

TOWN OF NORTH READING
DRAFT ENVIRONMENTAL IMPACT REPORT
TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
1	INTRODUCTION	
1.1	Project Background.....	1-1
1.2	Project History	1-1
1.3	Planning Tools	1-2
1.4	Terminology.....	1-3
1.5	Project Objective and Goals	1-3
1.5.1	Water Resources – Ipswich River	1-4
1.6	Recommended Plan.....	1-4
1.6.1	Costs and Schedule	1-5
1.6.2	Impacts.....	1-5
1.7	Permits and Approvals	1-6
1.7.1	Inter-Basin Transfer Act	1-6
2	EXISTING ENVIRONMENTAL CONDITIONS	
2.1	Infrastructure and Human Environment	
2.1.1	Land Use	2-1
2.1.2	Zoning	2-4
2.1.3	Buildout Analysis	2-7
2.1.4	Population Demographics	2-9
2.1.5	Planning Initiatives and Open Space	2-10
2.1.6	Stormwater.....	2-11
2.1.7	Impervious Surface	2-11
2.1.8	Historical and Archaeological Sites.....	2-11
2.2	Natural Environment	2-14
2.2.1	Climate	2-14
2.2.2	Soils	2-15
2.2.3	Topography	2-15
2.2.4	Hydrologic Conditions and Water Resources	2-18
2.2.5	Surficial Geology.....	2-18
2.2.6	Water Quality	2-20
2.2.7	Wetlands	2-20
2.2.8	Endangered Species	2-23
2.2.9	Floodplains	2-25
2.2.10	Air Quality.....	2-27
2.2.11	Environmental Hazards.....	2-27
2.2.11.1	Reportable Release Sites.....	2-28

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	2.2.11.2 Comprehensive Environmental Response, Compensation and Liability Information System	2-31
	2.2.11.4 Underground Storage Tanks	2-31
	2.2.11.5 Landfills	2-32
3	EXISTING WATER SUPPLY SYSTEMS	
3.1	Water Supply and Interconnections	3-1
3.1.1	Local Sources	3-1
3.1.1.1	Lakeside Boulevard Wellfield & WTP	3-4
3.1.1.2	Lakeside Boulevard Wellfield and Route 125 Well	3-4
3.1.1.3	Lakeside Water Treatment Plant	3-8
3.1.1.4	Railroad Bed Wellfield & West Villiage WTP	3-8
3.1.1.5	Railroad Bed Wellfield	3-8
3.1.1.6	West Village Water Treatment Plant.....	3-12
3.1.1.7	Central Street Wellfield and Pump Station....	3-12
3.1.1.8	Central Street Wellfield	3-12
3.1.1.9	Central Street Pump Station.....	3-13
3.1.2	Interconnections.....	3-15
3.1.3	Emergency Interconnections	3-15
3.2	Water Distribution Storage	3-15
3.3	Water Distribution Piping.....	3-16
3.4	Water System Management	3-18
3.5	Historical Water Use	3-18
3.6	Water Quality	3-20
3.6.1	Raw Water Quality	3-20
3.6.2	Filtered Water Quality	3-21
3.6.3	Distribution and Storage	3-22
3.6.4	Regulatory Compliance.....	3-22
3.6.5	Customer Complaints.....	3-23
3.7	Source Water Protection.....	3-25
3.8	Private Wells.....	3-25
3.9	Existing Water Conservation Measures	3-27
3.9.1	Billing	3-27
3.9.2	comprehensive Planning & Drought Management Planning	3-27
3.9.3	Water Audit	3-28
3.9.4	Leak Detection.....	3-28
3.9.5	Metering	3-28
3.9.6	Public Sector.....	3-28
3.9.7	Lawn & Landscape	3-28
3.9.8	Public Education & Outreach.....	3-29
4	WATER SUPPLY NEEDS ANALYSIS	
4.1	Introduction.....	4-1

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
4.2	Water Needs Assessment Methodology	4-1
4.3	Projected Water Demand	4-1
4.3.1	Population Projections	4-1
4.3.2	Water Demand Trends	4-2
4.3.3	Projected Residential Water Demand	4-4
4.3.4	Projected Non- Residential Water Demand	4-6
4.3.5	Maximum Daily Demand.....	4-7
4.3.6	Future Requirements.....	4-8
4.3.6.1	Per Capita Water Use	4-8
4.3.6.2	Residential & Non-residential Average Day Demand	4-8
4.3.6.3	Municipal Water Use.....	4-8
4.3.6.4	Unaccounted for Water Use.....	4-9
4.3.6.5	Residential and Non-residential Maximum Day Demand	4-10
4.3.6.6	Peak Hourly Demand	4-10
4.3.6.7	Projected Flow Summary	4-11
4.4	Permitted Water Supply.....	4-12
4.4.1	Local Sources	4-12
4.4.2	Interconnections.....	4-13
4.5	Water Needs Analysis	4-13
4.5.1	Water Operation & Maintenance Needs	4-14
4.5.2	Water Quality, Capacity, and Treatment Needs	4-16
4.5.2.1	Well Cleaning	4-17
4.5.2.2	Well Water Quality	4-17
4.5.3	Ipswich river Needs	4-19
4.5.3.1	Low Flow	4-20
4.5.3.2	High Flow/Flooding	4-20
4.6	Water Needs Analysis Summary	4-21
5	WATER SUPPLY ALTERNATIVES ANALYSIS	
5.1	Initial Screening	5-1
5.1.1	No Build	5-1
5.1.2	Water Conservation	5-3
5.1.2.1	Municipal Water Conservation	5-6
5.1.2.2	Nearby Communities Water Conservation....	5-8
5.1.2.3	IBTA Water Reduction Measures	5-9
5.1.3	Out of Town Alternative	5-10
5.1.3.1	Groundwater and Surface Water	5-10
5.1.3.2	Surface Water.....	5-11
5.1.3.3	Optimizing Local Sources	5-11
5.1.4	Out of Town Alternative	5-12
5.1.4.1	Neighboring Community Interconnection....	5-12
5.1.4.2	MWRA Connection.....	5-16

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
5.2	Advanced Alternatives Analysis	5-18
5.2.1	MWRA Connection	5-18
5.2.1.1	Advantages and Disadvantages.....	5-18
5.2.1.2	Reading and North Reading System Upgrades	5-20
5.2.1.3	MWRA Withdrawal and Costs	5-21
5.2.1.4	MWRA Policy OP#10 Admission Criteria....	5-23
5.2.1.5	Permits and other regulatory considerations/IBTA Requirements/ Decommissioning of water treatment plants/wells	5-24
5.2.2	Water Conservation Alternative	5-24
6	EXISTING WASTEWATER MANAGEMENT SYSTEMS	
6.1	On-site Wastewater Disposal Systems	6-1
6.1.1	Septic Systems.....	6-2
6.1.2	Cesspools.....	6-2
6.1.3	Tight Tanks and Grease Traps.....	6-3
6.1.4	Innovative/Alternative Technologies.....	6-5
6.1.5	Treatment Facilities (NPDES Permit)	6-5
6.1.6	Residuals Management	6-6
6.2	On-site Wastewater Disposal Systems Effectiveness	6-6
6.2.1	Septic System Failures and Rehabilitations	6-7
6.2.2	DEP Violations	6-7
6.3	North Reading Board of Health Septic System Regulations and Procedures	6-9
6.4	Collection Systems	6-9
7	EXISTING WASTEWATER NEEDS ANALYSIS	
7.1	Wastewater Needs Analysis Summary.....	7-1
7.2	Wastewater Needs Assessment Methodology	7-1
7.2.1	Category 5 Factors.....	7-3
7.2.1.1	Septic System Rehabilitations.....	7-3
7.2.1.2	Tight Tanks	7-4
7.2.1.3	Water Use Class	7-4
7.2.1.4	Impaired Waters	7-4
7.2.2	Category 2 Factors.....	7-5
7.2.2.1	Lot Size	7-5
7.2.2.2	Soil Drainage Class	7-7
7.2.2.3	Ponding	7-7
7.2.2.4	Flooding.....	7-9
7.2.2.5	Septic System Age.....	7-9
7.2.2.6	Pump Out Frequency	7-11
7.2.2.7	Zone 2 or IWPA	7-11
7.2.3	Category 1 Factors.....	7-13
7.2.3.1	Depth to Groundwater Table	7-13

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	7.2.3.2 Depth to restrictive Layer	7-15
	7.2.3.3 Water Use per Acre	7-17
	7.2.3.4 Wetlands	7-19
	7.2.3.5 Private Wells	7-19
	7.2.3.6 Outstanding Water Resource Protection Zone	7-19
	7.2.4 Wastewater Matrix Analysis Trends.....	7-19
7.3	Delineation of Study Areas.....	7-24
7.4	Study Area Descriptions and Assessments.....	7-27
	7.4.1 Martins Pond	7-27
	7.4.2 Lowell Road	7-28
	7.4.3 Park Street.....	7-28
	7.4.4 Concord Street.....	7-28
	7.4.5 Route 28 South	7-29
	7.4.6 Hillview	7-30
	7.4.7 Central Street North.....	7-30
	7.4.8 Eisenhower’s Pond	7-31
	7.4.9 High School.....	7-31
	7.4.10 Department of Public Works.....	7-32
	7.4.11 Crestwood Drive.....	7-32
	7.4.12 Mount Vernon	7-32
	7.4.13 Marblehead Street.....	7-33
	7.4.14 Orchard Drive	7-33
	7.4.15 Thomson.....	7-34
	7.4.16 Swan Pond.....	7-34
	7.4.17 Windshield Survey Summary.....	7-35
7.5	Wastewater Needs Area.....	7-35
	7.5.1 Potential Sewer Network Scenarios.....	7-36
	7.5.2 Proposed Sewer Network.....	7-37
7.6	Projected Sewer Wastewater Flow Needs	7-39
	7.6.1 Residential Wastewater Flows	7-39
	7.6.2 Commercial Wastewater Flows.....	7-39
	7.6.3 Adjustment Baseline Sewer Flows	7-40
	7.6.4 Projected Title 5 Flow Evaluation	7-40
	7.6.4.1 Typical Residential Flows	7-41
	7.6.4.2 Non-residential Flows	7-41
7.7	Other Needs and Considerations.....	7-43
	7.7.1 Ipswich River Needs.....	7-43
	7.7.1.1 Flow Balancing	7-43
	7.7.1.2 Water Quality.....	7-43
	7.7.1.3 Martins Pond	7-44
	7.7.2 Downtown Needs	7-44
7.8	Wastewater Management Needs Analysis Summary.....	7-45

