks were used as interceptor tanks, wet weather flows have been significantly higher than dry weather flows. Leaking building sewers, cracked tanks and poorly fitting tank covers are the most common sources of infiltration. Where all new tanks were installed and the building sewers tested or replaced, the ratio of wet weather to dry weather flows have been much lower (Otis, 1986). In all systems, foundation drains and roof leaders may be significant sources of inflow and SDGS projects should attempt to eliminate them during construction.

Experience with SDGS systems has shown that the criteria used to estimate design flows have been conservatively high. Design flows have generally ranged from 190 to 380 L/d (50-100 g/d) per capita with peaking factors ranging from 1 to 4. More recent designs have been based on flows per connection of 0.006 to 0.02 L/s (0.1-0.3 g/m). These design flow estimates have been successful because the interceptor tanks have storage available above the normal water level to store household flows for short peak flow periods.

Flow Velocities

Conventional sewer design is based on achieving "self-cleansing" velocities during normal daily peak flow periods to transport any grit which may enter the sewer, scour grease and resuspend solids that have settled in the sewer during low flow periods. However, in SDGS systems, the primary treatment provided in the interceptor tanks upstream of each connection remove grit, and most grease and settleable solids. Studies have shown that the remaining solids which enter the collectors and any slime growths which develop within the sewer are easily carried when flow velocities of 0.15 m/s (0.5 ft/s) are achieved (Otis, 1986). Experience with SDGS has shown that the normal flows which occur within the systems are able to keep the mains free-flowing. Thus, SDGS need not be designed to maintain minimum flow velocities during peak flows although many state agencies require that minimum velocities of 0.3 to 0.45 m/s (1.0-1.5 ft/s) during daily peak flow periods be maintain.

Maximum velocities should not exceed 4-5 m/s (13-16 f/s). At flow velocities above this limit, air can be entrained in the wastewater that may gather in air pockets to reduce the hydraulic capacity of the collector. Drop cleanouts or manholes should be employed where the pipe gradient results in excessive velocities.

Hydraulic Equations

Hydraulic equations used for design of the sewer mains are the same as those used in conventional gravity sewers. However, unlike conventional gravity sewers, sections of SDGS systems are allowed to be depressed below the hydraulic grade line such that flows may alternate between open channel and pressure flow. Therefore, separate analyses must be made for each section of sewer in which the type of flow does not change.

Both Manning's and Hazen-Williams pipe flow formulas are used. Roughness coefficients used range from 0.009 to 0.015 for Manning's "n" and 100 to 150 for Hazen-Williams "C". Typical values used are 0.013 and 140 respectively (Otis, 1986). Nomographs and hydraulic elements graphs may be found elsewhere (WPCF, 1982).

Design depths of flow allowed in the sewer mains have been either half-full or full. Most older systems designed with uniform gradients have used half-full conditions to dictate changes in pipe size. However, systems with variable gradients allow the collector main to be surcharged at capacity. In these systems, pipe size changes are dictated by the relative elevation of the hydraulic grade line to any service connection elevation.

Design procedures follow conventional sewer design except in sections where pressure flow occurs. In these sections, the elevation of the hydraulic grade during daily peak flow conditions must be determined to check that it is lower than any interceptor tank outlet invert. If not, free-flowing conditions will not be maintained at every connection. Where the hydraulic grade line is above a tank invert, the depth of the sewer can be increased to lower the hydraulic grate line, or the diameter of the main can be increased to reduce the frictional headloss or a STEP unit can be installed at the affected connection to lift the wastewater into the collector. If short term surcharging above any interceptor tank outlet inverts is expected, check values on the individual service lateral may suffice to prevent backflow.

Collector Mains

Layout

The layout of SDGS is a dendriform or branched system similar to that of conventional sewers except that the mains are usually not laid down the street center line so that expensive pavement restoration is avoided. In most cases, SDGS are located along side of the pavement in the street right-of-way. If there are numerous services on both sides of the street, collectors may be provided on both sides to eliminate pavement crossings.

