ONSITE SANITARY DISPOSAL SYSTEMS COST ANALYSIS

APRIL 28, 1992

Prepared For:

Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

Prepared by:

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1.0 INTRODUCTION

This report describes cost analyses of management practices that could be used to achieve the Onsite Sanitary Disposal Systems (OSDS) management measures for new and existing development presented in the "Management Measures for Sources of Nonpoint Pollution in Coastal Waters." The purpose of the cost analyses is to provide data to compare to current baseline OSDS costs for various locations throughout the coastal zone. These comparisons will serve as a basis for judging the economic achievability of the management measures.

2.0 TECHNICAL APPROACH

Thirty-two hypothetical scenarios were developed for this analysis. Scenarios 1 through 16 are for new development and scenarios 17 through 32 are for retrofit of existing OSDS. To complete the analysis, general and specific assumptions have been made for the 32 design scenarios. Specific assumptions are included in the discussion for each scenario. The following is a list of the general assumptions for each of the 32 design scenarios:

- One house occupied by four people equipped with two full baths, one kitchen sink, one utility sink, washing machine and dishwasher
- Daily wastewater flow of 180 gallons/day (before installation of low flow plumbing fixtures
- Drainfields were sized based on 180 gallons/day
- Each house is equipped with low flow plumbing fixtures
- Only low phosphate detergent is used
- No house is equipped with a garbage disposal
- The low flow plumbing cost for the new OSDS system is based on the difference between low flow plumbing and traditional plumbing fixtures.

Designs were based on recommendations presented in EPA's "Design Manual - Onsite Wastewater Treatment and Disposal Systems" dated 1980 and TVA's design guidelines for constructed wetlands for OSDS. Specific new OSDS designs and costs were developed for the following scenarios:

- Low, medium, and high percolation rates (120, 60, and 5 minutes/inch);
- Conventional septic systems including a septic tank and a drainfield;
- Recirculating sand filters including a septic tank, dosing tank, sand filter, pump, and a drainfield for nitrogen sensitive areas;
- Vaults for areas with inadequate separation distance from the seasonally high water table;
- Package treatment including a septic tank, package treatment, and drainfield for areas with inadequate separation distance from the seasonally high water table;
- Constructed wetlands including a septic tank, dosing tank, pump, constructed wetland, and drainfield for areas with inadequate separation distance from the seasonally high water table or nitrogen sensitive areas; and
- An evapotranspiration system for the Texas area.

Retrofit designs were completed assuming that a conventional OSDS was already in place. Specific retrofit of existing OSDS designs and costs were developed for the following scenarios:

- Low, medium, and high percolation rates (120, 60, and 5 minutes/inch);
- An alternate trench system for OSDS where the drainfield has failed do to water overloads;
- Recirculating sand filters for nitrogen sensitive areas;
- Vaults for OSDS that have failed due to inadequate separation distance from the seasonally high water table;
- Package treatment for OSDS that have failed due to inadequate separation distance from the seasonally high water table;
- Constructed wetlands for OSDS that have failed due to inadequate separation distance from the seasonally high water table or for nitrogen sensitive areas; and
- An evapotranspiration system for the Texas area.

It should be noted that low flow plumbing fixtures were not included in the retrofit of existing OSDS for the recirculating sand filter, package treatment, and constructed wetlands system designs.

Cost and effectiveness data were taken from Woodward-Clyde's "Urban BMPs Cost and Effectiveness Summary Data for 6217(g) Guidance - Onsite Sanitary Disposal Systems" dated 1992. Costs were based on 1988 dollars and the specific unit costs used in the analyses are as follows:

ITEM	COST
Septic Tank (1000 gallons)	$1,750
Septic Tank (4000 gallons)	$4,450
Pump out Septic Tank	$120
Recirculating Sand Filter (including dosing tank and pump)	$1,725
Drainfield	$12/linear foot
High Efficiency Dishwasher	$480
High Efficiency Washing Machine	$475
High Efficiency Kitchen and Laundry Faucets	$57
High Efficiency Bathroom Faucet	$47
High Efficiency Toilet	$138
High Efficiency Shower Head	$31
Pump and Dosing Tank for Constructed Wetland or Evapotranspiration System	$1,050
Constructed Wetland	$1.13/sq. ft.
Evapotranspiration Evaporation Field	$6.50/sq. ft.
Package Treatment Unit	$4,440

A summary of the various design costs are included in Table 1. The following is a list of specific assumptions used in each of the Scenarios.