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
8.1	Introduction.....	8-1
8.1.1	Evaluation Methodology.....	8-2
8.2	No-Build	8-2
8.2.1	Introduction	8-2
8.2.2	Ability to Meet Needs.....	8-2
8.2.3	Environmental Impacts	8-3
8.2.4	Economics	8-5
8.3	In Town Alternatives.....	8-7
8.3.1	Centralized Wastewater Collection System with NPDES Discharge	8-7
8.3.2	Centralized Wastewater Collection System with Groundwater Discharge Permit	8-10
8.3.3	Satellite Wastewater Collection System	8-11
8.3.3.1	Ability to Meet Needs	8-16
8.3.3.2	Environmental Impacts.....	8-16
8.3.3.3	Economics.....	8-16
8.3.4	Individual and Shared/Decentralized Treatment Facilities	8-18
8.4	Out of Town Alternatives	8-19
8.4.1	Regional WWTF Options	8-19
8.4.2	Out of Town Options	8-22
8.5	GLSD Alternative	8-23
8.5.1	Ability to Meet Needs.....	8-27
8.5.2	Environmental Impacts	8-27
8.5.3	Economics	8-28
8.6	High/Middle School Treatment Facility Optimization	8-29
8.6.1	Ability to Meet Needs.....	8-27
8.6.2	Environmental Impacts	8-27
8.6.3	Economics	8-28
8.7	Water Reuse	8-32
8.8	Selected Alternative	8-33
9	CONCLUSION AND RECOMMENDATION	
9.1	Recommended Projects	9-1
9.1.1	Water Supply Projects.....	9-1
9.1.1.1	Connection to MWRA through Reading	9-2
9.1.1.2	Water Conservation	9-2
9.1.2	Wastewater Management Projects.....	9-2
9.1.2.1	Alternatives Considered	9-2
9.1.2.2	Recommended Plan	9-3
9.1.3	Water Conservation Projects	9-4
9.1.3.1	Comprehensive Planning & Drought Management Planning	9-4
9.1.3.2	Water Audit.....	9-4
9.1.3.3	Leak Detection	9-4

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	9.1.3.4 Metering.....	9-5
	9.1.3.5 Rates	9-5
	9.1.3.6 Residential	9-5
	9.1.3.7 Public Sector	9.5
	9.1.3.8 Industrial, Commercial, and Institutional & Agricultural	9-6
	9.1.3.9 Lawn & Landscape.....	9-6
	9.1.3.10 Public Education & Outreach	9-6
9.2	Implementation	9-6
	9.2.1 Project Schedule	9-6
	9.2.2 Project Costs.....	9-8
9.3	Project Analysis	9-9
	9.3.1 Water Quality	9-14
	9.3.2 Public Health	9-14
	9.3.3 Water Balance and Ipswich River Impacts	9-14
	9.3.4 Stormwater Impacts	9-15
	9.3.5 Land Impacts	9-16
	9.3.6 Wetland and Surface Water Impacts.....	9-16
	9.3.7 Habitats of Rare Species.....	9-17
	9.3.8 Historic Places and Archaeological Resources.....	9-18
	9.3.9 Hazardous Materials.....	9-19
	9.3.10 Residential and Commercial Impacts.....	9-19
	9.3.11 Greenhouse Gas Impacts	9-19
	9.3.11.1 Wastewater Analysis.....	9-20
	9.3.11.2 Water Analysis	9-31
	9.3.11.3 GHG Reduction for Recommended Plan.....	9-37
9.4	Permitting and Agreements	9-38
	9.4.1 Water Related Permits	9-38
	9.4.2 Wastewater Related Permits	9-38
	9.4.3 Interbasin Transfer Act	9-38
	9.4.3.1 Donor Basin	9-40
	9.4.3.2 Receiving Basin	9-70
	9.4.4 Inter Municipal Agreements	9-70
9.5	Secondary Benefits.....	9-71
9.6	Public Participation	9-71
9.7	Non-Structural Recommendations	9-73

TABLE OF CONTENTS (CONT.)

APPENDICES

A	ENF CERTIFICATE AND COMMENT LETTERS
B	PUBLIC PARTICIPATION PRESENTATIONS
C	EXISTING IBTA RECOMMENDATION LETTER
D	ANNUAL STATISTICAL REPORTS
E	WATER CONSERVATION EFFORTS
F	TMDL EXCERPTS
G	WASTEWATER MANAGEMENT SYSTEM COST STUDY
H	DPW SITE HYDROLOGY: EXCERPT FROM DCWMP APPENDICES
I	DRACUT-METHUEN IMA
J	NORTH READING STORMWATER REPORT

TABLE OF CONTENTS (CONT.)

LIST OF TABLES

TABLE	DESCRIPTION	PAGE
2-1	Land Use	2-2
2-2	Top Employers	2-4
2-3	Zoning Districts	2-4
2-4	North Reading Census Data	2-9
2-5	Population Trends for the North Reading & Similar Neighboring Communities....	2-10
2-6	Soil Classification by Drainage	2-15
2-7	Rare and Endangered Species.....	2-23
2-8	Reportable Release Sites	2-29
3-1	Treatment Design Capacity	3-4
3-2	Lakeside Boulevard Sources and Pump Data.....	3-5
3-3	Railroad Well Sources and Pump Data.....	3-9
3-4	Central Street Well and Pump Data.....	3-13
3-5	Storage Facilities.....	3-16
3-6	Water Main Inventory	3-17
3-7	Historical Water Demand.....	3-7
3-8	Historical and Current Raw Water Quality Data (mg/l)	3-20
3-9	finished Water Quality – West Village	3-21
3-10	Finished Water Quality – Lakeside.....	3-22
4-1	Historical Water Demand.....	4-3
4-2	Historical Water Usage by Customer Category (MGD)	4-4
4-3	Per Capita Water Usage	4-5
4-4	Non-residential Water Demand	4-6
4-5	Confidently Estimated Municipal Use MG/Year	4-9
4-6	Unaccounted for Water Use	4-10
4-7	Projected Water Demands in MGD	4-11
4-8	Projected Water Demands (MGD).....	4-11
4-9	Annual Town Supply Withdrawal Amounts (MGD).....	4-12
4-10	Water Needs Summary (MGD)	4-14
4-11	Well Permitted Capacity	4-16
4-12	Well Pumping Rates.....	4-16
4-13	Well Specific Capacity.....	4-17
4-14	2014 Flow Rates	4-18
5-1	Planned Conservation Measures	5-5
5-2	Public Water Use and Impact of Water Conservation Measures 9/30/	5-7
6-1	On-Site Sewage Disposal Systems	6-2
6-2	Groundwater Discharge Permits	6-6
7-1	Scoring Factors	7-2
7-2	Factor Weighting	7-3
7-3	Wastewater Factor Scoring.....	7-20
7-4	Wastewater Needs Study Areas Trends Summary	7-25

TABLE OF CONTENTS (CONT.)

7-5	Top Three Factors Influencing Top Four Study Areas	7-35
7-6	Final Sewer Flows.....	7-39
7-7	Adjusted Sewer Flows.....	7-40
7-8	Estimated Residential Title 5 Flows	7-41
7-9	Estimated Non-residential Title 5 Flows.....	7-42
7-10	Estimated Total Title 5 Flows	7-42
7-11	High School WWTF MAX Daily Flow	7-44
8-1	Septic System GHG Emissions	8-4
8-2	No Build Emissions	8-5
8-3	GW Discharge Analysis – Typical Infiltration.....	8-10
8-4	GW Discharge analysis – Rapid Infiltration	8-11
8-5	GW Discharge Analysis – Satellite System	8-12
8-6	DPW Facility GHG Summary	8-17
8-7	GLSD Alternative GHG Summary.....	8-28
8-8	Approximate Cost Summary	8-29
9-1	Summary of Water Capital Costs	9-8
9-2	Summary of Wastewater Capital Costs.....	9-9
9-3	Ipswich River Water Balance	9-15
9-4	Summary of GHG Resources Used	9-21
9-5	CO ₂ Emissions from Private Treatment Facilities Due to Electricity	9-22
9-6	Septic System GHG Emissions	9-24
9-7	Pump Station Calculations	9-26
9-8	No Build Emissions Summary	9-27
9-9	Recommended Plan Summary with DPW Facility.....	9-28
9-10	Recommended Plan Summary without DPW Facility.....	9-28
9-11	Summary of Resources Used.....	9-32
9-12	Water Treated and Purchased by North Reading	9-33
9-13	Approach 1: Emissions Based on MEPA Averages	9-34
9-14	Approach 2: Emissions Based on North Reading’s Electrical Bills..	9-34
9-15	Vehicle Fleet CO ₂ Emissions	9-35
9-16	Booster Pump Station Calculations	9-36
9-17	Summary	9-37
9-18	Water Balance in Relation to Ipswich River Basin	9-40
9-19	MWRA Interbasin Transfer System	9-47
9-20	Demands of Prior Applicants to MWRA (MGD).....	9-49
9-21	Demands of New Communities (MGD)	9-50
9-22	MWRA Existing Service Area: Potential Water Demand Under Higher Growth Scenarios.....	9-54
9-23	MWRA Drought Management Stages	9-58
9-24	Number of Months in each Stage of MWRA’s Drought Management Plan.....	9-58
9-25	Communities Admitted to the MWRA Requiring Interbasin Act Approval.....	9-68

TABLE OF CONTENTS (CONT.)

LIST OF FIGURES

FIGURE	DESCRIPTION	PAGE
1-1	TITLE	
2-1	Land Use	2-3
2-2	Zoning	2-6
2-3	Underdeveloped Land	2-8
2-4	North Reading Population Trends Based on Town Census Data	2-9
2-5	Impervious Surfaces	2-11
2-6	Historical Places	2-12
2-7	Stat Standardized Precipitation Index	2-13
2-8	Soil Drainage	2-15
2-9	Topography	2-16
2-10	Surficial Geology	2-19
2-11	Integrated Waters GIS	2-21
2-12	Wetlands	2-22
2-13	Endangered Species	2-24
2-14	Flood Zones	2-26
2-15	Environmental Hazards	2-33
3-1	Water System	3-2
3-2	Historical Withdrawals from Town Sources	3-3
3-3	Lakeside Boulevard Water Treatment Plant Site Plan	3-6
3-4	Route 125 Well Site Plan	3-7
3-5	Railroad Bed Wellfield Site Plan	3-10
3-6	West Village Water Treatment Plant Site Plan	3-11
3-7	Central Street Wellfield and Pumping Station Site Plan	3-14
3-8	Town Water Production vs. Purchased Water	3-19
3-9	Water Quality Complaints	3-24
3-10	Well Users	3-26
5-1	System Improvements	5-22
6-1	Type of Treatment System	6-4
6-2	Septic System Rehabilitations	6-8
7-1	Lot Size	7-6
7-2	Ponding and Flooding	7-8
7-3	Septic System Age	7-10
7-4	Zone 1 and Outstanding Water Resources	7-12
7-5	Depth to Water Table	7-14
7-6	Depth to Restrictive Layer	7-16
7-7	Water Use *Gal/Day/Acre)	7-18
7-8	Wastewater Risk Mapping	7-23
7-9	Needs Study Areas	7-26
7-10	Proposed Collection System	7-38

TABLE OF CONTENTS (CONT.)

