3/16/04 NWIRP MEETING

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ARUSI ENVIRONMENTAL SERVICES

Locus TECHNOLOGIES

THE CLOSED-LOOP *IN SITU* BIOREMEDIATION SYSTEM

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Agenda

- Company Overview
- The Closed Loop In-Situ Bioremediation System
  - Description
  - Operation
  - Additives
  - Case Studies
  - Advantages
- NWIRP Bethpage AOC 22 Project Overview
- Questions and Discussion

ARUSI Company Overview

- Multi-Disciplined Environmental, Construction Management, Engineering and Design Firm
- 8(a) Certified Minority Owned and Operated with a Proven Track Record of Success
- Formed in 1987 and Have Completed Over $50 Million in Projects of Varying Scopes
- Headquartered in Phoenix, Arizona with Offices in Various Locations in the Southwest
- 2-Time Recipient of the Outstanding Minority Business Achievement Award from the City of Phoenix
- Selected as the Grand Canyon Minority Supplier of the Year in 2002

Locus Company Overview

- Highly Innovative ENR 200 Environmental Consulting and Engineering Firm
- Locus specializes in:
  - Consulting
  - Design
  - Construction
  - Information Management
  - Automation Services
- Headquartered in Walnut Creek, California with Offices throughout California, in Phoenix AZ, Boston MA, Asheville NC, and Paris France

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Company Overview

Who we serve:

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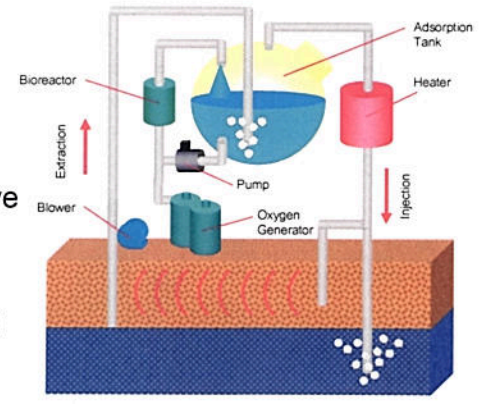
The Closed-Loop *In-Situ* Bioremediation System

System Description

- In Situ Bioremediation
- Utilizes Indigenous Microorganisms
- Creates a Subsurface Environment Conducive to Biodegradation of Contaminants
- Continuous Monitoring of the Environment Using Above Ground Bioreactor



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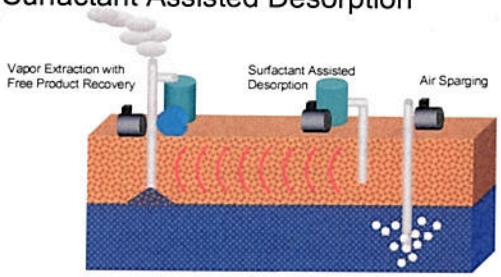
The Closed-Loop *In-Situ* Bioremediation System

System Description

- Combines Proven Technologies:
  - Vapor Extraction with Free Product Recovery
  - Air Sparging
  - Surfactant Assisted Desorption



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The Closed-Loop *In-Situ* Bioremediation System

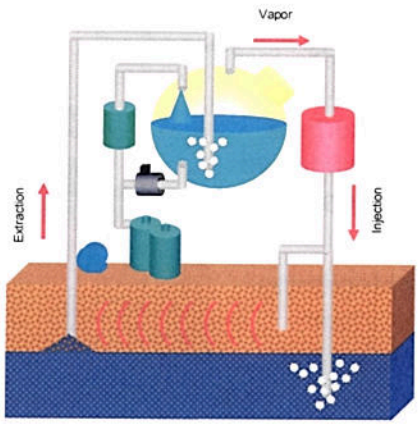
System Operation

Liquid media is recirculated through the bioreactor. O2 and nutrients are added to promote growth of desired microorganisms.

Soil vapor is sparged into the adsorption tank

Soil vapor is extracted from Subsurface bioreactor

Prior to starting the system, Any existing free product is recovered



Vapor containing the desired microorganism, moisture, nutrients and heat exits the adsorption tank

Nutrients, heat, and surfactant are added and injected into the subsurface environment

A subsurface bioreactor is created and maintained.

Vapor from the above-ground Bioreactor oxygenates the groundwater and volatizes the contaminant

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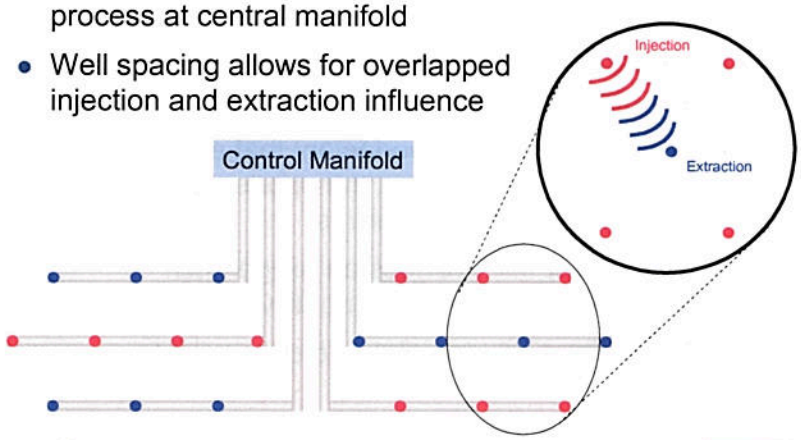
The Closed-Loop *In-Situ* Bioremediation System

System Operation

- Control of injection and extraction process at central manifold
- Well spacing allows for overlapped injection and extraction influence



