



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**Waterfront Mall - 90" Diameter Rehabilitation**

1. **Project Location:** 4<sup>th</sup> & M Streets, SW, Washington, DC. This 100 year old line conveys storm drainage to the Potomac River. Since a building is to be constructed over the pipe, the District of Columbia Water and Sewer Authority (DCWASA) required it to be structurally rehabilitated.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 90", Brick (3 layers), 800 feet of rehab plus 90" Brick below spring line and Unreinforced Concrete above spring line.
3. **When was it constructed and how long has it been in service:** Put into service in 1906.
4. **Rehab method used:** Danby Panel Lok III-E spiral would into the pipe with a finished diameter of 84" with full annulus grouting with cementitious grout with minimum compressive strength of 6,000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (6,000 psi) water blasting performed by Danby installer, Boyer, Inc.
6. **Method of flow bypass or diversion, if used:** Downstream inflatable plug to prevent backflow from tidal influenced river outlet and upstream sand bag weir with 2" submersible electric pump to bypass small base flow. During storm events, sewer was evacuated and downstream plug was deflated.
7. **Depth of pipe:** 22 feet.
8. **Depth of ground water:** Below pipe due to extensive dewatering on site for other building construction.
9. **Ventilation and odor control used:** Introduced fresh air into pipe past downstream plug through downstream and mid-point manholes by exhausting air from upstream manhole.
10. **Construction cost (total amount and cost per foot):** \$819,000 / \$1,024/ft.
11. **Month and year of start-up and end of construction:** July, 2009 – Dec., 2009.
12. **Problems encountered during construction:** Heavy rains delayed work progress, curves in pipeline and large manhole with spring line shelves required customizing panel installation. Large diameter required greater care in grouting to avoid deforming liner (no separate bracing was used to support liner). Cement and fly ash supplier had QC problems in his plant which necessitated removal and replacement of substandard grout. Material supplier changed.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?**  
None yet performed.
16. **Special Awards:** Boyer, Inc. received the 2010 Craftsmanship Award for Sewer Rehab from the Washington Builders Council for this project.

Reference: Mike Barnes  
District of Columbia Water and Sewer Authority (DCWASA)  
Telephone; 202-787-4125

Chad Sargent  
Clark Construction  
Telephone: 202-479-6850



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**South Metro Interceptor 102" Diameter Rehabilitation**

1. **Project Location:** Harbor Drive, San Diego, California. This line conveys sewage for approximately one half of the Metropolitan Sewerage System service area plus approximately 10-mgd from Tijuana, Mexico.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 102", RCP (16-ft lengths), 1200 feet of rehab (plus about 390 feet of repairs to "T-Lock" liner in original pipe).
3. **When was it constructed and how long has it been in service:** Put into service in 1964; manufactured by American Pipe and Construction Co.
4. **Rehab method used:** Danby Panel Lok III in top portion of pipe from 12" below the pipe centerline (top 240°), with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi. Prior to installing liner, 6"x6"-W2.9xW2.9 welded wire mesh was mechanically fastened to pipe wall in the top 90° of the pipe.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (15,000 psi) water blasting performed by the Danby licensee (Rondeau Bay Construction).
6. **Method of flow bypass or diversion, if used:** Constructed work platform over low flow level and partially regulated flow at pump plant.
7. **Depth of pipe:** 32 feet.
8. **Depth of ground water:** 5 feet.
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** \$702,000 / \$585/ft.
11. **Month and year of start-up and end of construction:** Dec. 1994 - March 1995.  
Work hours restricted to 1 a.m. to 5:45 a.m.
12. **Problems encountered during construction:** Heavy rains delayed work, curves in pipeline required customizing panels at pipe joints (every 16 feet), and large diameter required greater care in grouting to avoid deforming liner (no separate form work was used to support liner).
13. **Problems encountered after construction:** 1999 inspection showed poor installation QC resulted in need for repairs to some joints; 2002 inspection required repair due to over-grouting.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?**  
Inspection performed January 1999; liner was generally in good condition but several joints were poorly installed and needed repairs. 2002 inspection required repair due to over-grouting.