8-1	Septic System Age	8-6
8-2	Proposed Collection System.....	8-2
8-3	Potential Onsite Disposal Options	8-3
8-4	Potential Onsite Disposal Centralized town Owned Options.....	8-15
8-5	Andover Sewer System.....	8-26
8-6	Town Center Sewer Expansion	8-31
9-1	North Reading Impacts.....	9-11
9-2	Reading Impacts	9-12
9-3	Andover Impacts.....	9-13
9-4	General Plan MWRA Water System	9-41
9-5	MWRA Watersheds	9-41
9-6	Inflows and Outflows.....	9-42
9-7	Quabbin Reservoir Configuration.....	9-44
9-8	Withdrawals and Yield.....	9-52
9-9	Quabbin's Max Pool Descent	9-57
9-10	MWRA Annual Average System Demand	9-59
9-11	Reservoir Pattern Level.....	9-59
9-12	Nashua River Daily Releases	9-61
9-13	Quabbin Reservoir	9-63
9-14	Wachusett Reservoir/Nashua River Discharges	9-63

TOWN OF NORTH READING
DRAFT ENVIRONMENTAL IMPACT REPORT
TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
1	INTRODUCTION	
1.1	Project Background.....	1-1
1.2	Project History	1-1
1.3	Planning Tools	1-2
1.4	Terminology.....	1-3
1.5	Project Objective and Goals	1-3
1.5.1	Water Resources – Ipswich River	1-4
1.6	Recommended Plan.....	1-4
1.6.1	Costs and Schedule	1-5
1.6.2	Impacts.....	1-5
1.7	Permits and Approvals	1-6
1.7.1	Inter-Basin Transfer Act	1-6
2	EXISTING ENVIRONMENTAL CONDITIONS	
2.1	Infrastructure and Human Environment	
2.1.1	Land Use	2-1
2.1.2	Zoning.....	2-4
2.1.3	Buildout Analysis	2-7
2.1.4	Population Demographics	2-9
2.1.5	Planning Initiatives and Open Space	2-10
2.1.6	Stormwater.....	2-11
2.1.7	Impervious Surface.....	2-11
2.1.8	Historical and Archaeological Sites.....	2-11
2.2	Natural Environment	2-14
2.2.1	Climate	2-14
2.2.2	Soils	2-15
2.2.3	Topography	2-15
2.2.4	Hydrologic Conditions and Water Resources.....	2-18
2.2.5	Surficial Geology.....	2-18
2.2.6	Water Quality	2-20
2.2.7	Wetlands	2-20
2.2.8	Endangered Species	2-23
2.2.9	Floodplains	2-25
2.2.10	Air Quality.....	2-27
2.2.11	Environmental Hazards.....	2-27
2.2.11.1	Reportable Release Sites.....	2-28

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	2.2.11.2 Comprehensive Environmental Response, Compensation and Liability Information System	2-31
	2.2.11.4 Underground Storage Tanks	2-31
	2.2.11.5 Landfills	2-32
3	EXISTING WATER SUPPLY SYSTEMS	
3.1	Water Supply and Interconnections	3-1
3.1.1	Local Sources	3-1
3.1.1.1	Lakeside Boulevard Wellfield & WTP	3-4
3.1.1.2	Lakeside Boulevard Wellfield and Route 125 Well	3-4
3.1.1.3	Lakeside Water Treatment Plant	3-8
3.1.1.4	Railroad Bed Wellfield & West Villiage WTP	3-8
3.1.1.5	Railroad Bed Wellfield	3-8
3.1.1.6	West Village Water Treatment Plant.....	3-12
3.1.1.7	Central Street Wellfield and Pump Station....	3-12
3.1.1.8	Central Street Wellfield	3-12
3.1.1.9	Central Street Pump Station.....	3-13
3.1.2	Interconnections.....	3-15
3.1.3	Emergency Interconnections	3-15
3.2	Water Distribution Storage	3-15
3.3	Water Distribution Piping.....	3-16
3.4	Water System Management	3-18
3.5	Historical Water Use	3-18
3.6	Water Quality	3-20
3.6.1	Raw Water Quality	3-20
3.6.2	Filtered Water Quality	3-21
3.6.3	Distribution and Storage	3-22
3.6.4	Regulatory Compliance.....	3-22
3.6.5	Customer Complaints.....	3-23
3.7	Source Water Protection.....	3-25
3.8	Private Wells.....	3-25
3.9	Existing Water Conservation Measures	3-27
3.9.1	Billing	3-27
3.9.2	comprehensive Planning & Drought Management Planning	3-27
3.9.3	Water Audit	3-28
3.9.4	Leak Detection.....	3-28
3.9.5	Metering	3-28
3.9.6	Public Sector.....	3-28
3.9.7	Lawn & Landscape	3-28
3.9.8	Public Education & Outreach.....	3-29
4	WATER SUPPLY NEEDS ANALYSIS	
4.1	Introduction.....	4-1

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
4.2	Water Needs Assessment Methodology	4-1
4.3	Projected Water Demand	4-1
4.3.1	Population Projections	4-1
4.3.2	Water Demand Trends	4-2
4.3.3	Projected Residential Water Demand	4-4
4.3.4	Projected Non- Residential Water Demand	4-6
4.3.5	Maximum Daily Demand.....	4-7
4.3.6	Future Requirements.....	4-8
4.3.6.1	Per Capita Water Use	4-8
4.3.6.2	Residential & Non-residential Average Day Demand	4-8
4.3.6.3	Municipal Water Use.....	4-8
4.3.6.4	Unaccounted for Water Use.....	4-9
4.3.6.5	Residential and Non-residential Maximum Day Demand	4-10
4.3.6.6	Peak Hourly Demand	4-10
4.3.6.7	Projected Flow Summary	4-11
4.4	Permitted Water Supply.....	4-12
4.4.1	Local Sources	4-12
4.4.2	Interconnections.....	4-13
4.5	Water Needs Analysis	4-13
4.5.1	Water Operation & Maintenance Needs	4-14
4.5.2	Water Quality, Capacity, and Treatment Needs	4-16
4.5.2.1	Well Cleaning	4-17
4.5.2.2	Well Water Quality	4-17
4.5.3	Ipswich river Needs	4-19
4.5.3.1	Low Flow	4-20
4.5.3.2	High Flow/Flooding	4-20
4.6	Water Needs Analysis Summary	4-21
5	WATER SUPPLY ALTERNATIVES ANALYSIS	
5.1	Initial Screening	5-1
5.1.1	No Build	5-1
5.1.2	Water Conservation	5-3
5.1.2.1	Municipal Water Conservation	5-6
5.1.2.2	Nearby Communities Water Conservation....	5-8
5.1.2.3	IBTA Water Reduction Measures	5-9
5.1.3	Out of Town Alternative	5-10
5.1.3.1	Groundwater and Surface Water	5-10
5.1.3.2	Surface Water.....	5-11
5.1.3.3	Optimizing Local Sources	5-11
5.1.4	Out of Town Alternative	5-12
5.1.4.1	Neighboring Community Interconnection....	5-12
5.1.4.2	MWRA Connection.....	5-16

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
5.2	Advanced Alternatives Analysis	5-18
5.2.1	MWRA Connection	5-18
5.2.1.1	Advantages and Disadvantages.....	5-18
5.2.1.2	Reading and North Reading System Upgrades	5-20
5.2.1.3	MWRA Withdrawal and Costs	5-21
5.2.1.4	MWRA Policy OP#10 Admission Criteria....	5-23
5.2.1.5	Permits and other regulatory considerations/IBTA Requirements/ Decommissioning of water treatment plants/wells	5-24
5.2.2	Water Conservation Alternative	5-24
6	EXISTING WASTEWATER MANAGEMENT SYSTEMS	
6.1	On-site Wastewater Disposal Systems	6-1
6.1.1	Septic Systems.....	6-2
6.1.2	Cesspools.....	6-2
6.1.3	Tight Tanks and Grease Traps.....	6-3
6.1.4	Innovative/Alternative Technologies.....	6-5
6.1.5	Treatment Facilities (NPDES Permit)	6-5
6.1.6	Residuals Management	6-6
6.2	On-site Wastewater Disposal Systems Effectiveness	6-6
6.2.1	Septic System Failures and Rehabilitations	6-7
6.2.2	DEP Violations	6-7
6.3	North Reading Board of Health Septic System Regulations and Procedures	6-9
6.4	Collection Systems	6-9
7	EXISTING WASTEWATER NEEDS ANALYSIS	
7.1	Wastewater Needs Analysis Summary.....	7-1
7.2	Wastewater Needs Assessment Methodology	7-1
7.2.1	Category 5 Factors.....	7-3
7.2.1.1	Septic System Rehabilitations.....	7-3
7.2.1.2	Tight Tanks	7-4
7.2.1.3	Water Use Class	7-4
7.2.1.4	Impaired Waters	7-4
7.2.2	Category 2 Factors.....	7-5
7.2.2.1	Lot Size	7-5
7.2.2.2	Soil Drainage Class	7-7
7.2.2.3	Ponding	7-7
7.2.2.4	Flooding.....	7-9
7.2.2.5	Septic System Age.....	7-9
7.2.2.6	Pump Out Frequency	7-11
7.2.2.7	Zone 2 or IWPA	7-11
7.2.3	Category 1 Factors.....	7-13
7.2.3.1	Depth to Groundwater Table	7-13

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	7.2.3.2 Depth to restrictive Layer	7-15
	7.2.3.3 Water Use per Acre	7-17
	7.2.3.4 Wetlands	7-19
	7.2.3.5 Private Wells	7-19
	7.2.3.6 Outstanding Water Resource Protection Zone	7-19
	7.2.4 Wastewater Matrix Analysis Trends.....	7-19
7.3	Delineation of Study Areas.....	7-24
7.4	Study Area Descriptions and Assessments.....	7-27
	7.4.1 Martins Pond	7-27
	7.4.2 Lowell Road	7-28
	7.4.3 Park Street.....	7-28
	7.4.4 Concord Street.....	7-28
	7.4.5 Route 28 South	7-29
	7.4.6 Hillview	7-30
	7.4.7 Central Street North.....	7-30
	7.4.8 Eisenhower’s Pond	7-31
	7.4.9 High School.....	7-31
	7.4.10 Department of Public Works.....	7-32
	7.4.11 Crestwood Drive.....	7-32
	7.4.12 Mount Vernon	7-32
	7.4.13 Marblehead Street.....	7-33
	7.4.14 Orchard Drive	7-33
	7.4.15 Thomson.....	7-34
	7.4.16 Swan Pond.....	7-34
	7.4.17 Windshield Survey Summary.....	7-35
7.5	Wastewater Needs Area.....	7-35
	7.5.1 Potential Sewer Network Scenarios.....	7-36
	7.5.2 Proposed Sewer Network.....	7-37
7.6	Projected Sewer Wastewater Flow Needs	7-39
	7.6.1 Residential Wastewater Flows	7-39
	7.6.2 Commercial Wastewater Flows.....	7-39
	7.6.3 Adjustment Baseline Sewer Flows	7-40
	7.6.4 Projected Title 5 Flow Evaluation	7-40
	7.6.4.1 Typical Residential Flows	7-41
	7.6.4.2 Non-residential Flows	7-41
7.7	Other Needs and Considerations.....	7-43
	7.7.1 Ipswich River Needs.....	7-43
	7.7.1.1 Flow Balancing	7-43
	7.7.1.2 Water Quality.....	7-43
	7.7.1.3 Martins Pond	7-44
	7.7.2 Downtown Needs	7-44
7.8	Wastewater Management Needs Analysis Summary.....	7-45