Another alternative is to locate the collectors down the back property lines to serve a whole block with one collector. The backlot alternative may be the most accessible to homeowners since most septic tank systems are located in the backyard. Therefore, homeowners are not required to reroute the building sewer to the front of the lot, but access for interceptor maintenance may be limited. Since new interceptor tanks are usually installed, SDGS are installed most often in the front of the lots. If necessary, the building drains are reversed to direct the flow to the front.

Alignment and Grade

The horizontal alignment of SDGS need not be straight. Obvious obstacles such as various utilities, large trees, rock outcrops, etc. should be avoided with careful planning, but unforeseen obstacles can often be routed around by bending the pipe. The radius of the bend should not exceed that recommended by the manufacturer.

The gradient of SDGS must provide an overall fall sufficient to carry the estimated daily hourly peak flows, but the vertical alignment need not be uniform. Inflective gradients, where sections of the main are depressed below the static hydraulic grade line, are permissible if the invert elevation is controlled where the flow in the pipe changes from pressure to open channel flow. The elevation of these summits must be established such that the hydraulic grade line does not rise above any upstream interceptor tank outlet invert during peak flow conditions. Adequate venting must also be provided at the summit. Between these critical summits, the profile of the sewer should be reasonably uniform so unvented air pockets do not form which could create unanticipated headlosses in the conduit and excessive upstream surcharging.

Pipe Diameter

The pipe diameter is determined through hydraulic analysis. It varies according the to the number of connections and the available slope. The minimum diameter used is typically 100 mm (4 in), but 50 mm (2 in) pipe has been used successfully in recent projects (Meza, 1989). Where the smaller pipe is used, the interceptor outlets have flow control devices to control peak flows to a maximum rate and check valves at each service connection to prevent flooding of services during peak flow periods.

Depth

The depth of burial for the collector mains is determined by the elevation of the interceptor tank outlet invert elevations, frost depth or anticipated trench loadings. Either condition may control. In most cases, it is not attempted to set the depth such that all connections can drain by gravity. Where gravity drainage is not possible STEP lift stations are used at the affected connections. An optimum depth is selected to minimize the costs between excavation and the installation of STEP units. However, the depth must not be less than that sufficient to prevent damage from anticipated loadings. Where the pipe is not buried below pavement or subject to traffic loadings, the minimum depth is typically 0.75 m (30 in). Pipe manufacturer should be consulted to determine the minimum depth recommended. In cold climate areas, the frost depth may determine the minimum depth of burial unless insulated pipe is used.

Pipe Materials

Polyvinyl chloride (PVC) plastic pipe is the most commonly used pipe material in SDGS systems. Standard dimension ratio (SDR) 35 is used in most applications, but SDR 26 may be specified for road crossings or where water lines are within 3 m (10 ft). For deep burial, SDR 21 may be necessary. Where the use of STEP units is anticipated, only SDR 26 or 21 should be used for the collector mains because of the compatibility of pipe fittings. Typically, elastomeric (rubber ring) joints are used, however, for pipe smaller than 75 mm (3 in), only solvent weld joints may be available.

Flexible, high density polyethylene (HDPE) has been used infrequently, but successfully. Pipe joining is by heat fusion.

Service Laterals

Typical service laterals are 100 mm (4 in) PVC pipe, although laterals as small as 30 mm (1-1/4 in) have been used. The service lateral should be no larger than the diameter of the collector main to which it is connected. The connection is typically made with a wye or tee fitting. Where STEP units are used, wye fittings are preferred.

Occasionally, check valves are used upstream of the connection to the main to prevent flooding of the service connection during peak flows. If used, it is important that the valve be located at the collector main connection. Air binding of the service lateral can occur if the valve is located near the interceptor tank outlet (Bowne, 1989).

Interceptor Tanks

Location

The interceptor tanks should be located where they are easily accessible for periodic removal of accumulated solids. Typically, they are located near the house between the house and the collector main adjacent to or in place of the existing septic tank. If the collector main is located on the opposite side of the building, reversal of the building drainage may be desirable, but not necessary. Access for maintenance is the critical factor in location. In some projects, the tank has been located in the public right-of-way to eliminate the need for the utility district to enter private property to pump the tank (Figure 3.6).