Reference:

Bill Swallow  
Clean Water Program for Greater San Diego  
Telephone: 858-292-6485



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**EBMUD 105" RCP Rehab with Danby PL III**

1. **Project Location:** Main line into the East Bay Municipal Utility District's treatment plant in Emeryville, California; serving the entire east bay region (Oakland) of the San Francisco Bay area.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.) length of rehab portion:**  
Diameter = 105"; RCP, 352'.
3. **When was it constructed and how long has it been in service:** Unknown, not stated in contract documents.
4. **Rehab method used:** Danby Panel Lok III in top portion of pipe from 12" below the pipe centerline, with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi. Prior to installing liner, 4"x4"x1/4" welded wire mesh was mechanically fastened to pipe wall in those areas where the wall corrosion exceeded 2".
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (18,000 psi) water blasting performed by the Danby licensee (Rondeau Bay Construction).
6. **Method of flow bypass or diversion, if used:** Constructed work platform over low flow level and partially regulated flow at pump plant.
7. **Depth of pipe:** 25 feet.
8. **Depth of ground water:** 12 feet.
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** \$268,800 / \$764/ft
11. **Month and year of start-up and end of construction:** April 1993 - May 1993 (6wks); work hours were restricted to 1 a.m. to 5 a.m.
12. **Problems encountered during construction:** Significant diameter increase at crown after high pressure water blasting due to corrosion created enlarged annulus far exceeding the original estimate of surface wall loss; thus increasing the amount of welded wire mesh and grout required to meet the specification. Also, in these very large diameter pipes the grouting must be done in many more "lifts" (to limit vertical rise per lift) to avoid deforming the PVC liner.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?**  
East Bay MUD did a walk-through inspection of this pipe section on July 24, 1997 and found the liner to be in good condition and has prevented further corrosion in the lined section.

Reference:

Elsabeth Girma, P.E.  
East Bay Municipal Utility District  
Telephone: 510-287-1689



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**42" Hampton Roads Sanitation District Rehab**

1. **Project Location:** Hampton, Virginia.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 42", RCP, 1910 feet of rehab.
3. **When was it constructed and how long has it been in service:** Installed during WW II (about 1943).
4. **Rehab method used:** Danby Panel Lok III (spirally wound) with full annulus grouting with cementitious grout with minimum compressive strength of 7500 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure water jetting and vactor cleaning with some hand tool scraping performed by subcontractor.
6. **Method of flow bypass or diversion, if used:** Flows 100% pumped (about 6 mgd) around entire length of project via two 12" welded joint HDPE pipes. Laterals remained active at all times.
7. **Depth of pipe:** 8 - 15 feet.
8. **Depth of ground water:** To surface (adjacent to marina and siphoned under river).
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** \$600,000 / \$314/ft.
11. **Month and year of start-up and end of construction:** October (late) 1992 - February 1993.
12. **Problems encountered during construction:** Ground water seepage was a continual problem, requiring local suction pumping and, in especially bad locations, ground dewatering pumps (see attached photos). Heavy rains and high (flood) tides surcharged upstream pipes, requiring the removal of the pipe plugs and bypass pumps and reinstating full flow (10-12 mgd) to the project pipeline before annulus grouting; there was no damage to the liner which only had manhole bulkheads in place (see attached photos).
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Mr. Bill Salley, P.E.  
Hampton Roads Sanitary District, Virginia  
Telephone: 757-460-2261



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**54"x36" Brick Fifth Street Rehab**

1. **Project Location:** San Jose, California.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 54"x36" Egg, Brick, 6300 feet of rehab.
3. **When was it constructed and how long has it been in service:** Built in place in 1880.
4. **Rehab method used:** Danby Panel Lok III (spirally wound) with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (3,000 psi) water blasting performed by the Danby licensee (Rondeau Bay Construction, Inc.).
6. **Method of flow bypass or diversion, if used:** Flows 100% pumped/diverted during work day, but reinstated during non-work periods. Laterals remained active at all times.
7. **Depth of pipe:** 15 feet.
8. **Depth of ground water:** 10 feet.
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** \$2,380,000 / \$378/ft.
11. **Month and year of start-up and end of construction:** November 1992 - February 1993.
12. **Problems encountered during construction:** No significant problems. See attached PWM article.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Mr. Jay Schrock, P.E.  
JSC International  
Tel: 530-238-2018