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
8.1	Introduction.....	8-1
8.1.1	Evaluation Methodology.....	8-2
8.2	No-Build	8-2
8.2.1	Introduction	8-2
8.2.2	Ability to Meet Needs.....	8-2
8.2.3	Environmental Impacts	8-3
8.2.4	Economics	8-5
8.3	In Town Alternatives.....	8-7
8.3.1	Centralized Wastewater Collection System with NPDES Discharge	8-7
8.3.2	Centralized Wastewater Collection System with Groundwater Discharge Permit	8-10
8.3.3	Satellite Wastewater Collection System	8-11
8.3.3.1	Ability to Meet Needs	8-16
8.3.3.2	Environmental Impacts.....	8-16
8.3.3.3	Economics.....	8-16
8.3.4	Individual and Shared/Decentralized Treatment Facilities	8-18
8.4	Out of Town Alternatives	8-19
8.4.1	Regional WWTF Options	8-19
8.4.2	Out of Town Options	8-22
8.5	GLSD Alternative	8-23
8.5.1	Ability to Meet Needs.....	8-27
8.5.2	Environmental Impacts	8-27
8.5.3	Economics	8-28
8.6	High/Middle School Treatment Facility Optimization	8-29
8.6.1	Ability to Meet Needs.....	8-27
8.6.2	Environmental Impacts	8-27
8.6.3	Economics	8-28
8.7	Water Reuse	8-32
8.8	Selected Alternative	8-33
9	CONCLUSION AND RECOMMENDATION	
9.1	Recommended Projects	9-1
9.1.1	Water Supply Projects.....	9-1
9.1.1.1	Connection to MWRA through Reading	9-2
9.1.1.2	Water Conservation	9-2
9.1.2	Wastewater Management Projects.....	9-2
9.1.2.1	Alternatives Considered	9-2
9.1.2.2	Recommended Plan	9-3
9.1.3	Water Conservation Projects	9-4
9.1.3.1	Comprehensive Planning & Drought Management Planning	9-4
9.1.3.2	Water Audit.....	9-4
9.1.3.3	Leak Detection	9-4

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	9.1.3.4 Metering.....	9-5
	9.1.3.5 Rates	9-5
	9.1.3.6 Residential	9-5
	9.1.3.7 Public Sector	9.5
	9.1.3.8 Industrial, Commercial, and Institutional & Agricultural	9-6
	9.1.3.9 Lawn & Landscape.....	9-6
	9.1.3.10 Public Education & Outreach	9-6
9.2	Implementation	9-6
	9.2.1 Project Schedule	9-6
	9.2.2 Project Costs.....	9-8
9.3	Project Analysis	9-9
	9.3.1 Water Quality	9-14
	9.3.2 Public Health	9-14
	9.3.3 Water Balance and Ipswich River Impacts	9-14
	9.3.4 Stormwater Impacts	9-15
	9.3.5 Land Impacts	9-16
	9.3.6 Wetland and Surface Water Impacts.....	9-16
	9.3.7 Habitats of Rare Species.....	9-17
	9.3.8 Historic Places and Archaeological Resources.....	9-18
	9.3.9 Hazardous Materials.....	9-19
	9.3.10 Residential and Commercial Impacts.....	9-19
	9.3.11 Greenhouse Gas Impacts	9-19
	9.3.11.1 Wastewater Analysis.....	9-20
	9.3.11.2 Water Analysis	9-31
	9.3.11.3 GHG Reduction for Recommended Plan.....	9-37
9.4	Permitting and Agreements	9-38
	9.4.1 Water Related Permits	9-38
	9.4.2 Wastewater Related Permits	9-38
	9.4.3 Interbasin Transfer Act	9-38
	9.4.3.1 Donor Basin	9-40
	9.4.3.2 Receiving Basin	9-70
	9.4.4 Inter Municipal Agreements	9-70
9.5	Secondary Benefits.....	9-71
9.6	Public Participation	9-71
9.7	Non-Structural Recommendations	9-73

TABLE OF CONTENTS (CONT.)

APPENDICES

A	ENF CERTIFICATE AND COMMENT LETTERS
B	PUBLIC PARTICIPATION PRESENTATIONS
C	EXISTING IBTA RECOMMENDATION LETTER
D	ANNUAL STATISTICAL REPORTS
E	WATER CONSERVATION EFFORTS
F	TMDL EXCERPTS
G	WASTEWATER MANAGEMENT SYSTEM COST STUDY
H	DPW SITE HYDROLOGY: EXCERPT FROM DCWMP APPENDICES
I	DRACUT-METHUEN IMA
J	NORTH READING STORMWATER REPORT

TABLE OF CONTENTS (CONT.)

LIST OF TABLES

TABLE	DESCRIPTION	PAGE
2-1	Land Use	2-2
2-2	Top Employers	2-4
2-3	Zoning Districts	2-4
2-4	North Reading Census Data	2-9
2-5	Population Trends for the North Reading & Similar Neighboring Communities....	2-10
2-6	Soil Classification by Drainage	2-15
2-7	Rare and Endangered Species.....	2-23
2-8	Reportable Release Sites	2-29
3-1	Treatment Design Capacity	3-4
3-2	Lakeside Boulevard Sources and Pump Data.....	3-5
3-3	Railroad Well Sources and Pump Data.....	3-9
3-4	Central Street Well and Pump Data.....	3-13
3-5	Storage Facilities.....	3-16
3-6	Water Main Inventory	3-17
3-7	Historical Water Demand.....	3-7
3-8	Historical and Current Raw Water Quality Data (mg/l)	3-20
3-9	finished Water Quality – West Village	3-21
3-10	Finished Water Quality – Lakeside.....	3-22
4-1	Historical Water Demand.....	4-3
4-2	Historical Water Usage by Customer Category (MGD)	4-4
4-3	Per Capita Water Usage	4-5
4-4	Non-residential Water Demand	4-6
4-5	Confidently Estimated Municipal Use MG/Year	4-9
4-6	Unaccounted for Water Use	4-10
4-7	Projected Water Demands in MGD	4-11
4-8	Projected Water Demands (MGD).....	4-11
4-9	Annual Town Supply Withdrawal Amounts (MGD).....	4-12
4-10	Water Needs Summary (MGD)	4-14
4-11	Well Permitted Capacity	4-16
4-12	Well Pumping Rates.....	4-16
4-13	Well Specific Capacity.....	4-17
4-14	2014 Flow Rates	4-18
5-1	Planned Conservation Measures	5-5
5-2	Public Water Use and Impact of Water Conservation Measures 9/30/	5-7
6-1	On-Site Sewage Disposal Systems	6-2
6-2	Groundwater Discharge Permits	6-6
7-1	Scoring Factors	7-2
7-2	Factor Weighting	7-3
7-3	Wastewater Factor Scoring.....	7-20
7-4	Wastewater Needs Study Areas Trends Summary	7-25

TABLE OF CONTENTS (CONT.)

7-5	Top Three Factors Influencing Top Four Study Areas	7-35
7-6	Final Sewer Flows.....	7-39
7-7	Adjusted Sewer Flows.....	7-40
7-8	Estimated Residential Title 5 Flows	7-41
7-9	Estimated Non-residential Title 5 Flows.....	7-42
7-10	Estimated Total Title 5 Flows	7-42
7-11	High School WWTF MAX Daily Flow	7-44
8-1	Septic System GHG Emissions	8-4
8-2	No Build Emissions	8-5
8-3	GW Discharge Analysis – Typical Infiltration.....	8-10
8-4	GW Discharge analysis – Rapid Infiltration	8-11
8-5	GW Discharge Analysis – Satellite System	8-12
8-6	DPW Facility GHG Summary	8-17
8-7	GLSD Alternative GHG Summary.....	8-28
8-8	Approximate Cost Summary	8-29
9-1	Summary of Water Capital Costs	9-8
9-2	Summary of Wastewater Capital Costs.....	9-9
9-3	Ipswich River Water Balance	9-15
9-4	Summary of GHG Resources Used	9-21
9-5	CO ₂ Emissions from Private Treatment Facilities Due to Electricity	9-22
9-6	Septic System GHG Emissions	9-24
9-7	Pump Station Calculations	9-26
9-8	No Build Emissions Summary	9-27
9-9	Recommended Plan Summary with DPW Facility.....	9-28
9-10	Recommended Plan Summary without DPW Facility.....	9-28
9-11	Summary of Resources Used.....	9-32
9-12	Water Treated and Purchased by North Reading	9-33
9-13	Approach 1: Emissions Based on MEPA Averages	9-34
9-14	Approach 2: Emissions Based on North Reading’s Electrical Bills..	9-34
9-15	Vehicle Fleet CO ₂ Emissions	9-35
9-16	Booster Pump Station Calculations	9-36
9-17	Summary	9-37
9-18	Water Balance in Relation to Ipswich River Basin	9-40
9-19	MWRA Interbasin Transfer System	9-47
9-20	Demands of Prior Applicants to MWRA (MGD).....	9-49
9-21	Demands of New Communities (MGD)	9-50
9-22	MWRA Existing Service Area: Potential Water Demand Under Higher Growth Scenarios.....	9-54
9-23	MWRA Drought Management Stages	9-58
9-24	Number of Months in each Stage of MWRA’s Drought Management Plan.....	9-58
9-25	Communities Admitted to the MWRA Requiring Interbasin Act Approval.....	9-68

TABLE OF CONTENTS (CONT.)

LIST OF FIGURES

FIGURE	DESCRIPTION	PAGE
1-1	TITLE	
2-1	Land Use	2-3
2-2	Zoning	2-6
2-3	Underdeveloped Land	2-8
2-4	North Reading Population Trends Based on Town Census Data	2-9
2-5	Impervious Surfaces	2-11
2-6	Historical Places	2-12
2-7	Stat Standardized Precipitation Index	2-13
2-8	Soil Drainage	2-15
2-9	Topography	2-16
2-10	Surficial Geology	2-19
2-11	Integrated Waters GIS	2-21
2-12	Wetlands	2-22
2-13	Endangered Species	2-24
2-14	Flood Zones	2-26
2-15	Environmental Hazards	2-33
3-1	Water System	3-2
3-2	Historical Withdrawals from Town Sources	3-3
3-3	Lakeside Boulevard Water Treatment Plant Site Plan	3-6
3-4	Route 125 Well Site Plan	3-7
3-5	Railroad Bed Wellfield Site Plan	3-10
3-6	West Village Water Treatment Plant Site Plan	3-11
3-7	Central Street Wellfield and Pumping Station Site Plan	3-14
3-8	Town Water Production vs. Purchased Water	3-19
3-9	Water Quality Complaints	3-24
3-10	Well Users	3-26
5-1	System Improvements	5-22
6-1	Type of Treatment System	6-4
6-2	Septic System Rehabilitations	6-8
7-1	Lot Size	7-6
7-2	Ponding and Flooding	7-8
7-3	Septic System Age	7-10
7-4	Zone 1 and Outstanding Water Resources	7-12
7-5	Depth to Water Table	7-14
7-6	Depth to Restrictive Layer	7-16
7-7	Water Use *Gal/Day/Acre)	7-18
7-8	Wastewater Risk Mapping	7-23
7-9	Needs Study Areas	7-26
7-10	Proposed Collection System	7-38

TABLE OF CONTENTS (CONT.)