Design

Prefabricated, single-compartment septic tanks are typically used for interceptor tanks in SDGS systems. Most projects standardize the use of 3785 L (1000 gal) tanks for all residential connections. For commercial establishments, local septic tank codes are commonly used to determine the necessary volume. For a given volume, several tank designs may be available locally. Shallow tanks, or tanks with the greater water surface area for a given volume are preferred designs because of the greater flow attenuation that they provide.

Inlet and outlet baffles are provided in conventional septic tanks to retain solids within the tank. These baffles are adequate for SDGS applications. The inlet baffle must be open at the top to allow venting of the interceptor tank through the building plumbing stack vent. On the outlet, various "gas deflection" baffles or outlet screens may be used to capture low density or neutral buoyancy solids that might otherwise pass through the tank (Figure 3.7). These devices are not necessary, however, since these solids have not caused problems in SDGS systems.

Flow control devices may also be used on interceptor outlets to limit peak flow rates to a predetermined maximum. Surge chambers were added to interceptor tanks in early projects (Simmons, et al., 1982). The surge chamber contained a standpipe with a small orifice drilled near the bottom (Figure 3.8). During peak flow periods, the chamber provides storage for the wastewater while the orifice controls the rate of flow from the tank. These chambers are no longer used because the orifices plug readily so the chambers are not effective in flow attenuation (Ref: Markle, R., 1989). They also require about 0.3-0.4 (1.0-1.5 ft) of headloss which may require deeper burial of the collectors and, as a result, higher construction costs. Where flow control is desirable, it has been incorporated into outlet screening devices made from plastic such as polypropylene in such a manner that the typical freeboard provided in the tank is sufficient for the necessary storage volume (Figure 3.9).

Water tightness is a critical criterion in selection of an interceptor tank. For that reason, existing septic tanks are seldom converted to interceptor tanks. Earlier systems attempted to use the existing septic tank at each home to reduce construction costs. It was found that septic tanks are difficult to inspect and repair properly. SDGS systems with significant numbers of old tanks all have high ratios of wet weather to dry weather flows (Otis, 1986). Common practice now is to replace all tanks. This practice has the added advantage of requiring the property owner to replace the building sewer to ensure greater watertightness. Some projects incorporate the replacement of the building sewer to allow inspection of the building plumbing to eliminate roof leaders, foundation drains and other unwanted connections that contribute clear water inflow.

Access to the tank for periodic inspections and solids removal is required. A sufficiently large opening over the tank inlet or outlet to allow inspection and effective sludge removal should be provided. However, because of the septic wastes, personnel must not enter the tank. The opening should be a minimum of 45 cm (18 in) square or in diameter. A watertight riser terminating 15 cm (6 in) above grade with a bolted or locking air tight cover is preferred to a buried access.

Material

Prefabricated septic tanks are typically used for interceptor tanks. They are available in reinforced concrete, coated steel, fiberglass and high density polyethylene. Unfortunately, the quality of manufacture varies from locality to locality. Therefore, it is necessary to carefully inspect and test random tanks for structural soundness for the intended application and for watertightness. Coated steel tanks are not recommended because the coating is easily damaged leading to severe corrosion and short tank life.

All tank joints must be designed to be watertight. The joints include tank covers, manhole risers and covers and inlet and outlet connections.

Rubber gasket joints for inlet and outlet connections are preferred to provide some flexibility in case of tank settlement.

Manholes and Cleanouts

In most SDGS systems, cleanouts have replaced manholes except at major junctions at mains. Since hydraulic flushing is all that is necessary to maintain the mains in a free-flowing condition, cleanouts provide sufficient access to the mains. Cleanouts are less costly to install than manholes and are not a source of infiltration, inflow or grit. Since the SDGS system is not designed to carry grit, elimination of manholes is strongly recommended. They also eliminate what was a common source of odors in SDGS systems.

Cleanouts are typically located at upstream termini of mains, junctions of mains, changes in main diameter and at intervals of 120 to 300 m (400 - 1000 ft) (Figures 3.10). Cleanouts may also be used in place of drop manholes (Figure 3.11). The cleanouts are typically extended to ground surface within valve boxes.