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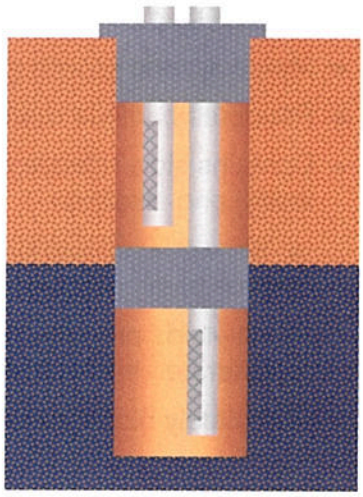
The Closed-Loop *In-Situ* Bioremediation System

System Operation

- Nested injection and extraction wells
- Targets treatment at a precise depth
- Accounts for heterogeneous soil strata



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The Closed-Loop *In-Situ* Bioremediation System

The Biotreatment Additives

- Meta-Boost[SM] – Enhances the metabolic rate of bacteria
- Nitro-Boost[SM] – Provides nitrogen, phosphorus, and other nutrients
- Desorb-A[SM] – Foam surfactant that emulsifies adsorbed hydrocarbons, transports nutrients, oxygen, and microorganisms
- Deep-Treat[SM] – Provides an oxygen rich environment, removes competitive microorganisms
- All additives are completely biodegradable

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The Closed-Loop *In-Situ* Bioremediation System

Meta-Boost [SM]

- Metabolic and growth stimulator for bacteria
- Promotes bacteria reproduction
- Contains slow release carbons (humic and fulvic acids) and alkaloids
  - Slow release carbons provide a ready food source to support and promote bacterial growth
  - Alkaloids promote rapid cell growth resulting in accelerated bacterial reproduction
- Completely biodegradable

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The Closed-Loop *In-Situ* Bioremediation System

Nitro-Boost SM

- Nutrient solution for bacteria
- Provides nitrogen, phosphorus, and other nutrients
- Contains micro nutrients including ammonium nitrate, monoammonium phosphate
- Completely biodegradable

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The Closed-Loop *In-Situ* Bioremediation System

Deep-Treat SM

- Provides an oxygen rich environment, removes competitive microorganisms
- Contains hydrogen peroxide and mineral water
- Variable H_2O_2 concentration for different applications:
  - Fenton's Reagent – 5-20% H_2O_2 concentration with chelated iron
  - Oxigenating the subsurface – 2 ppm H_2O_2 concentration
  - Removing biomass build-up – 3% H2O2 concentration
- Completely biodegradable

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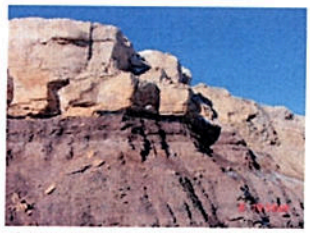
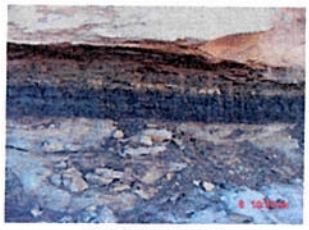
The Closed-Loop *In-Situ* Bioremediation System

Key Ingredient

- Key ingredient in additives derived from Leonardite deposit aged 75 million years
- Optimum quality due to unique geologic history
- 12% Humic Acid
- 2-3% Fulvic Acid



Sealed Rock Cap Covering Humic Deposit



Humic Shale Deposit

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The Closed-Loop *In-Situ* Bioremediation System

Desorb-A SM

- Biosurfactant wetting agent
- Foam surfactant that emulsifies adsorbed hydrocarbons
- Acts as the transport media for nutrients, oxygen, and microorganisms to the subsurface bioreactor
- Contains mixture of ionic and neutral surfactants including naturally generated surfactant from *pseudomonas aeruginosa* bacteria
- Completely biodegradable

The Closed-Loop *In-Situ* Bioremediation System

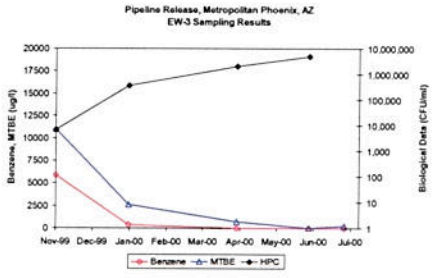
Case Study 1 – Major Pipeline Company

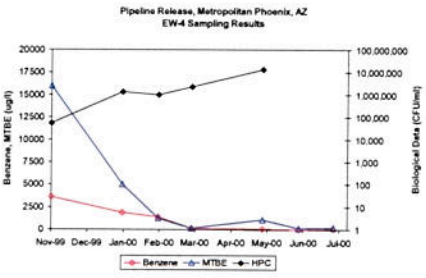
- Refined Product Pipeline Release of Gasoline with MTBE, Jet Fuel
- South of Metropolitan Phoenix, Arizona, November 1999 - July 2000

The Closed-Loop *In-Situ* Bioremediation System

Case Study 1 – Continued

- Reduction in Benzene & MTBE Over 8 Months of Operation
- Concurrent Growth of Microorganism Colonies
- Engineered Closed-Loop System Yielded Accelerated Results

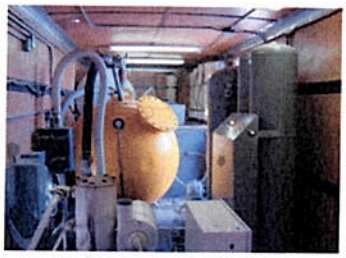




The Closed-Loop *In-Situ* Bioremediation System

Case Study 2 – Major Oil Company

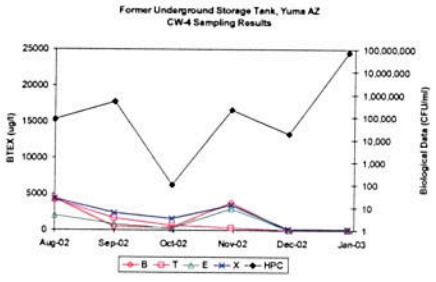
- Former Underground Storage Tank Release of Refined Gasoline and Petroleum
- Yuma, Arizona, July 2002 – March 2003