8-1	Septic System Age	8-6
8-2	Proposed Collection System.....	8-2
8-3	Potential Onsite Disposal Options	8-3
8-4	Potential Onsite Disposal Centralized town Owned Options.....	8-15
8-5	Andover Sewer System.....	8-26
8-6	Town Center Sewer Expansion	8-31
9-1	North Reading Impacts.....	9-11
9-2	Reading Impacts	9-12
9-3	Andover Impacts.....	9-13
9-4	General Plan MWRA Water System	9-41
9-5	MWRA Watersheds	9-41
9-6	Inflows and Outflows.....	9-42
9-7	Quabbin Reservoir Configuration.....	9-44
9-8	Withdrawals and Yield.....	9-52
9-9	Quabbin's Max Pool Descent	9-57
9-10	MWRA Annual Average System Demand	9-59
9-11	Reservoir Pattern Level.....	9-59
9-12	Nashua River Daily Releases	9-61
9-13	Quabbin Reservoir	9-63
9-14	Wachusett Reservoir/Nashua River Discharges	9-63

TOWN OF NORTH READING
DRAFT ENVIRONMENTAL IMPACT REPORT
TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
1	INTRODUCTION	
1.1	Project Background.....	1-1
1.2	Project History	1-1
1.3	Planning Tools	1-2
1.4	Terminology.....	1-3
1.5	Project Objective and Goals	1-3
1.5.1	Water Resources – Ipswich River	1-4
1.6	Recommended Plan.....	1-4
1.6.1	Costs and Schedule	1-5
1.6.2	Impacts.....	1-5
1.7	Permits and Approvals	1-6
1.7.1	Inter-Basin Transfer Act	1-6
2	EXISTING ENVIRONMENTAL CONDITIONS	
2.1	Infrastructure and Human Environment	
2.1.1	Land Use	2-1
2.1.2	Zoning.....	2-4
2.1.3	Buildout Analysis	2-7
2.1.4	Population Demographics	2-9
2.1.5	Planning Initiatives and Open Space	2-10
2.1.6	Stormwater.....	2-11
2.1.7	Impervious Surface.....	2-11
2.1.8	Historical and Archaeological Sites.....	2-11
2.2	Natural Environment	2-14
2.2.1	Climate	2-14
2.2.2	Soils	2-15
2.2.3	Topography	2-15
2.2.4	Hydrologic Conditions and Water Resources.....	2-18
2.2.5	Surficial Geology.....	2-18
2.2.6	Water Quality	2-20
2.2.7	Wetlands	2-20
2.2.8	Endangered Species	2-23
2.2.9	Floodplains	2-25
2.2.10	Air Quality.....	2-27
2.2.11	Environmental Hazards.....	2-27
2.2.11.1	Reportable Release Sites.....	2-28

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	2.2.11.2 Comprehensive Environmental Response, Compensation and Liability Information System	2-31
	2.2.11.4 Underground Storage Tanks	2-31
	2.2.11.5 Landfills	2-32
3	EXISTING WATER SUPPLY SYSTEMS	
3.1	Water Supply and Interconnections	3-1
3.1.1	Local Sources	3-1
3.1.1.1	Lakeside Boulevard Wellfield & WTP	3-4
3.1.1.2	Lakeside Boulevard Wellfield and Route 125 Well	3-4
3.1.1.3	Lakeside Water Treatment Plant	3-8
3.1.1.4	Railroad Bed Wellfield & West Villiage WTP	3-8
3.1.1.5	Railroad Bed Wellfield	3-8
3.1.1.6	West Village Water Treatment Plant.....	3-12
3.1.1.7	Central Street Wellfield and Pump Station....	3-12
3.1.1.8	Central Street Wellfield	3-12
3.1.1.9	Central Street Pump Station.....	3-13
3.1.2	Interconnections.....	3-15
3.1.3	Emergency Interconnections	3-15
3.2	Water Distribution Storage	3-15
3.3	Water Distribution Piping.....	3-16
3.4	Water System Management	3-18
3.5	Historical Water Use	3-18
3.6	Water Quality	3-20
3.6.1	Raw Water Quality	3-20
3.6.2	Filtered Water Quality	3-21
3.6.3	Distribution and Storage	3-22
3.6.4	Regulatory Compliance.....	3-22
3.6.5	Customer Complaints.....	3-23
3.7	Source Water Protection.....	3-25
3.8	Private Wells.....	3-25
3.9	Existing Water Conservation Measures	3-27
3.9.1	Billing	3-27
3.9.2	comprehensive Planning & Drought Management Planning	3-27
3.9.3	Water Audit	3-28
3.9.4	Leak Detection.....	3-28
3.9.5	Metering	3-28
3.9.6	Public Sector.....	3-28
3.9.7	Lawn & Landscape	3-28
3.9.8	Public Education & Outreach.....	3-29
4	WATER SUPPLY NEEDS ANALYSIS	
4.1	Introduction.....	4-1

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
4.2	Water Needs Assessment Methodology	4-1
4.3	Projected Water Demand	4-1
4.3.1	Population Projections	4-1
4.3.2	Water Demand Trends	4-2
4.3.3	Projected Residential Water Demand	4-4
4.3.4	Projected Non- Residential Water Demand	4-6
4.3.5	Maximum Daily Demand.....	4-7
4.3.6	Future Requirements.....	4-8
4.3.6.1	Per Capita Water Use	4-8
4.3.6.2	Residential & Non-residential Average Day Demand	4-8
4.3.6.3	Municipal Water Use.....	4-8
4.3.6.4	Unaccounted for Water Use.....	4-9
4.3.6.5	Residential and Non-residential Maximum Day Demand	4-10
4.3.6.6	Peak Hourly Demand	4-10
4.3.6.7	Projected Flow Summary	4-11
4.4	Permitted Water Supply.....	4-12
4.4.1	Local Sources	4-12
4.4.2	Interconnections.....	4-13
4.5	Water Needs Analysis	4-13
4.5.1	Water Operation & Maintenance Needs	4-14
4.5.2	Water Quality, Capacity, and Treatment Needs	4-16
4.5.2.1	Well Cleaning	4-17
4.5.2.2	Well Water Quality	4-17
4.5.3	Ipswich river Needs	4-19
4.5.3.1	Low Flow	4-20
4.5.3.2	High Flow/Flooding	4-20
4.6	Water Needs Analysis Summary	4-21
5	WATER SUPPLY ALTERNATIVES ANALYSIS	
5.1	Initial Screening	5-1
5.1.1	No Build	5-1
5.1.2	Water Conservation	5-3
5.1.2.1	Municipal Water Conservation	5-6
5.1.2.2	Nearby Communities Water Conservation....	5-8
5.1.2.3	IBTA Water Reduction Measures	5-9
5.1.3	Out of Town Alternative	5-10
5.1.3.1	Groundwater and Surface Water	5-10
5.1.3.2	Surface Water.....	5-11
5.1.3.3	Optimizing Local Sources	5-11
5.1.4	Out of Town Alternative	5-12
5.1.4.1	Neighboring Community Interconnection....	5-12
5.1.4.2	MWRA Connection.....	5-16

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
5.2	Advanced Alternatives Analysis	5-18
5.2.1	MWRA Connection	5-18
5.2.1.1	Advantages and Disadvantages.....	5-18
5.2.1.2	Reading and North Reading System Upgrades	5-20
5.2.1.3	MWRA Withdrawal and Costs	5-21
5.2.1.4	MWRA Policy OP#10 Admission Criteria....	5-23
5.2.1.5	Permits and other regulatory considerations/IBTA Requirements/ Decommissioning of water treatment plants/wells	5-24
5.2.2	Water Conservation Alternative	5-24
6	EXISTING WASTEWATER MANAGEMENT SYSTEMS	
6.1	On-site Wastewater Disposal Systems	6-1
6.1.1	Septic Systems.....	6-2
6.1.2	Cesspools.....	6-2
6.1.3	Tight Tanks and Grease Traps.....	6-3
6.1.4	Innovative/Alternative Technologies.....	6-5
6.1.5	Treatment Facilities (NPDES Permit)	6-5
6.1.6	Residuals Management	6-6
6.2	On-site Wastewater Disposal Systems Effectiveness	6-6
6.2.1	Septic System Failures and Rehabilitations	6-7
6.2.2	DEP Violations	6-7
6.3	North Reading Board of Health Septic System Regulations and Procedures	6-9
6.4	Collection Systems	6-9
7	EXISTING WASTEWATER NEEDS ANALYSIS	
7.1	Wastewater Needs Analysis Summary.....	7-1
7.2	Wastewater Needs Assessment Methodology	7-1
7.2.1	Category 5 Factors.....	7-3
7.2.1.1	Septic System Rehabilitations.....	7-3
7.2.1.2	Tight Tanks	7-4
7.2.1.3	Water Use Class	7-4
7.2.1.4	Impaired Waters	7-4
7.2.2	Category 2 Factors.....	7-5
7.2.2.1	Lot Size	7-5
7.2.2.2	Soil Drainage Class	7-7
7.2.2.3	Ponding	7-7
7.2.2.4	Flooding.....	7-9
7.2.2.5	Septic System Age.....	7-9
7.2.2.6	Pump Out Frequency	7-11
7.2.2.7	Zone 2 or IWPA	7-11
7.2.3	Category 1 Factors.....	7-13
7.2.3.1	Depth to Groundwater Table	7-13

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	7.2.3.2 Depth to restrictive Layer	7-15
	7.2.3.3 Water Use per Acre	7-17
	7.2.3.4 Wetlands	7-19
	7.2.3.5 Private Wells	7-19
	7.2.3.6 Outstanding Water Resource Protection Zone	7-19
	7.2.4 Wastewater Matrix Analysis Trends.....	7-19
7.3	Delineation of Study Areas.....	7-24
7.4	Study Area Descriptions and Assessments.....	7-27
	7.4.1 Martins Pond	7-27
	7.4.2 Lowell Road	7-28
	7.4.3 Park Street.....	7-28
	7.4.4 Concord Street.....	7-28
	7.4.5 Route 28 South	7-29
	7.4.6 Hillview	7-30
	7.4.7 Central Street North.....	7-30
	7.4.8 Eisenhower's Pond	7-31
	7.4.9 High School.....	7-31
	7.4.10 Department of Public Works.....	7-32
	7.4.11 Crestwood Drive.....	7-32
	7.4.12 Mount Vernon	7-32
	7.4.13 Marblehead Street.....	7-33
	7.4.14 Orchard Drive	7-33
	7.4.15 Thomson.....	7-34
	7.4.16 Swan Pond.....	7-34
	7.4.17 Windshield Survey Summary.....	7-35
7.5	Wastewater Needs Area.....	7-35
	7.5.1 Potential Sewer Network Scenarios.....	7-36
	7.5.2 Proposed Sewer Network.....	7-37
7.6	Projected Sewer Wastewater Flow Needs	7-39
	7.6.1 Residential Wastewater Flows	7-39
	7.6.2 Commercial Wastewater Flows.....	7-39
	7.6.3 Adjustment Baseline Sewer Flows	7-40
	7.6.4 Projected Title 5 Flow Evaluation	7-40
	7.6.4.1 Typical Residential Flows	7-41
	7.6.4.2 Non-residential Flows	7-41
7.7	Other Needs and Considerations.....	7-43
	7.7.1 Ipswich River Needs.....	7-43
	7.7.1.1 Flow Balancing	7-43
	7.7.1.2 Water Quality.....	7-43
	7.7.1.3 Martins Pond	7-44
	7.7.2 Downtown Needs	7-44
7.8	Wastewater Management Needs Analysis Summary.....	7-45