Manholes, if used, are located only at major junctions. The interiors should be coated with epoxy or other chemical resistant coating to prevent corrosion of the concrete.. The covers used are typically gas-tight covers to limit the egress of odors and inflow of clear water.

Where depressed sections occur, the sewer must be well vented. Cleanouts may be combined with air relief valves at high points in the mains (Figure 3.4) or an open vent cleanout installed (Figure 3.12).

Valves

Air release, combination air release/vacuum and check valves may be used in SDGS systems. Air release and combination air release/vacuum valves are used for air venting at summits in mains that have inflective gradients in lieu of other methods of venting. These valves must be designed for sewage applications with working mechanisms made of type 316 stainless steel or of a plastic proven to be suitable (Bowne, 1989). The valves are installed within meter or valve boxes set flush to grade and covered with a water tight lid (Figure 3.4). If odors are detected from the valve boxes, the boxes may be vented into a small buried gravel trench beside the boxes.

Check valves are sometimes used on the service connections at the point of connection to the main to prevent backflow during surcharged conditions. They have been used primarily in systems with 50 mm (2 in) mains. Many types of check valves are manufactured, but those with large, unobstructed passageways resilient seats have performed best. Wye pattern swing check valves are preferred over tee pattern valves when installed horizontally (Bowne, 1989). Although the systems with 100 mm (4 in) mains have operated well without check valves, they can provide an inexpensive factor of safety. An alternative method used to prevent pumping backups in some projects has been to provide an interceptor tank overflow pipe to the drain field of the abandoned septic tank system. In Australia, a "bounder trap" is included at every connection which provides an overflow to the groomed surface if backups occur (Figure 3.13)

Odors and Corrosion

Odors are a commonly reported problem with SDGS systems. The settled wastewater collected by SDGS is septic and therefore contains dissolved hydrogen sulfide and other malodorous gases. These gases tend to be released to the atmosphere in quantity where turbulent conditions occur such as in lift stations, drop cleanouts or hydraulic jumps which occur at rapid and large changes of grade or direction in the collector main. The odors escape primarily from the house plumbing stack vents, manholes or wet well covers of lift stations.

The odors have been easily controlled by either minimizing turbulence or sealing air outlets. Drop inlets have been effective in eliminating most odors at lift stations (Figure 3.14). Gas tight lift station covers should be installed if odors are persistent and odor control provided for the fresh air vent. An effective odor control measure is to terminate the vent in a buried gravel trench (Figure 3.15). Carbon filters have been used successfully, but require regular maintenance. Manholes should be replaced with cleanouts, but if used, gas tight covers can be used. Odors from house plumbing vents can be controlled most easily by sealing the vent on top of the interceptor tank outlet baffle or by installing water traps in the service lateral.

The atmosphere created by the released gases is very corrosive. Corrosion is a common problem in lift stations. Corrosion resistant materials must be used (See Pressure Sewer Systems). More recent SDGS systems have used wet well/dry well design for lift stations to reduce the exposure of components to the corrosive atmosphere.

OPERATION AND MAINTENANCE CONSIDERATIONS

Administration

Utility or special purpose districts are commonly formed to administer, operate and maintain SDGS systems located outside municipal boundaries. These districts vary in structure and powers from state to state, but they typically have most of the powers of municipal government except for methods of generating revenues.

The sewer utility should be responsible for maintenance of the entire system. This includes all interceptor tanks and any appurtenances such as STEP units located on private property. Typically, the utility district assumes responsibility for all SDGS components downstream from the interceptor tank inlet. In some projects, the responsibility for maintenance of the components located on private property have been left to individual property owner. This practice is favored by some districts to avoid the need to enter private property. However, since the interceptor tank is critical to the proper performance of the SDGS system, responsibility for maintenance should be retained by the district. It is strongly recommended that the district assume ownership of the interceptor tank and the components downstream of the tank to ensure access and timely appropriate maintenance.