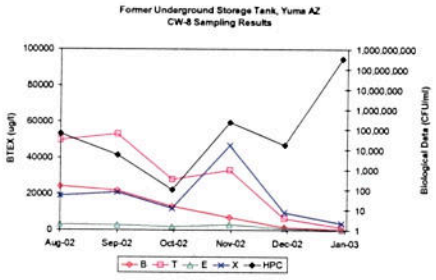


The Closed-Loop *In-Situ* Bioremediation System

Case Study 2 – Continued

- Free Product Removal in Less Than 60 Days
- Reduction in BTEX Over 5 Months of Operation
- Concurrent Growth of Microorganism Colonies
- Engineered Closed-Loop System Yielded Accelerated Results





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The Closed-Loop *In-Situ* Bioremediation System

System Advantages

- Integration of Known Remediation Techniques
- Time Efficient = Cost Effective
  - Less Time On-Site for Remediation
  - Faster Return of the Property to Productivity
- Effective Remediation of Soil and Groundwater
- Closed-Loop – No Atmospheric Emissions or Effluent Streams Produced
- In-Situ Treatment – Minimizes Site Disruption

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The Closed-Loop *In-Situ* Bioremediation System

System Advantages

- Demonstrated Effectiveness vs. BTEX, MTBE and "Heavy End" Petroleum Constituents
- Adapted to Address Solvents and Perchlorates
- Accepted by NFESC Under the Innovative Technologies BAA
  - Abstract can be viewed on the DENIX website
  - Titled: "The Closed-Loop Bioreactor System for *In-Situ* Bioremediation of Contaminated Soil and Groundwater"

DENIX.osd.

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NWIRP Bethpage AOC 22 Project Overview

Project Background

- Former UST site located south of Plant 3.
- Investigations between 1997-2002 confirmed the presence of petroleum product in soils at 10-60 ft bgs.
- The Navy has selected an active remediation approach based on NYSDEC comments.
- The pilot project objective is mass removal of fuel oil #4 and #6 from soil between 10-60 ft bgs.
- VOC impacted groundwater at AOC 22 is being addressed separately under another project.

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NWIRP Bethpage AOC 22 Project Overview

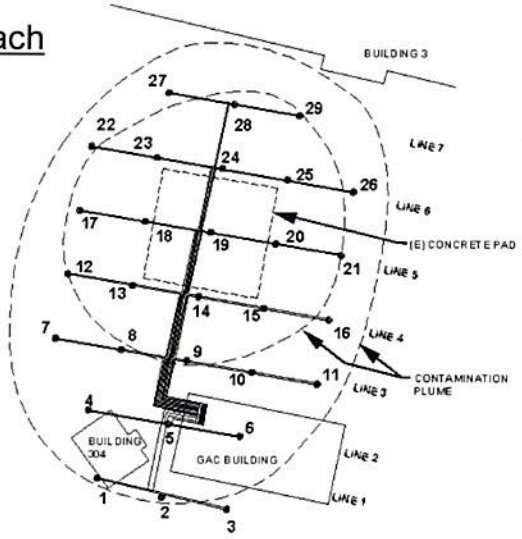
Project Approach

- Free Product Recovery (3-4 Months)
- Mobilization of Fuel Oil #6 (2 Months)
  - Surfactant application to soil above water table
  - Hydrogen Peroxide (Fenton's Reagent) oxidation below water table
- Closed-Loop Bioremediation (12 Months)
  - Creation of subsurface bioreactor
  - 12 treatment cycles, 1 month each

NWIRP Bethpage AOC 22 Project Overview

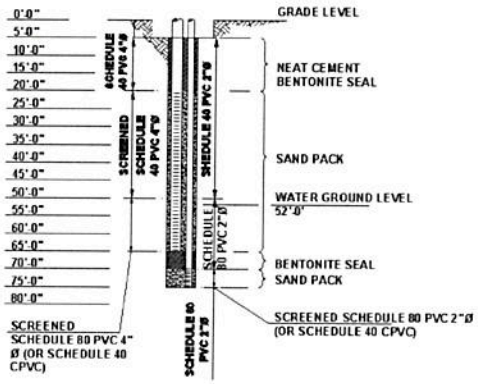
Project Approach

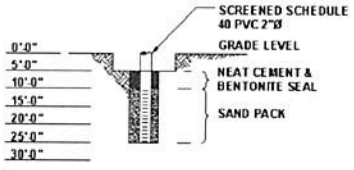
Remediation Wells and Piping Design



NWIRP Bethpage AOC 22 Project Overview

Project Approach





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NWIRP Bethpage AOC 22 Project Overview

Project Milestones

Design, Plans, Permits	2/04 – 7/04
Mobilization, System Installation	7/04 – 10/04
System Operation	10/04 – 10/05
- Groundwater Sampling & Analysis	Monthly
- Soil Sampling & Analysis	Every 2 Months
Final Report / Closeout	11/05 – 3/06
Site Restoration	3/06 – 5/06