**Spiral Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**42" & 48" RCP Alma Street Rehab**

1. **Project Location:** San Jose, California.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 42" & 48", RCP, 3600 feet of rehab.
3. **When was it constructed and how long has it been in service:** Unknown.
4. **Rehab method used:** Danby Spiral Lok (same cross section as PL III but only 8" wide and different edge locking design) with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi (800 psi required).
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (3,000 psi) water blasting performed by the Danby licensee (Rondeau Bay Construction).
6. **Method of flow bypass or diversion, if used:** Flows 100% diverted during work day, but reinstated during non-work periods.
7. **Depth of pipe:** 15 feet.
8. **Depth of ground water:** 10 feet.
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** \$875,000 / \$243/ft.
11. **Month and year of start-up and end of construction:** December 1990 - March 1991.
12. **Problems encountered during construction:** No significant problems.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** Yes (April 1993). The pipe was found to be in good condition.

Reference:

Mr. Ken Salvail  
City of San Jose  
Telephone: 408-277-4638



**Spiral Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**78" Los Angeles County Rehab Demonstration**

1. **Project Location:** Downey, California (Supervised by John Redner, LA County Sanitation Districts.)
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 78", RCP, 590 feet of rehab.
3. **When was it constructed and how long has it been in service:** Unknown.
4. **Rehab method used:** Danby Spiral Lok (same cross section as PL III but only 8" wide and different edge locking design) with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (3,000 psi) water blasting performed by the Danby licensee (Rondeau Bay Construction).
6. **Method of flow bypass or diversion, if used:** Flows 100% diverted by owner.
7. **Depth of pipe:** 20 feet.
8. **Depth of ground water:** 10 feet.
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** \$234,000 / \$397/ft.
11. **Month and year of start-up and end of construction:** August 1990 - September 1990 (4 weeks).
12. **Problems encountered during construction:** Installation of the Danby liner in a siphon under a street intersection slowed the completion of the project.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** Yes. The system was found to be in good condition (this section of pipe is inspected annually).

Reference:

Mr. John Redner  
Departmental Engineer, Sewerage Department  
County Sanitation Districts of Los Angeles County  
Telephone: 562-699-7411 ext.1701



**Spiral Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**60" Brick Cave Creek Rehab**

1. **Project Location:** Ottawa, Ontario, Canada.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 60", Brick, 722 feet of rehab.
3. **When was it constructed and how long has it been in service:** Unknown (probably built in mid-late 1800s).
4. **Rehab method used:** Danby Spiral Lok (same cross section as PL III but only 8" wide and different edge locking design) with full annulus grouting with cementitious grout with minimum compressive strength of 3000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (3,000 psi) water blasting performed by the Danby licensee (Taggart Construction).
6. **Method of flow bypass or diversion, if used:** Flows 100% pumped/diverted via buried temporary HDPE pipe.
7. **Depth of pipe:** 4 - 5 feet to crown.
8. **Depth of ground water:** 10 feet above pipe invert.
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** \$685,000 (Canadian); C\$975/ft. in 1990 (exchange rate about US\$0.80 = C\$1.00).
11. **Month and year of start-up and end of construction:** March 1990 - September 1990
12. **Problems encountered during construction:** Biggest problem was stopping infiltration of nearly 14 mgd from nearby aqueduct. Also, sharp S-curve in pipe and missing and protruding bricks made this a difficult first job for the Danby licensee.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** Yes. The system was found to be in good condition (see attached excerpts from report by project engineer, Larry O'Keefe).