TABLE 1 – SUMMARY OF COSTS FOR OSDS BMP SCENARIOS

NEW OSDS BMP SCENARIO'S COST ANALYSIS

SCEN NO.	WATER LOAD (GPD)	PERC RATE (MIN/IN)	TYPE OF SYSTEM	TANK SIZE (GAL)	DRAIN FIELD SIZE (SQ. FT.)	TANK COST ($)	DRAIN FIELD COST ($)	LOW FLOW PLUMB. COST ($)	TREAT. UNIT COST ($)	DESIGN COST ($)	CAPITAL COST ($)	O&M COST ($)/YR	DESIGN LIFE (YRS)
1	180	5	CONV	1000	150	$1,750	$1,800	$100	$0	$355	$4,005	$40	30
2	180	5	RE.SAN.FIL	1000	150	$1,750	$1,800	$100	$1,725	$528	$5,903	$190	30
3	180	5	VAULTS	4000	0	$4,450	$0	$100	$0	$445	$4,995	$2,400	30
4	180	5	PACK TRT	1000	150	$1,750	$1,800	$100	$4,400	$795	$8,845	$800	30
5	180	5	CON.WET.	1000	150	$1,750	$1,800	$100	$1,500	$505	$5,655	$140	30
6	180	60	CONV	1000	400	$1,750	$3,340	$100	$0	$509	$5,699	$40	30
7	180	60	RE.SAN.FIL	1000	400	$1,750	$3,340	$100	$1,725	$682	$7,597	$190	30
8	180	60	VAULTS	4000	0	$4,450	$0	$100	$0	$445	$4,995	$2,400	30
9	180	60	PACK TRT	1000	400	$1,750	$3,340	$100	$4,400	$949	$10,539	$800	30
10	180	60	CON.WET.	1000	400	$1,750	$3,340	$100	$1,500	$659	$7,349	$140	30
11	180	120	CONV	1000	900	$1,750	$7,515	$100	$0	$927	$10,292	$40	30
12	180	120	RE.SAN.FIL	1000	900	$1,750	$7,515	$100	$1,725	$1,099	$12,189	$190	30
13	180	120	VAULTS	4000	0	$4,450	$0	$100	$0	$445	$4,995	$2,400	30
14	180	120	PACK TRT	1000	900	$1,750	$7,515	$100	$4,400	$1,367	$15,132	$800	30
15	180	120	CON.WET.	1000	900	$1,750	$7,515	$100	$1,500	$1,077	$11,942	$140	30
16	180	N/A	EVAPOTRA	1000	2250	$1,750	$14,625	$100	$1,050	$1,743	$19,268	$120	30