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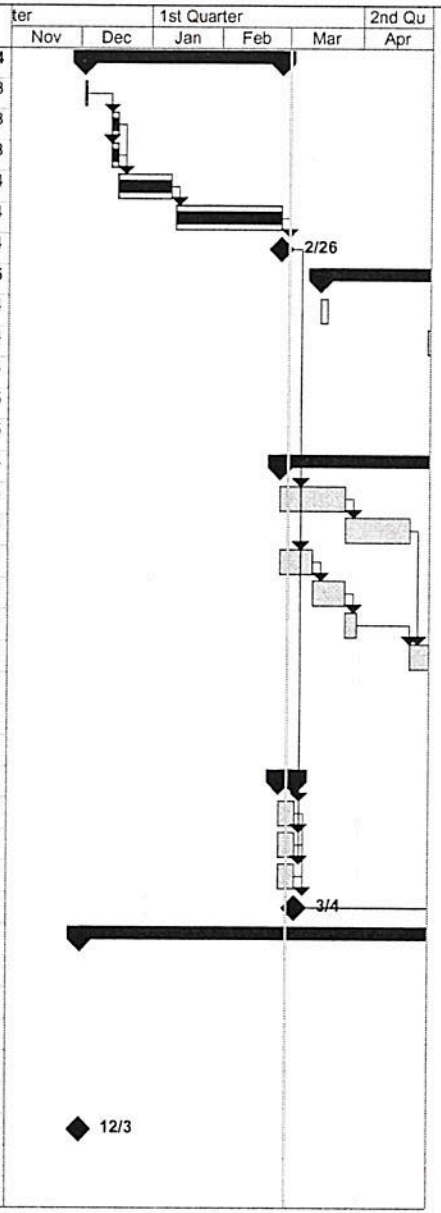
Additional Questions & Discussion

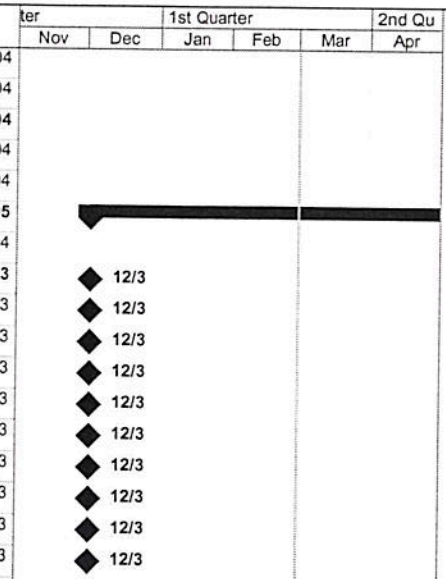
ID	Phase	ID	Task Name	Duration	Start	Finish
1	1000	1	**Task 1 - Pre Design Meeting / Site Walk**	**56 days**	**Wed 12/3/03**	**Thu 2/26/04**
2	1010	2	Fact Finding Conference Call	1 day	Wed 12/3/03	Wed 12/3/03
3	1020	3	Pre Design Meeting	3 days	Mon 12/15/03	Wed 12/17/03
4	1030	4	Site Walk	3 days	Mon 12/15/03	Wed 12/17/03
5	1040	5	Project Proposal	11 days	Thu 12/18/03	Fri 1/9/04
6	1050	6	Customer Review and Negotiations	34 days	Mon 1/12/04	Thu 2/26/04
7	1060	7	Project Award	0 days	Thu 2/26/04	Thu 2/26/04
8	**1500**	**8**	**Task 1.5 CLB Technology Introductions and Presentation**	**290 days**	**Mon 3/15/04**	**Tue 5/3/05**
9	1510	9	Technology Introduction to NYSDEC	3 days	Mon 3/15/04	Wed 3/17/04
10	1520	10	RAB Meeting 1 (April 2004)	3 days	Fri 4/30/04	Tue 5/4/04
11	1530	11	RAB Meeting 2 (August 2004)	3 days	Tue 8/31/04	Thu 9/2/04
12	1540	12	RAB Meeting 3 (December 2004)	3 days	Thu 12/30/04	Tue 1/4/05
13	1550	13	RAB Meeting 4 (April 2005)	3 days	Fri 4/29/05	Tue 5/3/05
14	**2000**	**14**	**Task 2 - Develop RAP, HASP, System Design Drawings**	**100 days**	**Fri 2/27/04**	**Mon 7/19/04**
15	2010	15	Develop Remedial Action Plan, Health & Safety Plan 50% Drafts	20 days	Fri 2/27/04	Thu 3/25/04
16	2020	16	Complete Remedial Action Plan, Health & Safety Plan Draft	20 days	Fri 3/26/04	Thu 4/22/04
17	2030	17	Develop System Design	10 days	Fri 2/27/04	Thu 3/11/04
18	2040	18	Develop System Design & Drawings	10 days	Fri 3/12/04	Thu 3/25/04
19	2050	19	RAP, HASP, Design Presentation	3 days	Fri 3/26/04	Tue 3/30/04
20	2060	20	NAVFAC, NYSDEC Review of Drafts	20 days	Fri 4/23/04	Thu 5/20/04
21	2070	21	Response to NAVFAC, NYSDEC	10 days	Fri 5/21/04	Fri 6/4/04
22	2080	22	Final Draft Submission	10 days	Mon 6/7/04	Fri 6/18/04
23	2090	23	Final Draft - Client Approval (not to exceed 45 days)	20 days	Mon 6/21/04	Mon 7/19/04
24	**3000**	**24**	**Task 3 - Site Construction, Environmental, and Drilling Permits**	**5 days**	**Fri 2/27/04**	**Thu 3/4/04**
25	3010	25	Site Construction Permits (if Necessary)	5 days	Fri 2/27/04	Thu 3/4/04
26	3020	26	Environmental Permits (if Necessary)	5 days	Fri 2/27/04	Thu 3/4/04
27	3030	27	Drilling Permits (if Necessary)	5 days	Fri 2/27/04	Thu 3/4/04
28	3040	28	Site Cleared for Work	0 days	Thu 3/4/04	Thu 3/4/04
29	**4000**	**29**	**Task 4 - CLB Well and Piping Infrastructure Installation**	**226 days**	**Wed 12/3/03**	**Tue 10/26/04**
30	4010	30	Utility Location (Potholing)	3 days	Tue 7/20/04	Thu 7/22/04
31	4020	31	Drilling Mobilization	1 day	Fri 7/23/04	Fri 7/23/04
32	4030	32	Drilling and Installation of 28 Deep Treatment Wells	45 days	Mon 7/26/04	Mon 9/27/04
33	4040	33	Drilling and Installation of 6 Shallow Treatment Wells	5 days	Mon 7/26/04	Fri 7/30/04
34	4060	34	Decontamination, Collection and Disposal of IDW	45 days	Mon 7/26/04	Mon 9/27/04
35	4070	35	Drilling and Installation, Decon, IDW 50% Complete Milestone	0 days	Wed 12/3/03	Wed 12/3/03
36	4080	36	Demobilization	1 day	Tue 9/28/04	Tue 9/28/04
37	4090	37	Trenching and Infrastructure Installation	20 days	Wed 9/29/04	Tue 10/26/04