To obtain access to the SDGS components located on private property, perpetual general easements are typically secured from the owner. The easements can take several forms, but general easements or easements by exhibit are recommended over metes and bounds easements because of the time and expense of writing metes and bounds. In most cases, the easements are obtained without compensation to the owner. Where it is necessary to cross private property with the collector mains, metes and bounds easements are usually used.

An example of a general easement appears below:

KNOW ALL MEN BY THESE PRESENTS:

That, in consideration of One Dollar and other good and valuable consideration paid to the undersigned respectively, hereinafter referred to as GRANTORS by the utility district, hereinafter referred to as GRANTEE, the receipt whereof is hereby acknowledged, the GRANTORS each, for their respective heirs, distributees, personal representatives, successors and assigns, do hereby grant, bargain, sell, transfer, convey, release, quit claim and remise unto the GRANTEE, its successors and assigns, a PERPETUAL EASEMENT to erect, construct, install, lay, use, operate, maintain, inspect, alter, clean, remove and replace sewer pipes, pumps, interceptor tanks and all appurtenances necessary and incident to the purposes of the easement, and, in connection with the same, temporarily to place machinery and materials which may be necessary to effect the purposes of the easement upon lands of the respective GRANTORS situate in the name of county and state TOGETHER WITH the right of ingress and egress over adjacent lands of GRANTORS, their respective heirs, distributees, personal representatives, successors and assigns, as the same may be required in order to effect the purposes of the easement. The location of the easement on the lands of each GRANTOR is respectively shown on Sheet No. __ of Contract No. __ for the contract drawings of the local entity, dated _____.

The GRANTEE expressly agrees that any and all disturbance to the surface of the lands of the GRANTOR will be promptly repaired and to the extent possible restored to their pre-existing condition, whether such disturbance takes place during the initial installation or at any time thereafter as may be occasioned by subsequent repairs or maintenance to the said sewer line and interceptor tank with the easement area.

Executed at the local entity on the respective dates as follows:

Date	Signature	Street Address	Tax Acct.
______	____________	________________	________
______	____________	________________	________

Operation and Maintenance Manual

An operation and maintenance manual is essential to every project. Although most maintenance tasks are relatively simple and usually do not involve mechanical equipment, the manual does provide a valuable reference for location of components and services and typical drawings detailing the design and construction of each component. In addition, the manual should contain a comprehensive maintenance log to document all maintenance performed and any performance problems and the corrective actions taken.

A good manual should contain, at a minimum, the following:

1. Description of the system

   A description of the botu system and each of its components should be provided. The component descriptions should include the function of each, their relation to adjacent components and typical performance characteristics. Specific design data, shop drawings, as-built plans and profiles of the collector mains and detailed plan drawings of each service connection are essential.

2. Description of the system operation

   Normal operation, emergency operation situations and procedures and failsafe features should be described.

3. System testing, inspection, and monitoring

   The purpose and methods of all recommended testing, inspections and monitoring should be described. Sample recording forms should also be included.

4. Preventive maintenance procedures and schedules

   A clear description of all preventive maintenance procedures is needed with specific schedules for their performance.

5. Troubleshooting

   A description of common operating problems, how they may be diagnosed and procedures to correct them is helpful.

6. Safety

   Safety practices and precautions should be described to alert personnel to the potential hazards and methods to avoid or mitigate them. The dangers of working with septic wastes which generate dangerous hydrogen sulfide and methane gases must be emphasized.

7. Recordkeeping Logs and Forms

   Sample recordkeeping forms and logs should be provided.

8. Equipment Shop Drawings and Manuals

Shop drawings and installation and maintenance manuals of all major equipment should be included. Manufacturers and their suppliers should be listed with contact names, addresses and telephone numbers.

9. Utilities List

A list of all utilities in the project area, location maps and contact names, addresses and phone numbers should be provided.

10. System Drawings

Complete as-built drawings of the system are necessary. Detailed drawings of the service connections showing the precise location of all components with maintenance logs for each should be included.