EXISTING OSDS BMP SCENARIO'S COST ANALYSIS

SCEN NO.	WATER LOAD (GPD)	PERC RATE (MIN/IN)	TYPE OF SYSTEM	TANK SIZE (GAL)	DRAIN FIELD SIZE (SQ. FT.)	TANK COST ($)	DRAIN FIELD COST ($)	LOW FLOW PLUMB. COST ($)	TREAT. UNIT COST ($)	DESIGN COST ($)	CAPITAL COST ($)	O&M COST ($)/YR	DESIGN LIFE (YRS)
17	180	5	ATL TRCH	1000	75	$0	$900	$1,500	$0	$90	$2,490	$40	30
18	180	5	RE.SAN.FIL	1000	150	$0	$0	$0	$1,725	$173	$1,898	$190	30
19	180	5	VAULTS	4000	150	$4,450	$0	$1,500	$0	$445	$6,395	$2,400	30
20	180	5	PACK TRT	1000	150	$0	$0	$0	$4,400	$440	$4,840	$800	30
21	180	5	CON. WET.	1000	150	$0	$0	$0	$1,500	$150	$1,650	$140	30
22	180	60	ATL TRCH	1000	200	$0	$1,670	$1,500	$0	$167	$3,337	$40	30
23	180	60	RE.SAN.FIL	1000	400	$0	$0	$0	$1,725	$173	$1,898	$190	30
24	180	60	VAULTS	4000	400	$4,450	$0	$1,500	$0	$445	$6,395	$2,400	30
25	180	60	PACK TRT	1000	400	$0	$0	$0	$4,400	$440	$4,840	$800	30
26	180	60	CON. WET.	1000	400	$0	$0	$0	$1,500	$150	$1,650	$140	30
27	180	120	ATL TRCH	1000	450	$0	$3,758	$1,500	$0	$376	$5,633	$40	30
28	180	120	RE.SAN.FIL	1000	900	$0	$0	$0	$1,725	$173	$1,898	$190	30
29	180	120	VAULTS	4000	900	$4,450	$0	$1,500	$0	$445	$6,395	$2,400	30
30	180	120	PACK TRT	1000	900	$0	$0	$0	$4,400	$440	$4,840	$800	30
31	180	120	CON. WET.	1000	900	$0	$0	$0	$1,500	$150	$1,650	$140	30
32	180	N/A	EVAPOTRA	1000	2250	$0	$14,625	$0	$1,050	$1,568	$17,243	$120	30

NOTE:

CONV.	=	Conventional Septic System
RE.SAN.FIL	=	Recirculation Sand Filter
CON. WET.	=	Constructed Wetland
ALT.TRCH.	=	Alternate Trench
PACK.TRT.	=	Package Treatment
EVAPOTRA	=	Evapotranspiration System

2.1 New OSDS - Scenarios 1 through 16

Scenario #1: Conventional OSDS for High Percolation Rate Soils

- Treatment consists of a septic tank (1000 gal.) and a drainfield.
- Drainfield size based on a loading rate of 1.2 gpd/sq. ft.
- The septic tank is pumped out once every three years.

Scenario #2: Recirculating Sand Filter for High Percolation Rate Soils

- Treatment consists of a septic tank (1000 gal.), a recirculating sand filter, and a drainfield.
- Drainfield size based on a loading rate of 1.2 gpd/sq. ft.
- The septic tank is pumped out once every three years.

Scenario #3: Vault for High Percolation Rate Soils

- Treatment consists of a vault/holding tank (4000 gal.).
- No drainfield is necessary when a holding tank is used.
- The holding tank is pumped out twice a month.

Scenario #4: Package Treatment for High Percolation Rate Soils

- Treatment consists of a septic tank (1000 gal.), a package treatment unit, and a drainfield.
- Drainfield size based on a loading rate of 1.2 gpd/sq. ft.
- The septic tank is pumped out once every three years.

Scenario #5: Constructed Wetland for High Percolation Rate Soils

- Treatment consists of a septic tank (1000 gal.), constructed wetland, and a drainfield.

- Drainfield size based on a loading rate of 1.2 gpd/sq. ft.
- Septic tank is pumped out once every three years.

Scenario #6: **Conventional OSDS for Medium Percolation Rate Soils**

- Treatment consists of a septic tank (1000 gal.) and a drainfield.
- Drainfield size based on a loading rate of 0.45 gpd/sq. ft.
- The septic tank is pumped out once every three years.

Scenario #7: **Recirculating Sand Filter for Medium Percolation Rate Soils**

- Treatment consists of a septic tank (1000 gal.), a recirculating sand filter, and a drainfield.
- Drainfield size based on a loading rate of 0.45 gpd/sq. ft.
- The septic tank is pumped out once every three years.