Project: Bethpage CLB Pilot Demo
Date: Mon 3/1/04

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

ID	Phase	ID	Task Name	Duration	Start	Finish
38	4100	38	Soil Analytical	55 days	Mon 7/26/04	Mon 10/11/04
39	4110	39	Groundwater Analytical	55 days	Mon 7/26/04	Mon 10/11/04
40	**4500**	**40**	**Task 4.5 - Overhead Power Distribution System**	**40 days**	**Tue 7/20/04**	**Tue 9/14/04**
41	4510	41	Design Coordination and Approval	20 days	Tue 7/20/04	Mon 8/16/04
42	4520	42	Installation	20 days	Tue 8/17/04	Tue 9/14/04
43	**5000**	**43**	**Task 5 - Start Up and Operation of the CLB System**	**480 days**	**Wed 12/3/03**	**Wed 10/26/05**
44	5005	44	Mobilization and System Start Up	5 days	Wed 10/27/04	Tue 11/2/04
45	**5010**	**45**	**System Performance (Sliding Scale)**	**0 days**	**Wed 12/3/03**	**Wed 12/3/03**
46	5015	46	First Milestone 10% Reduction	0 days	Wed 12/3/03	Wed 12/3/03
47	5020	47	Second Milestone 20% Reduction	0 days	Wed 12/3/03	Wed 12/3/03
48	5025	48	Third Milestone 30% Reduction	0 days	Wed 12/3/03	Wed 12/3/03
49	5030	49	Fourth Milestone 40% Reduction	0 days	Wed 12/3/03	Wed 12/3/03
50	5035	50	Fifth Milestone 50% Reduction	0 days	Wed 12/3/03	Wed 12/3/03
51	5040	51	Sixth Milestone 60% Reduction	0 days	Wed 12/3/03	Wed 12/3/03
52	5045	52	Seventh Milestone 70% Reduction	0 days	Wed 12/3/03	Wed 12/3/03
53	5050	53	Eighth Milestone 80% Reduction	0 days	Wed 12/3/03	Wed 12/3/03
54	5055	54	Ninth Milestone 90% Reduction	0 days	Wed 12/3/03	Wed 12/3/03
55	**5060**	**55**	**1st Treatment Cycle**	**31 days**	**Tue 11/2/04**	**Fri 12/17/04**
74	**5155**	**74**	**2nd Treatment Cycle**	**30 days**	**Thu 12/2/04**	**Mon 1/17/05**
93	**5250**	**93**	**3rd Treatment Cycle**	**33 days**	**Sat 1/1/05**	**Wed 2/16/05**
106	**5315**	**106**	**4th Treatment Cycle**	**33 days**	**Sat 1/29/05**	**Wed 3/16/05**
119	**5380**	**119**	**5th Treatment Cycle**	**33 days**	**Sat 2/26/05**	**Wed 4/13/05**
132	**5445**	**132**	**6th Treatment Cycle**	**33 days**	**Sat 3/26/05**	**Wed 5/11/05**
145	**5510**	**145**	**7th Treatment Cycle**	**33 days**	**Sat 4/23/05**	**Thu 6/9/05**
158	**5575**	**158**	**8th Treatment Cycle**	**32 days**	**Sat 5/21/05**	**Thu 7/7/05**
171	**5640**	**171**	**9th Treatment Cycle**	**32 days**	**Sat 6/18/05**	**Wed 8/3/05**
184	**5705**	**184**	**10th Treatment Cycle**	**33 days**	**Sat 7/16/05**	**Wed 8/31/05**
197	**5770**	**197**	**11th Treatment Cycle**	**32 days**	**Sat 8/13/05**	**Wed 9/28/05**
210	**5835**	**210**	**12th Treatment Cycle**	**33 days**	**Sat 9/10/05**	**Wed 10/26/05**
223	**6000**	**223**	**Task 6 - Confirmation Borings**	**223 days**	**Mon 1/3/05**	**Mon 11/14/05**
224	**6010**	**224**	**Soil Confirmation Boring 1**	**26 days**	**Mon 1/3/05**	**Mon 2/7/05**
225	6020	225	Drilling Mobilization	1 day	Mon 1/3/05	Mon 1/3/05
226	6030	226	Drilling and Sample Collection	5 days	Tue 1/4/05	Mon 1/10/05
227	6040	227	IDW Collection, Transportation, and Disposal	5 days	Tue 1/11/05	Mon 1/17/05
228	6050	228	Soil Analytical	15 days	Tue 1/18/05	Mon 2/7/05
229	**6060**	**229**	**Soil Confirmation Boring 2**	**26 days**	**Mon 2/28/05**	**Mon 4/4/05**
230	6070	230	Drilling Mobilization	1 day	Mon 2/28/05	Mon 2/28/05