Reference:

Mr. Larry O'Keefe  
Ottawa Regional Engineer  
Ottawa, Canada  
Telephone: 613-728-0132



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**66"/72" North Relief Trunk Sewer Rehab**

1. **Project Location:** San Jose, California.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** RCP 66" (2,560') and 72" (2110') of rehab.
3. **When was it constructed and how long has it been in service:** Unknown
4. **Rehab method used:** Danby Panel Lok III (spirally wound) with full annulus grouting with cementitious grout with minimum compressive strength of 6000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (3,000 - 10,000 psi) water blasting performed by the Danby licensee (Rondeau Bay Construction).
6. **Method of flow bypass or diversion, if used:** Flows 100% diverted during work day, but reinstated during non-work periods. Laterals remained active at all times.
7. **Depth of pipe:** 15 feet.
8. **Depth of ground water:** 10 feet.
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** \$2,599,020 / \$556.54/ft.
11. **Month and year of start-up and end of construction:** May 1996 - September 1996.
12. **Problems encountered during construction:** Some problems with establishing diversion. In addition to the known horizontal curves, there were several unexpected vertical curves (undulations creating ponds/sumps) which slowed liner installation and required transition sections in liner. Also, there was an 18" pipe crossing the interior of the pipe at the crown.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Mr. Ken Salvail  
City of San Jose  
Telephone: 408-277-4638



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**60" Cast-in-Place Concrete Pipe**

1. **Project Location:** Residential area of Houston, Texas. Pipe actually forms a foot bridge over a small river.
  2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 60", Cast-in-place concrete pipe, 1106 linear feet.
  3. **When was it constructed and how long has it been in service:** Unknown age, but severely corroded in upper 2/3 of pipe.
  4. **Rehab method used:** Danby Panel Lok III with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi.
  5. **Cleaning method used (if required) and who cleaned the line:** High pressure (10,000 psi) water blasting performed by the Danby licensee (Kinsel Industries, Inc.).
  6. **Method of flow bypass or diversion, if used:** Flows 100% pumped via 3 Godwin pumps (100% over capacity) and temporary HDPE fusion welded pipe.
  7. **Depth of pipe:** 0 -10 feet to crown.
  8. **Depth of ground water:** No ground water above pipe invert.
  9. **Ventilation and odor control used:** Fresh air pumped into pipe at upstream manhole, and suction fan at downstream manhole to provide adequate ventilation during the work periods.
  10. **Construction cost (total amount and cost per foot):** \$540,000 (\$8.14/ID in-ft).
  11. **Month and year of start-up and end of construction:** June 22 - July 24, 1998.
  12. **Problems encountered during construction:** Due to construction method used in building this pipe, variations in alignments (both horizontal and vertical) and in wall thickness were severe enough so that 54" Hobas slipliner (original choice for rehab) could not be installed. The Danby liner installed was 55" ID with alignment adjustments at discrete location as required.
  13. **Problems encountered after construction:** None.
  14. **Health and safety:** Used conventional confined space entry program.
  15. **Has any re-inspection been performed? What was the condition of the pipe?** No.
- Reference:

Mac Bakri, P.E.  
City of Houston  
Telephone: 713-646-5609  
Project: 4250-98R (GFS #R1040-06-03)



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**108" Concrete Storm Drain**

1. **Project Location:** Downtown Houston, Texas. Pipe runs under Austin Street, near the Convention Center and was part of the Grand Prix racecourse in October 1998.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 108", Concrete block built-in-place pipe, 655 linear feet; also approximately 60 feet of 120".
3. **When was it constructed and how long has it been in service:** Unknown age. Cracks in crown and about 30° from invert possibly caused by nearby excavation causing loss of side soil support.
4. **Rehab method used:** Danby Panel Lok with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi. Also used external grouting to consolidate side soil support.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (10,000 psi) water blasting performed by the Danby licensee (Kinsel Industries, Inc.).
6. **Method of flow bypass or diversion, if used:** None.
7. **Depth of pipe:** 15 feet to crown.
8. **Depth of ground water:** Five (5) feet of ground water above pipe invert.
9. **Ventilation and odor control used:** Fresh air pumped into pipe at upstream manhole, and suction fan at downstream manhole to provide adequate ventilation during the work periods.
10. **Construction cost (total amount and cost per foot):** \$750,000 (\$9.62/ID in-ft).
11. **Month and year of start-up and end of construction:** August 15-October 30, 1998.
12. **Problems encountered during construction:** In addition to the cracks, there were several abrupt offsets in the pipe alignment (mostly vertical); at one point, for example, there is the equivalent of a "dropped joint" where the flow channel has a vertical dimension of only 94" while the horizontal diameter is 108". Twelve inches downstream from this point the pipe returns to approximately circular with a diameter of 108". Hurricane induced rains produced surcharge flows when the project was about 75% complete (about 550ft lined, only about 400ft with various grout levels). All work in progress survived without damage.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Gary Oradat, P.E.