Scenario #8: **Vault**

- Treatment consists of a holding tank (4000 gal.).
- No drainfield is necessary when a holding tank is used.
- The holding tank is pumped out twice a month.

Scenario #9: **Package Treatment for Medium Percolation Rate Soils**

- Treatment consists of a septic tank (1000 gal.), a package treatment unit, and a drainfield.
- Drainfield size based on a loading rate of 0.45 gpd/sq. ft.
- The septic tank is pumped out once every three years.

Scenario #10: Constructed Wetland for Medium Percolation Rate Soils

- Treatment consists of a septic tank (1000 gal.), constructed wetland, and a drainfield.
- Drainfield size based on a loading rate of 0.45 gpd/sq. ft.
- Septic tank is pumped out once every three years.

Scenario #11: Conventional OSDS for Low Percolation Rate Soils

- Treatment consists of a septic tank (1000 gal.) and a drainfield.
- Drainfield size based on a loading rate of 0.2 gpd/sq. ft.
- The septic tank is pumped out once every three years.

Scenario #12: Recirculating Sand Filter for Low Percolation Rate Soils

- Treatment consists of a septic tank (1000 gal.), a recirculating sand filter, and a drainfield.
- Drainfield size based on a loading rate of 0.2 gpd/sq. ft.
- The septic tank is pumped out once every three years.

Scenario #13: Vault

- Treatment consists of a holding tank (4000 gal.).
- No drainfield is necessary when a holding tank is used.
- The holding tank is pumped out twice a month.

Scenario #14: Package Treatment for Low Percolation Rate Soils

- Treatment consists of a septic tank (1000 gal.), a package treatment unit, and a drainfield.
- Drainfield size based on a loading rate of 0.2 gpd/sq. ft.
- The septic tank is pumped out once every three years.

Scenario #15: Constructed Wetland for Low Percolation Rate Soils

- Treatment consists of a septic tank (1000 gal.), constructed wetland, and a drainfield.
- Drainfield size based on a loading rate of 0.2 gpd/sq. ft.
- Septic tank is pumped out once every three years.

Scenario #16: Evapotranspiration System

- This site has a high water table and the soil is impermeable.
- This site is assumed to be in Texas.
- Treatment consists of a septic tank (1000 gal.)and an evapotranspiration drainfield.
- Drainfield size is based on a loading rate of 0.08 gpd/sq. ft.
- The septic tank is pumped out once every three years.

2.2 Retrofit Existing OSDS - Scenarios 17 through 32

Scenario #17: Alternate Trench for High Percolation Rate Soils

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- An alternate drainfield half the size of the existing drainfield is added to existing system.
- Drainfield size based on a loading rate of 1.2 gpd/sq. ft.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are replaced with low flow plumbing fixtures.

Scenario #18: Recirculating Sand Filter for High Percolation Rate Soils

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- A recirculating sand filter is added to existing system.

- A new drainfield is not required.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

Scenario #19: **Vault**

- Existing treatment is replaced with a holding tank (4000 gal.).
- No drainfield is necessary when a holding tank is used.
- The holding tank is pumped out twice a month.
- The existing plumbing fixtures are replaced with low flow plumbing fixtures.

Scenario #20: **Package Treatment for High Percolation Rate Soils**

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- A package treatment unit is added to existing system.
- A new drainfield is not required.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

Scenario #21: **Constructed Wetland for High Percolation Rate Soils**

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- A constructed wetland is added to the existing system.
- A new drainfield is not required.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

Scenario #22: **Alternate Trench for Medium Percolation Rate Soils**

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- An alternate drainfield half the size of the existing drainfield is added to existing system.
- Drainfield size based on a loading rate of 0.45 gpd/sq. ft.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are replaced with low flow plumbing fixtures.

Scenario #23: **Recirculating Sand Filter for Medium Percolation Rate Soils**

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- A recirculating sand filter is added to existing system.
- A new drainfield is not required.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

Scenario #24: **Vault**

- Existing treatment is replaced with a holding tank (4000 gal.).
- No drainfield is necessary when a holding tank is used.
- The holding tank is pumped out twice a month.
- The existing plumbing fixtures are replaced with low flow plumbing fixtures.