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
8.1	Introduction.....	8-1
8.1.1	Evaluation Methodology.....	8-2
8.2	No-Build	8-2
8.2.1	Introduction	8-2
8.2.2	Ability to Meet Needs.....	8-2
8.2.3	Environmental Impacts	8-3
8.2.4	Economics	8-5
8.3	In Town Alternatives.....	8-7
8.3.1	Centralized Wastewater Collection System with NPDES Discharge	8-7
8.3.2	Centralized Wastewater Collection System with Groundwater Discharge Permit	8-10
8.3.3	Satellite Wastewater Collection System	8-11
8.3.3.1	Ability to Meet Needs	8-16
8.3.3.2	Environmental Impacts.....	8-16
8.3.3.3	Economics.....	8-16
8.3.4	Individual and Shared/Decentralized Treatment Facilities	8-18
8.4	Out of Town Alternatives	8-19
8.4.1	Regional WWTF Options	8-19
8.4.2	Out of Town Options	8-22
8.5	GLSD Alternative	8-23
8.5.1	Ability to Meet Needs.....	8-27
8.5.2	Environmental Impacts	8-27
8.5.3	Economics	8-28
8.6	High/Middle School Treatment Facility Optimization	8-29
8.6.1	Ability to Meet Needs.....	8-27
8.6.2	Environmental Impacts	8-27
8.6.3	Economics	8-28
8.7	Water Reuse	8-32
8.8	Selected Alternative	8-33
9	CONCLUSION AND RECOMMENDATION	
9.1	Recommended Projects	9-1
9.1.1	Water Supply Projects.....	9-1
9.1.1.1	Connection to MWRA through Reading	9-2
9.1.1.2	Water Conservation	9-2
9.1.2	Wastewater Management Projects.....	9-2
9.1.2.1	Alternatives Considered	9-2
9.1.2.2	Recommended Plan	9-3
9.1.3	Water Conservation Projects	9-4
9.1.3.1	Comprehensive Planning & Drought Management Planning	9-4
9.1.3.2	Water Audit.....	9-4
9.1.3.3	Leak Detection	9-4

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	9.1.3.4 Metering.....	9-5
	9.1.3.5 Rates	9-5
	9.1.3.6 Residential	9-5
	9.1.3.7 Public Sector	9.5
	9.1.3.8 Industrial, Commercial, and Institutional & Agricultural	9-6
	9.1.3.9 Lawn & Landscape.....	9-6
	9.1.3.10 Public Education & Outreach	9-6
9.2	Implementation	9-6
	9.2.1 Project Schedule	9-6
	9.2.2 Project Costs.....	9-8
9.3	Project Analysis	9-9
	9.3.1 Water Quality	9-14
	9.3.2 Public Health	9-14
	9.3.3 Water Balance and Ipswich River Impacts	9-14
	9.3.4 Stormwater Impacts	9-15
	9.3.5 Land Impacts	9-16
	9.3.6 Wetland and Surface Water Impacts.....	9-16
	9.3.7 Habitats of Rare Species.....	9-17
	9.3.8 Historic Places and Archaeological Resources.....	9-18
	9.3.9 Hazardous Materials.....	9-19
	9.3.10 Residential and Commercial Impacts.....	9-19
	9.3.11 Greenhouse Gas Impacts	9-19
	9.3.11.1 Wastewater Analysis.....	9-20
	9.3.11.2 Water Analysis	9-31
	9.3.11.3 GHG Reduction for Recommended Plan.....	9-37
9.4	Permitting and Agreements	9-38
	9.4.1 Water Related Permits	9-38
	9.4.2 Wastewater Related Permits	9-38
	9.4.3 Interbasin Transfer Act	9-38
	9.4.3.1 Donor Basin	9-40
	9.4.3.2 Receiving Basin	9-70
	9.4.4 Inter Municipal Agreements	9-70
9.5	Secondary Benefits.....	9-71
9.6	Public Participation	9-71
9.7	Non-Structural Recommendations	9-73

TABLE OF CONTENTS (CONT.)

APPENDICES

A	ENF CERTIFICATE AND COMMENT LETTERS
B	PUBLIC PARTICIPATION PRESENTATIONS
C	EXISTING IBTA RECOMMENDATION LETTER
D	ANNUAL STATISTICAL REPORTS
E	WATER CONSERVATION EFFORTS
F	TMDL EXCERPTS
G	WASTEWATER MANAGEMENT SYSTEM COST STUDY
H	DPW SITE HYDROLOGY: EXCERPT FROM DCWMP APPENDICES
I	DRACUT-METHUEN IMA
J	NORTH READING STORMWATER REPORT

TABLE OF CONTENTS (CONT.)

LIST OF TABLES

TABLE	DESCRIPTION	PAGE
2-1	Land Use	2-2
2-2	Top Employers	2-4
2-3	Zoning Districts	2-4
2-4	North Reading Census Data	2-9
2-5	Population Trends for the North Reading & Similar Neighboring Communities....	2-10
2-6	Soil Classification by Drainage	2-15
2-7	Rare and Endangered Species.....	2-23
2-8	Reportable Release Sites	2-29
3-1	Treatment Design Capacity	3-4
3-2	Lakeside Boulevard Sources and Pump Data.....	3-5
3-3	Railroad Well Sources and Pump Data.....	3-9
3-4	Central Street Well and Pump Data.....	3-13
3-5	Storage Facilities.....	3-16
3-6	Water Main Inventory	3-17
3-7	Historical Water Demand.....	3-7
3-8	Historical and Current Raw Water Quality Data (mg/l)	3-20
3-9	finished Water Quality – West Village	3-21
3-10	Finished Water Quality – Lakeside.....	3-22
4-1	Historical Water Demand.....	4-3
4-2	Historical Water Usage by Customer Category (MGD)	4-4
4-3	Per Capita Water Usage	4-5
4-4	Non-residential Water Demand	4-6
4-5	Confidently Estimated Municipal Use MG/Year	4-9
4-6	Unaccounted for Water Use	4-10
4-7	Projected Water Demands in MGD	4-11
4-8	Projected Water Demands (MGD).....	4-11
4-9	Annual Town Supply Withdrawal Amounts (MGD).....	4-12
4-10	Water Needs Summary (MGD)	4-14
4-11	Well Permitted Capacity	4-16
4-12	Well Pumping Rates.....	4-16
4-13	Well Specific Capacity.....	4-17
4-14	2014 Flow Rates	4-18
5-1	Planned Conservation Measures	5-5
5-2	Public Water Use and Impact of Water Conservation Measures 9/30/	5-7
6-1	On-Site Sewage Disposal Systems	6-2
6-2	Groundwater Discharge Permits	6-6
7-1	Scoring Factors	7-2
7-2	Factor Weighting	7-3
7-3	Wastewater Factor Scoring.....	7-20
7-4	Wastewater Needs Study Areas Trends Summary	7-25

TABLE OF CONTENTS (CONT.)

7-5	Top Three Factors Influencing Top Four Study Areas	7-35
7-6	Final Sewer Flows.....	7-39
7-7	Adjusted Sewer Flows.....	7-40
7-8	Estimated Residential Title 5 Flows	7-41
7-9	Estimated Non-residential Title 5 Flows.....	7-42
7-10	Estimated Total Title 5 Flows	7-42
7-11	High School WWTF MAX Daily Flow	7-44
8-1	Septic System GHG Emissions	8-4
8-2	No Build Emissions	8-5
8-3	GW Discharge Analysis – Typical Infiltration.....	8-10
8-4	GW Discharge analysis – Rapid Infiltration	8-11
8-5	GW Discharge Analysis – Satellite System	8-12
8-6	DPW Facility GHG Summary	8-17
8-7	GLSD Alternative GHG Summary.....	8-28
8-8	Approximate Cost Summary	8-29
9-1	Summary of Water Capital Costs	9-8
9-2	Summary of Wastewater Capital Costs.....	9-9
9-3	Ipswich River Water Balance	9-15
9-4	Summary of GHG Resources Used	9-21
9-5	CO ₂ Emissions from Private Treatment Facilities Due to Electricity	9-22
9-6	Septic System GHG Emissions	9-24
9-7	Pump Station Calculations	9-26
9-8	No Build Emissions Summary	9-27
9-9	Recommended Plan Summary with DPW Facility.....	9-28
9-10	Recommended Plan Summary without DPW Facility.....	9-28
9-11	Summary of Resources Used.....	9-32
9-12	Water Treated and Purchased by North Reading	9-33
9-13	Approach 1: Emissions Based on MEPA Averages	9-34
9-14	Approach 2: Emissions Based on North Reading’s Electrical Bills..	9-34
9-15	Vehicle Fleet CO ₂ Emissions	9-35
9-16	Booster Pump Station Calculations	9-36
9-17	Summary	9-37
9-18	Water Balance in Relation to Ipswich River Basin	9-40
9-19	MWRA Interbasin Transfer System	9-47
9-20	Demands of Prior Applicants to MWRA (MGD).....	9-49
9-21	Demands of New Communities (MGD)	9-50
9-22	MWRA Existing Service Area: Potential Water Demand Under Higher Growth Scenarios.....	9-54
9-23	MWRA Drought Management Stages	9-58
9-24	Number of Months in each Stage of MWRA’s Drought Management Plan.....	9-58
9-25	Communities Admitted to the MWRA Requiring Interbasin Act Approval.....	9-68

TABLE OF CONTENTS (CONT.)

LIST OF FIGURES

FIGURE	DESCRIPTION	PAGE
1-1	TITLE	
2-1	Land Use	2-3
2-2	Zoning	2-6
2-3	Underdeveloped Land	2-8
2-4	North Reading Population Trends Based on Town Census Data	2-9
2-5	Impervious Surfaces	2-11
2-6	Historical Places	2-12
2-7	Stat Standardized Precipitation Index	2-13
2-8	Soil Drainage	2-15
2-9	Topography	2-16
2-10	Surficial Geology	2-19
2-11	Integrated Waters GIS	2-21
2-12	Wetlands	2-22
2-13	Endangered Species	2-24
2-14	Flood Zones	2-26
2-15	Environmental Hazards	2-33
3-1	Water System	3-2
3-2	Historical Withdrawals from Town Sources	3-3
3-3	Lakeside Boulevard Water Treatment Plant Site Plan	3-6
3-4	Route 125 Well Site Plan	3-7
3-5	Railroad Bed Wellfield Site Plan	3-10
3-6	West Village Water Treatment Plant Site Plan	3-11
3-7	Central Street Wellfield and Pumping Station Site Plan	3-14
3-8	Town Water Production vs. Purchased Water	3-19
3-9	Water Quality Complaints	3-24
3-10	Well Users	3-26
5-1	System Improvements	5-22
6-1	Type of Treatment System	6-4
6-2	Septic System Rehabilitations	6-8
7-1	Lot Size	7-6
7-2	Ponding and Flooding	7-8
7-3	Septic System Age	7-10
7-4	Zone 1 and Outstanding Water Resources	7-12
7-5	Depth to Water Table	7-14
7-6	Depth to Restrictive Layer	7-16
7-7	Water Use *Gal/Day/Acre)	7-18
7-8	Wastewater Risk Mapping	7-23
7-9	Needs Study Areas	7-26
7-10	Proposed Collection System	7-38

TABLE OF CONTENTS (CONT.)