City of Houston (Now with Coastal Water Authority, Tel: 713-658-9020)

Telephone: 713-837-0448

Project: N-0671-01-3



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**66" x 66" Semi-Elliptical Sewer**

1. **Project Location:** Joint Outfall "A" Unit 3C Trunk Sewer, County Sanitation District No. 2.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 66" x 66" Semi-Elliptical Sewer made of unreinforced concrete with clay tile lining. Original project was designed as 1305' of rehab but later reduced to about 800'.
3. **When was it constructed and how long has it been in service:** Unknown age. Many clay tiles had fallen off and the exposed concrete was severely corroded
4. **Rehab method used:** Danby Panel Lok with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi. Panel Lok flat panels arched from "J" strip anchors at invert corners. No lining of invert. Section under railroad track had 4" of grout and steel rebar designed by District's structural engineers.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (10,000 psi) water blasting performed by the Danby licensee (Sancon Technologies, Inc.).
6. **Method of flow bypass or diversion, if used:** None. Pipe was out of service.
7. **Depth of pipe:** 3 to 5 feet to crown.
8. **Depth of ground water:** No ground water.
9. **Ventilation and odor control used:** Fresh air pumped into pipe at upstream manhole, and suction fan at downstream manhole to provide adequate ventilation during the work periods.
10. **Construction cost (total amount and cost per foot):** Unknown because of negotiated change in scope. Danby estimates \$690/ft.
11. **Month and year of start-up and end of construction:** August 1 -October 20, 1999.
12. **Problems encountered during construction:** None. Transitions into and out of the thicker grout wall section, as well as from semi-elliptical pipe into circular 60" pipe slowed normal productivity. Danby and licensee sought and received permission to change grout mix design to lower heat of hydration in thicker section.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Jane Fong  
County Sanitation Districts of Los Angeles County  
Telephone: 562-699-7411, ext. 1631



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**120" CMP Culvert**

1. **Project Location:** Canton, Illinois.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 120" CMP (400' – double barrel).
3. **When was it constructed and how long has it been in service:** Unknown
4. **Rehab method used:** Danby Panel Lok IIIE (spirally wound) with full annulus grouting with cementitious grout with minimum compressive strength of 6000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (3,000 - 10,000 psi) water blasting performed by the Danby contractor (L. J. Keefe Inc./Chicago).
6. **Method of flow bypass or diversion, if used:** Flows 100% diverted during work day to second barrel while lining was underway in first barrel.
7. **Depth of pipe:** 35 feet.
8. **Depth of ground water:** 10 feet.
9. **Ventilation and odor control used:** Not required (good natural ventilation).
10. **Construction cost (total amount and cost per foot):** \$500,000 / \$1250/ft.
11. **Month and year of start-up and end of construction:** May 2001 – November 2001.
12. **Problems encountered during construction:** Some problems with QC of grout supplier resulting in variations in grout mix properties. Better vendor QC solved problem.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** Yes, in Jan 2009; report states that "Overall, the system has performed well" but some minor cracking and gouges due to large debris impact.

Reference:

Mr. Nicholas Volk  
Illinois Dept. of Transportation  
Telephone: 309-691-5355  
IDOT Contract #88750



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**72" & 84" CMP Culverts**

1. **Project Location:** Coos County, OR.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 72" and 84" CMP (125 ft of 72" and 90 ft of 84").
3. **When was it constructed and how long has it been in service:** Unknown
4. **Rehab method used:** Danby Panel Lok IIIE (84") and Panel Lok III (72") (spirally wound) with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (3,000 - 10,000 psi) water blasting performed by the Danby contractor (Houshour Inc.).
6. **Method of flow bypass or diversion, if used:** None required.
7. **Depth of pipe:** 20-30 feet.
8. **Depth of ground water:** 10 feet.
9. **Ventilation and odor control used:** Not required (good natural ventilation).
10. **Construction cost (total amount and cost per foot):** \$220,000; \$1023/ft. (Includes some non Danby work.)
11. **Month and year of start-up and end of construction:** July 2002 – September 2002.
12. **Problems encountered during construction:** Some problems with grout mixer producing inconsistent grout mixes; change to Danby recommended mixer solved problem.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Mr. John Woodroof  
Oregon Dept. of Transportation  
Telephone: 503-986-3366