Staff and Equipment Requirements

Operation and maintenance requirements of SDGS systems are generally simple in nature requiring no special qualifications for maintenance staff other than familiarity with the system operation. The operator's responsibilities will be limited largely to service calls, new service connection inspections and administrative duties. In most systems, interceptor tank pumping is usually performed by an outside contractor under the direction of the utility district.

ent is also limited. A truck mounted centrifugal suction
to ide most emergency operation equipment needs.
hould be purchased to reach between cleanouts. Other
ovided by outside contractors as needed.

ing for SDGS maintenance personnel is not necessary.
lls, however, are desirable. If a significant number of
ns include STEP units, an understanding of pumps and
is also helpful. (For a small number of such units, it
utility district to retain local plumbing and electrical
available for any necessary repairs.) The staff should
ngers of exposure to sewer gases and to avoid entry into
less properly protected. Since a significant portion of
ted private property, it is important that the staff
ation skills and a willingness to work with people.

ory

ems have few mechanical parts, the need to maintain a
ory is limited. However, if individual STEP units are
ystem requiring that spare pumps and controls must be
gency repairs. A minimum of two spare pumps and the
itches and controls should be maintained. Pipe and pipe
kept on hand to repair any pipeline breaks that may
eptor lids and riser rings should also be kept.

As-Built Drawings

As -built drawings of the entire SDGS system including all on-lot facilities is essential to maintenance of the system. Curvilinear alignments and few manholes or cleanouts make locating the collector main routes difficult unless accurate drawings tying the location of the line to permanent structures are developed. As-built drawings of each individual service connection should also be made. These drawings are necessary when repairs are needed or when the components must be located to avoid damage due to other construction activities.

Maintenance

Normal

Normal maintenance is generally limited to call-outs by users. The call-outs are usually due to plumbing backups or to odors. In nearly every case reported, the plumbing backups were due to obstructions in the building sewer. Although the building sewer is the property owner's responsibility, most utilities have assisted the owner in clearing the obstruction. Odor complaints are common. As with the plumbing backups, faulty venting in the building plumbing is usually the cause. If improved venting fails to eliminate the odor complaints, the interceptor inlet vent can be sealed or running traps placed in the service lateral to prevent the sewer main from venting through the service connection.

Preventive

Preventive maintenance includes inspection and pumping of the interceptor tanks, inspection and cleaning of the collection mains and inspection and servicing of any STEP units or lift stations.

Interceptor Tanks: The interceptor tanks must be evacuated of solids periodically to prevent solids from entering the collector mains. Prescribed pumping frequencies are typically 3 to 5 years, but operating experience indicates that a longer time between pumpings, of 7 to 10 years, is adequate. Restaurants and other high use facilities, such as taverns, require more frequent pumping. Common practice is to pump tanks serving these facilities every 6 to 12 months. Tank inspection is usually performed immediately after the tank has been evacuated to check for cracks, leaks, baffle integrity and general condition of the tank. If effluent screens are used on the tank outlet, they must be pulled and cleaned by flushing with water. Annual flushing of the screens is recommended if they are to be effective.

Most utilities do not perform the pumping themselves. Private pumpers are usually hired through annual contracts to pump a designated number of tanks each year and to be on call for emergency pumping. The septage removed is usually land spread or discharged into a regional treatment plant. During the pumping operations, utility district personnel should be present to record the depth of sludge and thickness of any scum in each tank so that the schedule can be altered according to need.

Collector Mains: Periodic inspection and cleaning of the collector mains is usually recommended maintenance functions. Hydraulic flushing is most often recommended for cleaning. Pressure hoses to push pigs through the mains has also been suggested as a cleaning method, but is not recommended if the collector mains are SDR 35 pipe. Reported performance of systems has been good and, therefore, inspection and flushing has not been deemed necessary by most utilities and has seldom been performed. In systems where the mains have been inspected, no noticeable solids accumulations have been noted. The experience with SDGS in Australia is similar. Many large systems there have been operating over 30 years without main cleaning. However, regular flushing is still recommended for long flat sections in which daily peak flow velocities are less than 0.15 m/s (0.5 ft/s).

Lift Stations: Mainline lift stations should be inspected on a daily or weekly basis. Pump operation, alarms and switch function should be checked and running times of the pumps recorded. The discharge rate of each pump should be calibrated annually.