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Task
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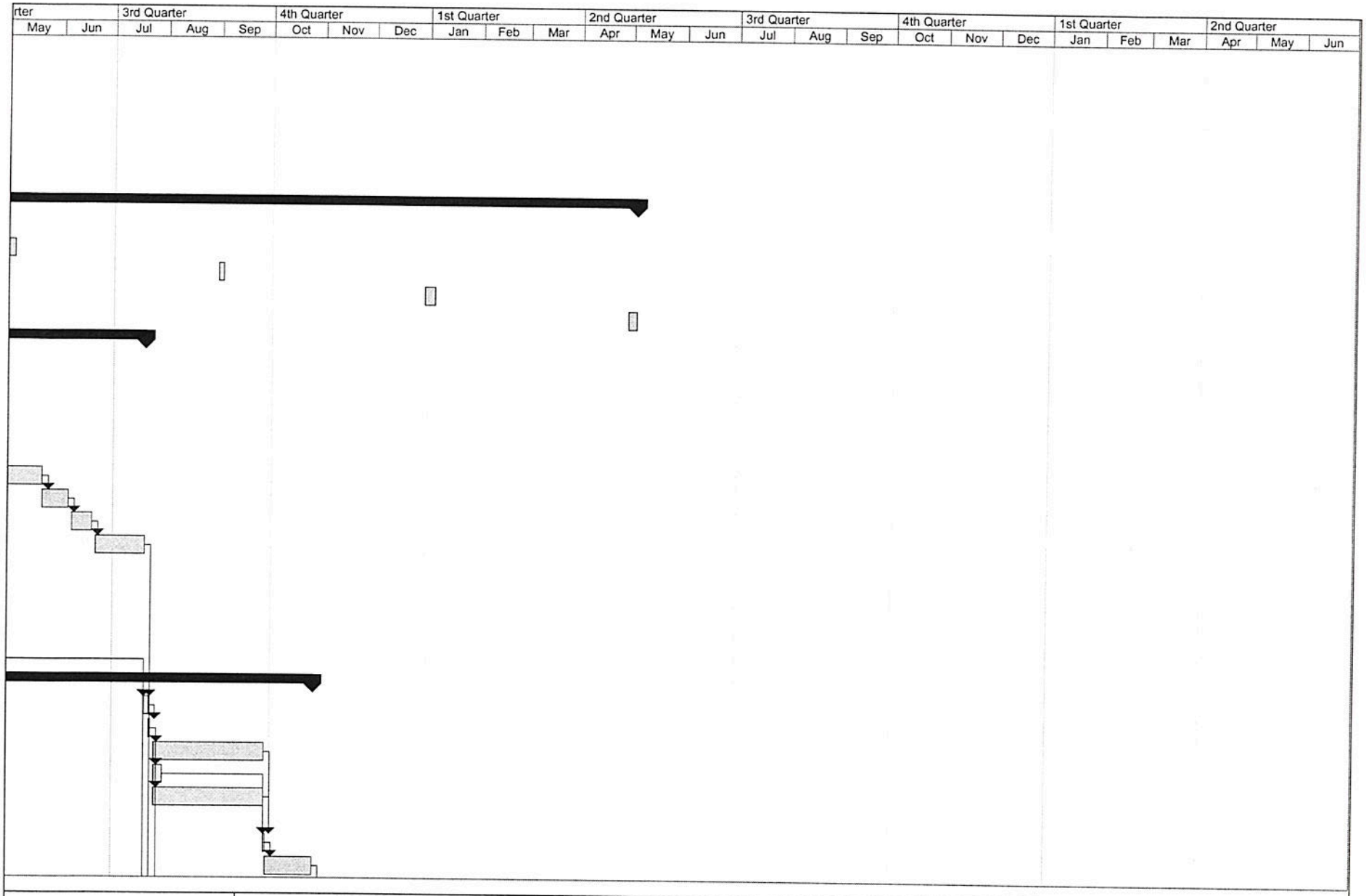
ID	Phase	ID	Task Name	Duration	Start	Finish
231	6080	231	Drilling and Sample Collection	5 days	Tue 3/1/05	Mon 3/7/05
232	6090	232	IDW Collection, Transportation, and Disposal	5 days	Tue 3/8/05	Mon 3/14/05
233	6100	233	Soil Analytical	15 days	Tue 3/15/05	Mon 4/4/05
234	**6110**	**234**	**Soil Confirmation Boring 3**	**26 days**	**Mon 4/25/05**	**Tue 5/31/05**
235	6120	235	Drilling Mobilization	1 day	Mon 4/25/05	Mon 4/25/05
236	6130	236	Drilling and Sample Collection	5 days	Tue 4/26/05	Mon 5/2/05
237	6140	237	IDW Collection, Transportation, and Disposal	5 days	Tue 5/3/05	Mon 5/9/05
238	6150	238	Soil Analytical	15 days	Tue 5/10/05	Tue 5/31/05
239	**6160**	**239**	**Soil Confirmation Boring 4**	**26 days**	**Mon 6/20/05**	**Tue 7/26/05**
240	6170	240	Drilling Mobilization	1 day	Mon 6/20/05	Mon 6/20/05
241	6180	241	Drilling and Sample Collection	5 days	Tue 6/21/05	Mon 6/27/05
242	6190	242	IDW Collection, Transportation, and Disposal	5 days	Tue 6/28/05	Tue 7/5/05
243	6200	243	Soil Analytical	15 days	Wed 7/6/05	Tue 7/26/05
244	**6210**	**244**	**Soil Confirmation Boring 5**	**26 days**	**Mon 8/15/05**	**Tue 9/20/05**
245	6220	245	Drilling Mobilization	1 day	Mon 8/15/05	Mon 8/15/05
246	6230	246	Drilling and Sample Collection	5 days	Tue 8/16/05	Mon 8/22/05
247	6240	247	IDW Collection, Transportation, and Disposal	5 days	Tue 8/23/05	Mon 8/29/05
248	6250	248	Soil Analytical	15 days	Tue 8/30/05	Tue 9/20/05
249	**6260**	**249**	**Soil Confirmation Boring 6**	**26 days**	**Mon 10/10/05**	**Mon 11/14/05**
250	6270	250	Drilling Mobilization	1 day	Mon 10/10/05	Mon 10/10/05
251	6280	251	Drilling and Sample Collection	5 days	Tue 10/11/05	Mon 10/17/05
252	6290	252	IDW Collection, Transportation, and Disposal	5 days	Tue 10/18/05	Mon 10/24/05
253	6300	253	Soil Analytical	15 days	Tue 10/25/05	Mon 11/14/05
254	**7000**	**254**	**Task 7 - Final Report and Petition for Site Closure**	**90 days**	**Tue 11/15/05**	**Wed 3/22/06**
255	7010	255	Final Report - 50% Draft	20 days	Tue 11/15/05	Tue 12/13/05
256	7020	256	Final Report - Draft	20 days	Wed 12/14/05	Wed 1/11/06
257	7030	257	NAVFAC, NYSDEC Review of Drafts	20 days	Thu 1/12/06	Wed 2/8/06
258	7040	258	Final Draft Submission	10 days	Thu 2/9/06	Wed 2/22/06
259	7050	259	Final Draft - Client Approval (not to exceed 45 days)	20 days	Thu 2/23/06	Wed 3/22/06
260	**8000**	**260**	**Task 8 - Site Restoration**	**32 days**	**Thu 3/23/06**	**Fri 5/5/06**
261	8010	261	Drill Rig Mobilization	1 day	Thu 3/23/06	Thu 3/23/06
262	8020	262	Well Abandonment	10 days	Fri 3/24/06	Thu 4/6/06
263	8030	263	Drill Rig Demobilization	1 day	Fri 4/7/06	Fri 4/7/06
264	8040	264	Site Restoration	20 days	Mon 4/10/06	Fri 5/5/06
265	**8050**	**265**	**Optional**	**1 day?**	**Wed 12/3/03**	**Wed 12/3/03**
266	4050	266	Two Shallow Treatment Well Installation	1 day?	Wed 12/3/03	Wed 12/3/03
267	8060	267	Two Shallow Treatment Well Abandonment	1 day?	Wed 12/3/03	Wed 12/3/03