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**78" Cast-in-Place Concrete Pipe**

1. **Project Location:** Sims Bayou area of Houston, Texas. Pipe runs across/under and along Interstate Highway I 45.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 78"/84", Cast-in-place reinforced concrete pipe, 8164/279 linear feet.
3. **When was it constructed and how long has it been in service:** Unknown age, but severely corroded in upper 1/2 of pipe.
4. **Rehab method used:** Danby Panel Lok with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (10,000 psi) water blasting performed by the Danby licensee (Kinsel Industries, Inc.).
6. **Method of flow bypass or diversion, if used:** Flows 100% pumped bypass.
7. **Depth of pipe:** 13 - 15 feet to crown.
8. **Depth of ground water:** Ground water 1.0 – 5.0 feet above pipe crown.
9. **Ventilation and odor control used:** Fresh air pumped into pipe at upstream manhole, and suction fan at downstream manhole to provide adequate ventilation during the work periods.
10. **Construction cost (total amount and cost per foot):** \$5,056,311(\$7.80/ID in-ft).
11. **Month and year of start-up and end of construction:** August 1998 – June 1999.
12. **Problems encountered during construction:** Due to construction method used in building this pipe, variations in alignments (both horizontal and vertical) and in wall thickness were severe. The Danby liner installed was 72"-75" ID with alignment adjustments at discrete location as required. Due to high flows from side sewers in the downstream portion of this line, the 84" section was sliplined with Hobas FRP pipe.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Ken Korb, P.E.  
Pate Engineers  
Telephone: 713-462-3178  
Project: GFS #R-2002-01-3, File No. 4707-1



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**66" North Relief Trunk Sewer Rehab #2**

1. **Project Location:** San Jose, California.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 66" (1,806').
3. **When was it constructed and how long has it been in service:** Unknown
4. **Rehab method used:** Danby Panel Lok III (spirally wound) with full annulus grouting with cementitious grout with minimum compressive strength of 6000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (3,000 - 10,000 psi) water blasting performed by the Danby licensee (Stacy & Witbeck Inc.).
6. **Method of flow bypass or diversion, if used:** Flows 100% diverted during work day, but reinstated during non-work periods. Laterals remained active at all times.
7. **Depth of pipe:** 15 feet.
8. **Depth of ground water:** 10 feet.
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** \$1,588,000; \$879.29/ft.
11. **Month and year of start-up and end of construction:** May 2000 – November 2000.
12. **Problems encountered during construction:** Some problems with establishing diversion. Hydroblast cleaning revealed significantly more crown corrosion than anticipated and some delay encountered while design review was conducted.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Mr. Ken Salvail  
City of San Jose  
Telephone: 408-277-4638



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**58"/60"/66" RCP Sewer**

1. **Project Location:** 1900 Block of Probandt Street, San Antonio, TX.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 58"/60"/66" RCP Sewer; lengths 110'/20'/524'; severe corrosion in crown.
3. **When was it constructed and how long has it been in service:** Unknown
4. **Rehab method used:** Danby Panel Lok III (spirally wound) with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (3,000 - 10,000 psi) water blasting performed by the Danby licensee (Kinsel Industries Inc.).
6. **Method of flow bypass or diversion, if used:** Flows 100% diverted during work day, but reinstated during non-work periods.
7. **Depth of pipe:** 15 feet.
8. **Depth of ground water:** 10 feet.
9. **Ventilation and odor control used:** Fresh air pumped into pipe past upstream air dam; maintained sealed lids during non-work periods, and adequate ventilation to carry odors downstream during the work periods.
10. **Construction cost (total amount and cost per foot):** Unknown (to Danby LLC).
11. **Month and year of start-up and end of construction:** August 1999-September 1999.
12. **Problems encountered during construction:** None
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Mr. Jeffrey J. Haby, P.E., Project Engineer  
San Antonio Water System, SAWS Project No. 99-3528  
Telephone: 210-704-7182