Emergency Operation

Mainline or service lateral obstructions and lift station failures require that emergency actions be taken to limit the time the systems is out of service to prevent environmental or property damage that might occur. It requires that the utilities have defined emergency operation procedures.

Obstructions: If an obstruction occurs, the utility must be able to respond quickly such that backups do not occur at upstream service connections. Usually the obstruction will be.caused by construction debris which cannot be removed by simple flushing. It may require that the main be excavated to remove the obstruction. While the obstruction is cleared, the utility must be prepared to pump from the cleanout, manhole or interceptor tank immediately above the obstruction to a cleanout or manhole below. A contractor's centrifugal suction pump or truck mounted pump works well for this.

Fortunately, obstructions have been rare. All reported obstructions have occurred soon after construction or after a service connection has made. Construction debris has been the cause. Obstructions from other causes have not been reported.

Lift Stations: Lift stations may fail due to loss of power or a mechanical failure. Standby emergency generators can be provided for power during prolonged outages, but the generators can be costly and require regular maintenance. Because of the costs, many small communities have provided added storage at the lift station (Figure 3.16) and/or truck mounted pumps that can pump from the wet well to a downstream hose connection on the forcemain (Figure 3.17). This latter method also works well for mechanical failures.

Record Keeping

Good record keeping of all operation and maintenance duties performed is essential for preventive maintenance and trouble shooting when problems occur. A daily log should be kept and maintenance reports on all equipment filed. Flows at the mainline lift stations should be estimated daily by recording the pump running times. This is helpful in evaluating whether infiltration or inflow problems are developing. A record of each service call and corrective action taken should be filed by service connection identification number. This record should include tank inspection and pumping reports. These records are particularly useful if reviewed prior to a service call out.

Troubleshooting

Odors

Odors are the most frequently reported problem with SDGS systems. Odors typically occur at lift stations and from house plumbing stack vents, particularly at homes located at higher elevations or ends of lines. Odors are most pronounced where turbulence occurs. The turbulence releases the obnoxious gases dissolved in the wastewater.

Odors at lift stations have been successfully eliminated by installing drop inlets that extend below the pump shut off level. This eliminates most of the turbulence. Other successful corrective measures include soil odor filters (Figure 3.15), air tight wet well covers and vents that extend 3 to 5 m (10-15 ft) above grade.

Odors at individual connections originate from the collection main. If a sanitary tee or similar baffle device is used at the interceptor tank inlet or outlet, the top of the tee can be sealed or capped to prevent the gases escaping into the building sewer. P-traps or running traps on the service lateral have also been used (Figure 3.13). In some cases, extension of the main further upslope to where it can be terminated in a vented subsurface gravel trench has been employed successfully. The trench filters the odors before venting the gas to the atmosphere.

Corrosion

Corrosion is a problem that is largely limited to lift stations and manholes. Nonferrous hardware must be used in lift station wet wells. Concrete manholes and wet wells must be coated with corrosion resistant materials. Alternatively, corrosion problems can be reduced in lift stations by using wet well/dry well construction with a well vented wet well.

Infiltration/Inflow

Clear water infiltration/inflow was a common problem with earlier SDGS systems that used a high percentage of existing septic tanks for interceptor tanks. Leaking tanks or building sewers were the primary entry points of clear water. Systems that have installed all new interceptor tanks and pressure test building sewers and tanks have few infiltration/inflow problems.

SYSTEM COSTS

Construction

SDGS systems have resulted in reported savings of 0 to 50% in comparison to conventional gravity sewers. The unavoidable costly component of SDGS is the installation of the interceptor tanks which in some instances, have caused the construction costs of SDGS to exceed the estimated costs of conventional sewer construction. However, the pretreatment provided by SDGS eliminates the need for primary treatment which may reduce the cost of the treatment facility.

Construction costs are affected directly by site factors and system design. Site factors include topography, depth to bedrock, depth to ground water, soil type and other factors that can affect the cost of pipeline installation. Some of these factors can be mitigated through thoughtful design. The design itself can also reduce construction costs independent of site factors.