Scenario #25: Package Treatment for Medium Percolation Rate Soils

- Existing treatment consists of a septic tank (1000 gal.) a drainfield.
- A package treatment unit is added to existing system.
- A new drainfield is not required.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

Scenario #26: Constructed Wetland for Medium Percolation Rate Soils

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- A constructed wetland is added to the existing system.
- A new drainfield is not required.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

Scenario #27: Alternate Trench for Low Percolation Rate Soils

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- An alternate drainfield half the size of the existing drainfield is added to existing system.
- Drainfield size based on a loading rate of 0.2 gpd/sq. ft.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are replaced with low flow plumbing fixtures.

Scenario #28: **Recirculating Sand Filter for Low Percolation Rate Soils**

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- A recirculating sand filter is added to existing system.
- A new drainfield is not required.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

Scenario #29: **Vault**

- Existing treatment is replaced with a holding tank (4000 gal.).
- No drainfield is necessary when a holding tank is used.
- The holding tank is pumped out twice a month.
- The existing plumbing fixtures are replaced with low flow plumbing fixtures.

Scenario #30: **Package Treatment for Low Percolation Rate Soils**

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- A package treatment unit is added to existing system.
- A new drainfield is not required.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

Scenario #31: **Constructed Wetland for Low Percolation Rate Soils**

- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- A constructed wetland is added to the existing system.
- A new drainfield is not required.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

Scenario #32: **Evapotranspiration System**

- This site has a high water table and the soil is impermeable.
- This site is assumed to be in Texas.
- Existing treatment consists of a septic tank (1000 gal.) and a drainfield.
- An evapotranspiration drainfield is installed in place of existing drainfield.
- The septic tank is pumped out once every three years.
- The existing plumbing fixtures are retained.

3.0 SUMMARY

The costs for the various OSDS practices varied considerably. As could be expected, the percolation rate had a strong influence on the costs because of the impacts percolation rates have on drainfield sizes.

3.1 New OSDS

For the new OSDS, the conventional system is the most cost effective. However, a conventional system cannot be used in nitrogen sensitive areas and in areas with inadequate separation distance from the seasonally high water table. For nitrogen sensitive areas, recirculating sand filters and constructed wetlands could be used. Of these to systems, the constructed wetland is slightly less expensive (about $250). However, recirculating sand filters have been more widely

applied. The TVA design procedure is relatively new and has only been widely applied to residences in Kentucky.

In areas with inadequate separation distance, vaults, package treatment, and constructed wetlands were evaluated. The constructed wetlands are the most economical practice. Vaults have a very high maintenance cost and package treatment requires much more maintenance by the homeowner than constructed wetlands.

The evapotranspiration system was evaluated because of the special characteristics of the Orange County, Texas area being evaluated for baseline cost. The system is very costly due to the size of the evaporation field required to handle the average daily loads. However, the cost of the system may be less than the cost of installing a centralized sewage treatment and collection system.

3.2 Retrofit of Existing OSDS

For OSDS that have failing drainfields due to water overloading, the alternate trench practice is an economical retrofit alternative. The alternate trench can be used initially to allow the exiting drainfield to revert to aerobic conditions. In most instances, flow can then be alternated between the new trench and the existing drainfield without causing the existing drainfield to again fail.

In nitrogen sensitive areas, the recirculating sand filter and constructed wetlands practices can be implemented for under $2,000. Again the recirculating sand filter has been the more widely applied technology. In the event that the drainfield also needs to be replaced, the implementation of these practices should include low flow plumbing fixtures. The increased cost for this option would vary from $2,400 to $5,200 depending on the percolation rate of the soil.

For retrofit due to inadequate separation distance, the constructed wetland is again the most economical alternative. For the special case of Orange County, Texas, the evapotranspiration system is still a costly practice (over $17,000 per household). However, this may still be more economical than installing a centralized sewage treatment and collection system.