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**60" x 70" Semi-Elliptical Sewer**

1. **Project Location:** West Los Angeles Interceptor Sewer Rehabilitation & Venice Jasmine Diversion Sewer W.O. E2000743 & E2000822, Culver City, California.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 60" x 70" Semi-Elliptical Sewer made of unreinforced concrete; project length of 3,750 linear feet. Severe corrosion in crown of sewer (as much as 5" of the 7" original wall thickness).
3. **When was it constructed and how long has it been in service:** Cast-in-place construction in the early 1900's.
4. **Rehab method used:** Danby Panel Lok with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi. Panel Lok flat panels arched from "J" strip anchors at invert corners. No lining of invert.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (10,000 psi) water blasting performed by the Danby licensee (Stacy & Witbeck, Inc.).
6. **Method of flow bypass or diversion, if used:** Full bypass pumping of 21 MGD flow.
7. **Depth of pipe:** 5 to 20 feet to crown.
8. **Depth of ground water:** No ground water.
9. **Ventilation and odor control used:** Fresh air pumped into pipe at upstream manhole, and suction fan at downstream manhole to provide adequate ventilation during the work periods. Odor control of exhaust air as required by City.
10. **Construction cost (total amount and cost per foot):** \$3,742,000 / \$1,000/ft (includes approximately \$1,400,000 in bypass cost).
11. **Month and year of start-up and end of construction:** June 1997 – June 1998.
12. **Problems encountered during construction:** Initial specifications required monolithic grouting that, in turn, required formwork. Use of wood forms impeded cooling at the PVC surface resulting in excessive temperature differential across the grout thickness that resulted in cracking of the grout (high cement content produced high heat of hydration). Removal of forms and stage grouting resolved the problem. Grout cracks repaired by injecting epoxy grout.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Steve Nakaido, P.E.  
Collection Systems Engineering Division, City of Los Angeles  
Telephone: 213-847-8430



**Panel Lok Pipe Renovation System  
Danby LLC (formerly Danby of North America, Inc.)**

**78" Cast-in-Place Concrete Pipe**

1. **Project Location:** Sims Bayou area of Houston, Texas. Pipe runs across/under and along Interstate Highway I 45.
2. **Diameter of line, sewer pipe material (RCP, MCIP, brick, etc.), length of rehab portion:** 78"/72", Cast-in-place reinforced concrete pipe, 8500/1500 linear feet.
3. **When was it constructed and how long has it been in service:** Unknown age, but severely corroded in upper 1/2 of pipe.
4. **Rehab method used:** Danby Panel Lok with full annulus grouting with cementitious grout with minimum compressive strength of 5000 psi. Rebar reinforcement added where original rebar was corroded.
5. **Cleaning method used (if required) and who cleaned the line:** High pressure (10,000 psi) water blasting performed by the Danby contractor (Boyer, Inc.) after debris removal from invert by specially designed buckets and rough cleaning of walls with large pneumatic tires used as "squeegees". (See ASCE Pipelines 2005 Conference paper *Structural Rehabilitation of Cast-In-Place Concrete Sewers*.)
6. **Method of flow bypass or diversion, if used:** Flows 100% diverted bypass.
7. **Depth of pipe:** 13 - 15 feet to crown.
8. **Depth of ground water:** Ground water 1.0 – 5.0 feet above pipe crown.
9. **Ventilation and odor control used:** Fresh air pumped into pipe at upstream manhole, and suction fan at downstream manhole to provide adequate ventilation during the work periods.
10. **Construction cost (total amount and cost per foot):** \$5,056,311(\$7.80/ID in-ft).
11. **Month and year of start-up and end of construction:** September 2004 – June 2005.
12. **Problems encountered during construction:** Due to construction method used in building this pipe, variations in alignments (both horizontal and vertical) and in wall thickness were severe. The Danby liner installed was 4" ID smaller than host pipe with alignment adjustments at discrete location as required.
13. **Problems encountered after construction:** None.
14. **Health and safety:** Used conventional confined space entry program.
15. **Has any re-inspection been performed? What was the condition of the pipe?** No.

Reference:

Tyler Mosher, P.E.  
Weston Solutions, Inc.  
Telephone: 713-985-6660