In a study of 10 systems, construction costs of individual components were ranked from most costly to least costly as follows (Otis, 1986):

1. Collector mains
2. Interceptor tanks (including service lateral)
3. Mainline lift stations
4. Pavement restoration
5. Crossings (road, stream, utility)
6. STEP lift stations
7. Manholes
8. Site restoration
9. Force main
10. Cleanouts

This ranking suggests in which areas efforts should be made in system design and construction methods to reduce the total costs.

Costs of installing the collector mains and the inteceptor tanks typically accounts for over 50% of the total costs of construction. Pipe installation costs are affected most by the depth of excavation. Where frost does not control the depth at which the sewers must be installed, shallow placement can reduce the total costs significantly. Consideration should be given to eliminating gravity drainage for basement drains. Greater use of individual STEP units can also reduce the required depth of the collectors. Several projects have shown that hybrid systems using pressure connections into gravity collectors can be cost effective in areas of undulating topography. Reducing the depth may also eliminate the need for some mainline lift stations. Shallow placement will allow the use of continuous trenching equipment as well.

The cost of installation of the interceptor tanks and service laterals includes the cost of evacuation and abandonment of the existing septic tank. Installation costs should be reduced by combining more than one connection on one tank. However, this is seldom done.

Often times the cost of the service connection is affected by the attitude of the contractor towards working on private property. Many contractors dislike working on private property because of the insistence of the property owner for complete restoration of their property. Several methods have been used to mitigate this problem to control the cost. Video taping of each site prior to construction helps to resolve complaints concerning appropriate restoration. Letting a separate contract for the service connections to allow a smaller contractor who is typically more accustomed to working with property owners to perform the work has been effective. Placement of the interceptor tanks in the public right-of-way eliminates the need to enter private property altogether. This latter approach is seldom used because of space restrictions and the additional cost to the property owner for longer building sewer connections.

Operation and Maintenance

The most significant operation and maintenance costs of projects reviewed are labor, interceptor tank pumping and system depreciation. An operator must be on call at all times, but the time required for preventive maintenance is small. Most projects do not employ full time staff, finding that 5 to 10 hours per week is sufficient for preventive maintenance.

Interceptor tank pumping is usually performed by outside contractors. Most projects are pumping each tank every 2 t 3 years which has been found to be more frequent than necessary. Pumping of residential tanks every 7 to 10 years appears to be sufficient. Commercial establishments, particularly those with food service may require pumping every 6 to 12 months.

Other operating and maintenance costs include administration, utilities, insurance and occasional repairs. These costs account for 20 to 30 percent of the total operation and maintenance costs.

User Charges/Assessments

User charges typically include administration, operation and maintenance, depreciation and debt retirement costs. In most projects, flat rates for residential connections are charged because water meters are not provided. Surcharges are usually placed on commercial connections based on assumed water use.

Flat rates are also frequently used for assessments. These may take the form of hookup charges. A two tiered system is common. The first tier is for connections made at the time of system construction. The second is for future connections. Existing users at the time of construction are usually provided the interceptor tank and service lateral while future users must pay for the tank and lateral in addition to the hookup fee.

SYSTEM MANAGEMENT CONSIDERATIONS

User Responsibilities

Typically, the user is responsible for only the building sewer from the building to the interceptor tank. If a STEP unit is included as part of the service connection, the owner is also responsible for providing power to the control panel. Beyond these limited responsibilities, the owner must also see that access to all components of the system located on the property is maintained.

Sewer Utility Responsibilities

The utility is usually responsible for the installation, operation and maintenance of the entire system commencing at the inlet to the interceptor tank. Outside contractors may be employed to perform some tasks such as installing service connections or pumping of the interceptor tanks.

DESIGN EXAMPLE

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ALTERNATIVE CONVEYANCE SYSTEMS
SMALL DIAMETER GRAVITY SEWERS

CHAPTER 1: OVERVIEW OF ALTERNATIVE CONVEYANCE SYSTEMS

CHAPTER 3: SMALL DIAMETER GRAVITY SEWERS