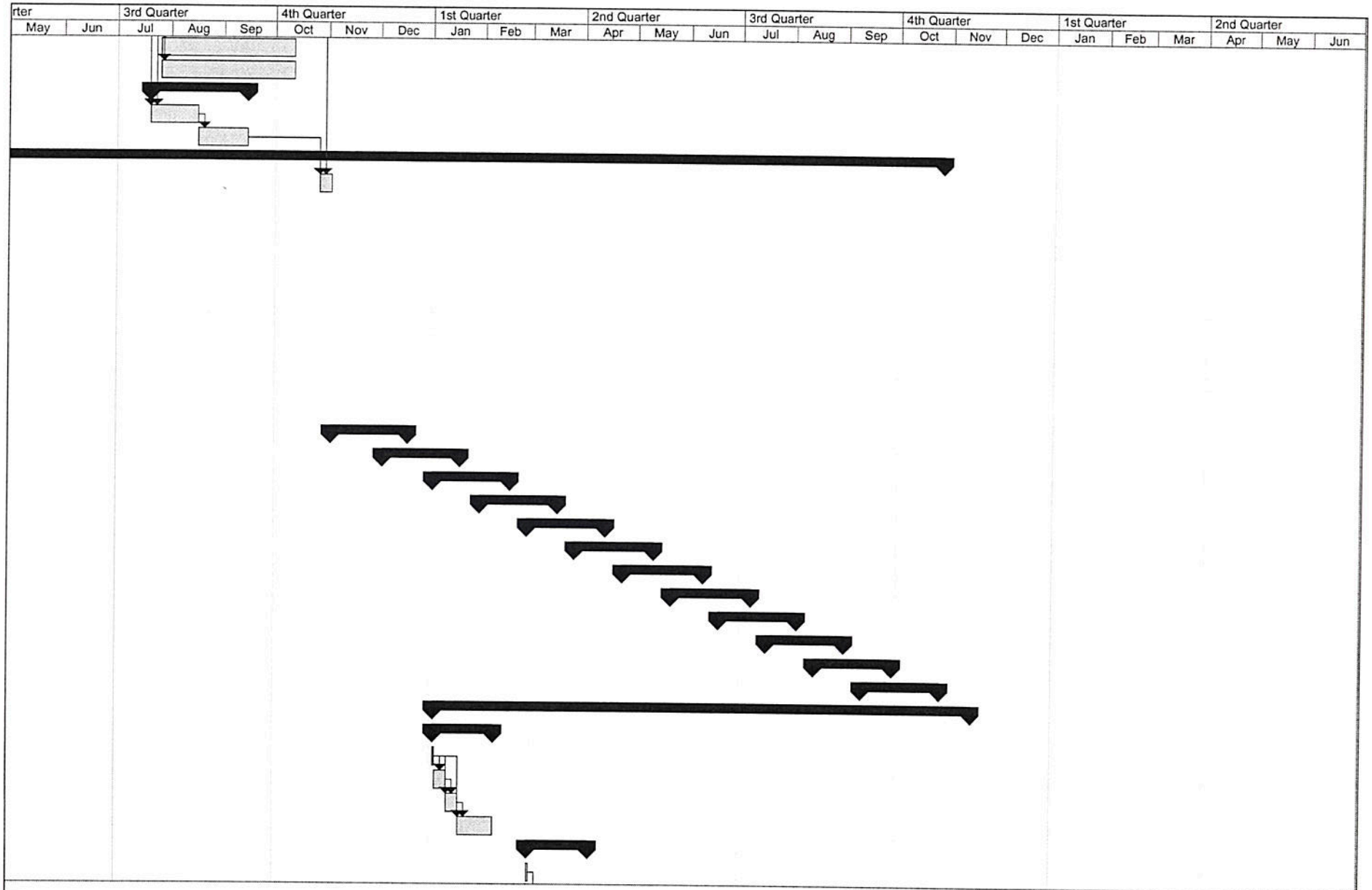
Project: Bethpage CLB Pilot Demo
Date: Mon 3/1/04