8-1	Septic System Age	8-6
8-2	Proposed Collection System.....	8-2
8-3	Potential Onsite Disposal Options	8-3
8-4	Potential Onsite Disposal Centralized town Owned Options.....	8-15
8-5	Andover Sewer System.....	8-26
8-6	Town Center Sewer Expansion	8-31
9-1	North Reading Impacts.....	9-11
9-2	Reading Impacts	9-12
9-3	Andover Impacts.....	9-13
9-4	General Plan MWRA Water System	9-41
9-5	MWRA Watersheds	9-41
9-6	Inflows and Outflows.....	9-42
9-7	Quabbin Reservoir Configuration.....	9-44
9-8	Withdrawals and Yield.....	9-52
9-9	Quabbin's Max Pool Descent	9-57
9-10	MWRA Annual Average System Demand	9-59
9-11	Reservoir Pattern Level.....	9-59
9-12	Nashua River Daily Releases	9-61
9-13	Quabbin Reservoir	9-63
9-14	Wachusett Reservoir/Nashua River Discharges	9-63

TOWN OF NORTH READING
DRAFT ENVIRONMENTAL IMPACT REPORT
TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
1	INTRODUCTION	
1.1	Project Background.....	1-1
1.2	Project History	1-1
1.3	Planning Tools	1-2
1.4	Terminology.....	1-3
1.5	Project Objective and Goals	1-3
1.5.1	Water Resources – Ipswich River	1-4
1.6	Recommended Plan.....	1-4
1.6.1	Costs and Schedule	1-5
1.6.2	Impacts.....	1-5
1.7	Permits and Approvals	1-6
1.7.1	Inter-Basin Transfer Act	1-6
2	EXISTING ENVIRONMENTAL CONDITIONS	
2.1	Infrastructure and Human Environment	
2.1.1	Land Use	2-1
2.1.2	Zoning.....	2-4
2.1.3	Buildout Analysis	2-7
2.1.4	Population Demographics	2-9
2.1.5	Planning Initiatives and Open Space	2-10
2.1.6	Stormwater.....	2-11
2.1.7	Impervious Surface.....	2-11
2.1.8	Historical and Archaeological Sites.....	2-11
2.2	Natural Environment	2-14
2.2.1	Climate	2-14
2.2.2	Soils	2-15
2.2.3	Topography	2-15
2.2.4	Hydrologic Conditions and Water Resources.....	2-18
2.2.5	Surficial Geology.....	2-18
2.2.6	Water Quality	2-20
2.2.7	Wetlands	2-20
2.2.8	Endangered Species	2-23
2.2.9	Floodplains	2-25
2.2.10	Air Quality.....	2-27
2.2.11	Environmental Hazards.....	2-27
2.2.11.1	Reportable Release Sites.....	2-28

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	2.2.11.2 Comprehensive Environmental Response, Compensation and Liability Information System	2-31
	2.2.11.4 Underground Storage Tanks	2-31
	2.2.11.5 Landfills	2-32
3	EXISTING WATER SUPPLY SYSTEMS	
3.1	Water Supply and Interconnections	3-1
3.1.1	Local Sources	3-1
3.1.1.1	Lakeside Boulevard Wellfield & WTP	3-4
3.1.1.2	Lakeside Boulevard Wellfield and Route 125 Well	3-4
3.1.1.3	Lakeside Water Treatment Plant	3-8
3.1.1.4	Railroad Bed Wellfield & West Villiage WTP	3-8
3.1.1.5	Railroad Bed Wellfield	3-8
3.1.1.6	West Village Water Treatment Plant.....	3-12
3.1.1.7	Central Street Wellfield and Pump Station....	3-12
3.1.1.8	Central Street Wellfield	3-12
3.1.1.9	Central Street Pump Station.....	3-13
3.1.2	Interconnections.....	3-15
3.1.3	Emergency Interconnections	3-15
3.2	Water Distribution Storage	3-15
3.3	Water Distribution Piping.....	3-16
3.4	Water System Management	3-18
3.5	Historical Water Use	3-18
3.6	Water Quality	3-20
3.6.1	Raw Water Quality	3-20
3.6.2	Filtered Water Quality	3-21
3.6.3	Distribution and Storage	3-22
3.6.4	Regulatory Compliance.....	3-22
3.6.5	Customer Complaints.....	3-23
3.7	Source Water Protection.....	3-25
3.8	Private Wells.....	3-25
3.9	Existing Water Conservation Measures	3-27
3.9.1	Billing	3-27
3.9.2	comprehensive Planning & Drought Management Planning	3-27
3.9.3	Water Audit	3-28
3.9.4	Leak Detection.....	3-28
3.9.5	Metering	3-28
3.9.6	Public Sector.....	3-28
3.9.7	Lawn & Landscape	3-28
3.9.8	Public Education & Outreach.....	3-29
4	WATER SUPPLY NEEDS ANALYSIS	
4.1	Introduction.....	4-1

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
4.2	Water Needs Assessment Methodology	4-1
4.3	Projected Water Demand	4-1
4.3.1	Population Projections	4-1
4.3.2	Water Demand Trends	4-2
4.3.3	Projected Residential Water Demand	4-4
4.3.4	Projected Non- Residential Water Demand	4-6
4.3.5	Maximum Daily Demand.....	4-7
4.3.6	Future Requirements.....	4-8
4.3.6.1	Per Capita Water Use	4-8
4.3.6.2	Residential & Non-residential Average Day Demand	4-8
4.3.6.3	Municipal Water Use.....	4-8
4.3.6.4	Unaccounted for Water Use.....	4-9
4.3.6.5	Residential and Non-residential Maximum Day Demand	4-10
4.3.6.6	Peak Hourly Demand	4-10
4.3.6.7	Projected Flow Summary	4-11
4.4	Permitted Water Supply.....	4-12
4.4.1	Local Sources	4-12
4.4.2	Interconnections.....	4-13
4.5	Water Needs Analysis	4-13
4.5.1	Water Operation & Maintenance Needs	4-14
4.5.2	Water Quality, Capacity, and Treatment Needs	4-16
4.5.2.1	Well Cleaning	4-17
4.5.2.2	Well Water Quality	4-17
4.5.3	Ipswich river Needs	4-19
4.5.3.1	Low Flow	4-20
4.5.3.2	High Flow/Flooding	4-20
4.6	Water Needs Analysis Summary	4-21
5	WATER SUPPLY ALTERNATIVES ANALYSIS	
5.1	Initial Screening	5-1
5.1.1	No Build	5-1
5.1.2	Water Conservation	5-3
5.1.2.1	Municipal Water Conservation	5-6
5.1.2.2	Nearby Communities Water Conservation....	5-8
5.1.2.3	IBTA Water Reduction Measures	5-9
5.1.3	Out of Town Alternative	5-10
5.1.3.1	Groundwater and Surface Water	5-10
5.1.3.2	Surface Water.....	5-11
5.1.3.3	Optimizing Local Sources	5-11
5.1.4	Out of Town Alternative	5-12
5.1.4.1	Neighboring Community Interconnection....	5-12
5.1.4.2	MWRA Connection.....	5-16

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
5.2	Advanced Alternatives Analysis	5-18
5.2.1	MWRA Connection	5-18
5.2.1.1	Advantages and Disadvantages.....	5-18
5.2.1.2	Reading and North Reading System Upgrades	5-20
5.2.1.3	MWRA Withdrawal and Costs	5-21
5.2.1.4	MWRA Policy OP#10 Admission Criteria....	5-23
5.2.1.5	Permits and other regulatory considerations/IBTA Requirements/ Decommissioning of water treatment plants/wells	5-24
5.2.2	Water Conservation Alternative	5-24
6	EXISTING WASTEWATER MANAGEMENT SYSTEMS	
6.1	On-site Wastewater Disposal Systems	6-1
6.1.1	Septic Systems.....	6-2
6.1.2	Cesspools.....	6-2
6.1.3	Tight Tanks and Grease Traps.....	6-3
6.1.4	Innovative/Alternative Technologies.....	6-5
6.1.5	Treatment Facilities (NPDES Permit)	6-5
6.1.6	Residuals Management	6-6
6.2	On-site Wastewater Disposal Systems Effectiveness	6-6
6.2.1	Septic System Failures and Rehabilitations	6-7
6.2.2	DEP Violations	6-7
6.3	North Reading Board of Health Septic System Regulations and Procedures	6-9
6.4	Collection Systems	6-9
7	EXISTING WASTEWATER NEEDS ANALYSIS	
7.1	Wastewater Needs Analysis Summary.....	7-1
7.2	Wastewater Needs Assessment Methodology	7-1
7.2.1	Category 5 Factors.....	7-3
7.2.1.1	Septic System Rehabilitations.....	7-3
7.2.1.2	Tight Tanks	7-4
7.2.1.3	Water Use Class	7-4
7.2.1.4	Impaired Waters	7-4
7.2.2	Category 2 Factors.....	7-5
7.2.2.1	Lot Size	7-5
7.2.2.2	Soil Drainage Class	7-7
7.2.2.3	Ponding	7-7
7.2.2.4	Flooding.....	7-9
7.2.2.5	Septic System Age.....	7-9
7.2.2.6	Pump Out Frequency	7-11
7.2.2.7	Zone 2 or IWPA	7-11
7.2.3	Category 1 Factors.....	7-13
7.2.3.1	Depth to Groundwater Table	7-13

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	7.2.3.2 Depth to restrictive Layer	7-15
	7.2.3.3 Water Use per Acre	7-17
	7.2.3.4 Wetlands	7-19
	7.2.3.5 Private Wells	7-19
	7.2.3.6 Outstanding Water Resource Protection Zone	7-19
	7.2.4 Wastewater Matrix Analysis Trends.....	7-19
7.3	Delineation of Study Areas.....	7-24
7.4	Study Area Descriptions and Assessments.....	7-27
	7.4.1 Martins Pond	7-27
	7.4.2 Lowell Road	7-28
	7.4.3 Park Street.....	7-28
	7.4.4 Concord Street.....	7-28
	7.4.5 Route 28 South	7-29
	7.4.6 Hillview	7-30
	7.4.7 Central Street North.....	7-30
	7.4.8 Eisenhower's Pond	7-31
	7.4.9 High School.....	7-31
	7.4.10 Department of Public Works.....	7-32
	7.4.11 Crestwood Drive.....	7-32
	7.4.12 Mount Vernon	7-32
	7.4.13 Marblehead Street.....	7-33
	7.4.14 Orchard Drive	7-33
	7.4.15 Thomson.....	7-34
	7.4.16 Swan Pond.....	7-34
	7.4.17 Windshield Survey Summary.....	7-35
7.5	Wastewater Needs Area.....	7-35
	7.5.1 Potential Sewer Network Scenarios.....	7-36
	7.5.2 Proposed Sewer Network.....	7-37
7.6	Projected Sewer Wastewater Flow Needs	7-39
	7.6.1 Residential Wastewater Flows	7-39
	7.6.2 Commercial Wastewater Flows.....	7-39
	7.6.3 Adjustment Baseline Sewer Flows	7-40
	7.6.4 Projected Title 5 Flow Evaluation	7-40
	7.6.4.1 Typical Residential Flows	7-41
	7.6.4.2 Non-residential Flows	7-41
7.7	Other Needs and Considerations.....	7-43
	7.7.1 Ipswich River Needs.....	7-43
	7.7.1.1 Flow Balancing	7-43
	7.7.1.2 Water Quality.....	7-43
	7.7.1.3 Martins Pond	7-44
	7.7.2 Downtown Needs	7-44
7.8	Wastewater Management Needs Analysis Summary.....	7-45

