

## WATER WELL REHABILITATION

A Practical Guide to Understanding Well Problems and Solutions

By Neil Mansuy

Layne GeoSciences, Inc.

A Subsidiary of Layne Christensen Company





## CONTENTS

1. IN	RODUCTION
2 WE	LL CONSTRUCTION
Z. VVI	Water Supply Development
	Geological Formation
	Well Screen
	Types of Screen Openings
	Cemented Gravel Pack
	Well Casing
	Sanitary Well Seal
	Annular Seal
	Drainage Away from the Well Head
	Well Screen and Gravel Pack Selection
	PVC Wells and Biofouling
	Developing Gravel Pack Wells
	Thickness of Gravel Pack
	Naturally Developed Wells 12
	Initial Well Development Process
	Entrance Velocities
	Pump Test
	Discharge Capacity and Specific Capacity 14
	Well Efficiency 16
	Losses of Static Water Level
	unisands lisV at nonegrooms knowld
	ROUNDWATER MICROBIOLOGY
J. 01	Sources of Biofouling Microorganisms
	Current Bacterial Testing Methods
	Other Organisms in Groundwater Systems
	Surface Water Infiltration
	O. DIAGNOSING WELL PROBLEMS
4. LC	NGEVITY OF REHABILITATION TREATMENTS
	Accumulation of Materials in Wells and Systems
	Zone of Fouling
	Rate of Iron Deposition
	Rate of Biofouling
	Longevity of Rehabilitation Treatments
	Water Well Rehabilitation Benefits 36
	Economic Analysis of Well Rehabilitation
E ID	ENTIFICATION OF WELL PROBLEMS 4
3. ID	Benefits of Problem Identification 4
	Lost Capacity 43
	Turbidity Problems 4
	Turbuity Fromettis

	Corrosion Problems	
	Red Water Problems	. 48
	Single Well Water Quality Variations	
	Odor Problems	. 52
6	ELL CONSTRUCTION	
6.	UNSAFE BACTERIAL RESULTS	
	Sources of Unsafe Samples	
	Total Coliforms	
	Analytical Procedures	
	Problems in Achieving Safe Samples	
	Hygiene Risk Surveys on Wells	. 62
7	WELL HYDRAULICS	. 65
	Flow Dynamics of Wells	
	Position of Biofouling Relative to Well Screen	
	Suction Flow Control Devices	
	Developing Covered Pack Walle	. 75
8.	MICROBIAL TRANSFORMATION IN OXIDATION AND	
	REDUCTION	. 75
	Nitrate Problems in Wells	
	Sulfur Cycle in Groundwater	
	Putter Test	
9.	CAUSES OF WELL PLUGGING PROBLEMS	. 83
	Categories	
	Mechanical Plugging	
	Mineral Encrustation in Well Plugging	
	Iron-Related Bacteria	
	Slime-Forming Bacteria	
	Sulfate-Reducing Bacteria	
	Surgace Water infiltration	
10	DIAGNOSING WELL PROBLEMS	
	Historical Records	
	Diagnosis Utilizing Water Chemistry Analysis	
	Diagnosis with Deposit Analysis	102
	Diagnosis with Biological Activity Reaction Tests (BARTTM).	102
	Diagnosis Using Hetertrophic Plate Count	108
	Driller's Log for Diagnosis of Problems	110
		110
	Economic Analysis of Well Rehabilitation	
11	. WATER WELL REHABILITATION	113
	Introduction to Solutions	113
	Pretreatment	116
	Various Treatment Applications	117
	Development or Redevelopment Stage	117
	Surge and Purge	120
	Sonar JetTM Well Dehabilitation	120

Chemical Applications in Well Rehabilitation	121
Phosphorus Treatment Products	126
Shock Chlorination and Other Oxidizing Agents	127
Disinfectants	127
Efficacy of Using Pellet Chlorinators in Water	131
Selection of Acids	132
Advances in Technologies and Chemistries	135
Aqua Freed <sup>™</sup>	138
Environmental Safety Concerns	148
12. WELL DEVELOPMENT AND MAINTENANCE	151
Well Development	151
Preventative Maintenance of Wells	155
Layne Anoxic Block System (LABS) <sup>TM</sup>	157
Closing Remarks	160
SELECTED BIBLIOGRAPHY	163
INDEX	165