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline



Project: Bethpage CLB Pilot Demo
Date: Mon 3/1/04

Task	Milestone	External Tasks
Split	Summary	External Milestone
Progress	Project Summary	Deadline



Project: Bethpage CLB Pilot Demo
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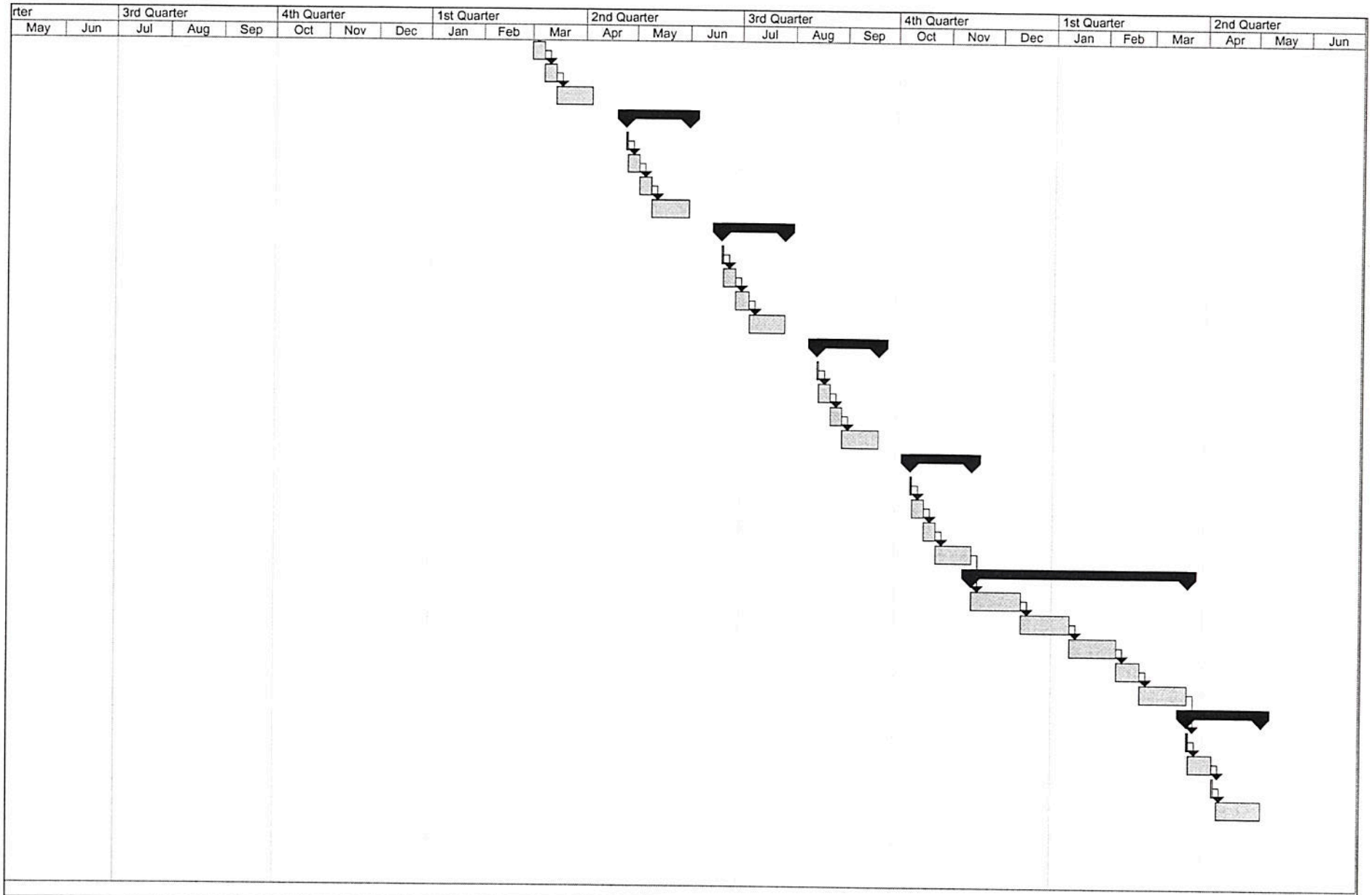
Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	



Project: Bethpage CLB Pilot Demo
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Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	

AOC 22 TECHNOLOGY MEETING — MARCH 16, 2004

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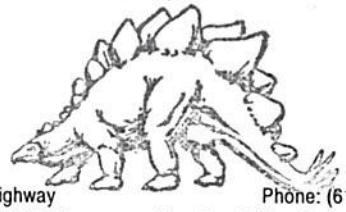

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