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
8.1	Introduction.....	8-1
8.1.1	Evaluation Methodology.....	8-2
8.2	No-Build	8-2
8.2.1	Introduction	8-2
8.2.2	Ability to Meet Needs.....	8-2
8.2.3	Environmental Impacts	8-3
8.2.4	Economics	8-5
8.3	In Town Alternatives.....	8-7
8.3.1	Centralized Wastewater Collection System with NPDES Discharge	8-7
8.3.2	Centralized Wastewater Collection System with Groundwater Discharge Permit	8-10
8.3.3	Satellite Wastewater Collection System	8-11
8.3.3.1	Ability to Meet Needs	8-16
8.3.3.2	Environmental Impacts.....	8-16
8.3.3.3	Economics.....	8-16
8.3.4	Individual and Shared/Decentralized Treatment Facilities	8-18
8.4	Out of Town Alternatives	8-19
8.4.1	Regional WWTF Options	8-19
8.4.2	Out of Town Options	8-22
8.5	GLSD Alternative	8-23
8.5.1	Ability to Meet Needs.....	8-27
8.5.2	Environmental Impacts	8-27
8.5.3	Economics	8-28
8.6	High/Middle School Treatment Facility Optimization	8-29
8.6.1	Ability to Meet Needs.....	8-27
8.6.2	Environmental Impacts	8-27
8.6.3	Economics	8-28
8.7	Water Reuse	8-32
8.8	Selected Alternative	8-33
9	CONCLUSION AND RECOMMENDATION	
9.1	Recommended Projects	9-1
9.1.1	Water Supply Projects.....	9-1
9.1.1.1	Connection to MWRA through Reading	9-2
9.1.1.2	Water Conservation	9-2
9.1.2	Wastewater Management Projects.....	9-2
9.1.2.1	Alternatives Considered	9-2
9.1.2.2	Recommended Plan	9-3
9.1.3	Water Conservation Projects	9-4
9.1.3.1	Comprehensive Planning & Drought Management Planning	9-4
9.1.3.2	Water Audit.....	9-4
9.1.3.3	Leak Detection	9-4

TABLE OF CONTENTS (CONT.)

SECTION	DESCRIPTION	PAGE
	9.1.3.4 Metering.....	9-5
	9.1.3.5 Rates	9-5
	9.1.3.6 Residential	9-5
	9.1.3.7 Public Sector	9.5
	9.1.3.8 Industrial, Commercial, and Institutional & Agricultural	9-6
	9.1.3.9 Lawn & Landscape.....	9-6
	9.1.3.10 Public Education & Outreach	9-6
9.2	Implementation	9-6
	9.2.1 Project Schedule	9-6
	9.2.2 Project Costs.....	9-8
9.3	Project Analysis	9-9
	9.3.1 Water Quality	9-14
	9.3.2 Public Health	9-14
	9.3.3 Water Balance and Ipswich River Impacts	9-14
	9.3.4 Stormwater Impacts	9-15
	9.3.5 Land Impacts	9-16
	9.3.6 Wetland and Surface Water Impacts.....	9-16
	9.3.7 Habitats of Rare Species.....	9-17
	9.3.8 Historic Places and Archaeological Resources.....	9-18
	9.3.9 Hazardous Materials.....	9-19
	9.3.10 Residential and Commercial Impacts.....	9-19
	9.3.11 Greenhouse Gas Impacts	9-19
	9.3.11.1 Wastewater Analysis.....	9-20
	9.3.11.2 Water Analysis	9-31
	9.3.11.3 GHG Reduction for Recommended Plan.....	9-37
9.4	Permitting and Agreements	9-38
	9.4.1 Water Related Permits	9-38
	9.4.2 Wastewater Related Permits	9-38
	9.4.3 Interbasin Transfer Act	9-38
	9.4.3.1 Donor Basin	9-40
	9.4.3.2 Receiving Basin	9-70
	9.4.4 Inter Municipal Agreements	9-70
9.5	Secondary Benefits.....	9-71
9.6	Public Participation	9-71
9.7	Non-Structural Recommendations	9-73

TABLE OF CONTENTS (CONT.)

APPENDICES

A	ENF CERTIFICATE AND COMMENT LETTERS
B	PUBLIC PARTICIPATION PRESENTATIONS
C	EXISTING IBTA RECOMMENDATION LETTER
D	ANNUAL STATISTICAL REPORTS
E	WATER CONSERVATION EFFORTS
F	TMDL EXCERPTS
G	WASTEWATER MANAGEMENT SYSTEM COST STUDY
H	DPW SITE HYDROLOGY: EXCERPT FROM DCWMP APPENDICES
I	DRACUT-METHUEN IMA
J	NORTH READING STORMWATER REPORT

TABLE OF CONTENTS (CONT.)

LIST OF TABLES

TABLE	DESCRIPTION	PAGE
2-1	Land Use	2-2
2-2	Top Employers	2-4
2-3	Zoning Districts	2-4
2-4	North Reading Census Data	2-9
2-5	Population Trends for the North Reading & Similar Neighboring Communities....	2-10
2-6	Soil Classification by Drainage	2-15
2-7	Rare and Endangered Species.....	2-23
2-8	Reportable Release Sites	2-29
3-1	Treatment Design Capacity	3-4
3-2	Lakeside Boulevard Sources and Pump Data.....	3-5
3-3	Railroad Well Sources and Pump Data.....	3-9
3-4	Central Street Well and Pump Data.....	3-13
3-5	Storage Facilities.....	3-16
3-6	Water Main Inventory	3-17
3-7	Historical Water Demand.....	3-7
3-8	Historical and Current Raw Water Quality Data (mg/l)	3-20
3-9	finished Water Quality – West Village	3-21
3-10	Finished Water Quality – Lakeside.....	3-22
4-1	Historical Water Demand.....	4-3
4-2	Historical Water Usage by Customer Category (MGD)	4-4
4-3	Per Capita Water Usage	4-5
4-4	Non-residential Water Demand	4-6
4-5	Confidently Estimated Municipal Use MG/Year	4-9
4-6	Unaccounted for Water Use	4-10
4-7	Projected Water Demands in MGD	4-11
4-8	Projected Water Demands (MGD).....	4-11
4-9	Annual Town Supply Withdrawal Amounts (MGD).....	4-12
4-10	Water Needs Summary (MGD)	4-14
4-11	Well Permitted Capacity	4-16
4-12	Well Pumping Rates.....	4-16
4-13	Well Specific Capacity.....	4-17
4-14	2014 Flow Rates	4-18
5-1	Planned Conservation Measures	5-5
5-2	Public Water Use and Impact of Water Conservation Measures 9/30/	5-7
6-1	On-Site Sewage Disposal Systems	6-2
6-2	Groundwater Discharge Permits	6-6
7-1	Scoring Factors	7-2
7-2	Factor Weighting	7-3
7-3	Wastewater Factor Scoring.....	7-20
7-4	Wastewater Needs Study Areas Trends Summary	7-25

TABLE OF CONTENTS (CONT.)

7-5	Top Three Factors Influencing Top Four Study Areas	7-35
7-6	Final Sewer Flows.....	7-39
7-7	Adjusted Sewer Flows.....	7-40
7-8	Estimated Residential Title 5 Flows	7-41
7-9	Estimated Non-residential Title 5 Flows.....	7-42
7-10	Estimated Total Title 5 Flows	7-42
7-11	High School WWTF MAX Daily Flow	7-44
8-1	Septic System GHG Emissions	8-4
8-2	No Build Emissions	8-5
8-3	GW Discharge Analysis – Typical Infiltration.....	8-10
8-4	GW Discharge analysis – Rapid Infiltration	8-11
8-5	GW Discharge Analysis – Satellite System	8-12
8-6	DPW Facility GHG Summary	8-17
8-7	GLSD Alternative GHG Summary.....	8-28
8-8	Approximate Cost Summary	8-29
9-1	Summary of Water Capital Costs	9-8
9-2	Summary of Wastewater Capital Costs.....	9-9
9-3	Ipswich River Water Balance	9-15
9-4	Summary of GHG Resources Used	9-21
9-5	CO ₂ Emissions from Private Treatment Facilities Due to Electricity	9-22
9-6	Septic System GHG Emissions	9-24
9-7	Pump Station Calculations	9-26
9-8	No Build Emissions Summary	9-27
9-9	Recommended Plan Summary with DPW Facility.....	9-28
9-10	Recommended Plan Summary without DPW Facility.....	9-28
9-11	Summary of Resources Used.....	9-32
9-12	Water Treated and Purchased by North Reading	9-33
9-13	Approach 1: Emissions Based on MEPA Averages	9-34
9-14	Approach 2: Emissions Based on North Reading’s Electrical Bills..	9-34
9-15	Vehicle Fleet CO ₂ Emissions	9-35
9-16	Booster Pump Station Calculations	9-36
9-17	Summary	9-37
9-18	Water Balance in Relation to Ipswich River Basin	9-40
9-19	MWRA Interbasin Transfer System	9-47
9-20	Demands of Prior Applicants to MWRA (MGD).....	9-49
9-21	Demands of New Communities (MGD)	9-50
9-22	MWRA Existing Service Area: Potential Water Demand Under Higher Growth Scenarios.....	9-54
9-23	MWRA Drought Management Stages	9-58
9-24	Number of Months in each Stage of MWRA’s Drought Management Plan.....	9-58
9-25	Communities Admitted to the MWRA Requiring Interbasin Act Approval.....	9-68

TABLE OF CONTENTS (CONT.)

LIST OF FIGURES

FIGURE	DESCRIPTION	PAGE
1-1	TITLE	
2-1	Land Use	2-3
2-2	Zoning	2-6
2-3	Underdeveloped Land	2-8
2-4	North Reading Population Trends Based on Town Census Data	2-9
2-5	Impervious Surfaces	2-11
2-6	Historical Places	2-12
2-7	Stat Standardized Precipitation Index	2-13
2-8	Soil Drainage	2-15
2-9	Topography	2-16
2-10	Surficial Geology	2-19
2-11	Integrated Waters GIS	2-21
2-12	Wetlands	2-22
2-13	Endangered Species	2-24
2-14	Flood Zones	2-26
2-15	Environmental Hazards	2-33
3-1	Water System	3-2
3-2	Historical Withdrawals from Town Sources	3-3
3-3	Lakeside Boulevard Water Treatment Plant Site Plan	3-6
3-4	Route 125 Well Site Plan	3-7
3-5	Railroad Bed Wellfield Site Plan	3-10
3-6	West Village Water Treatment Plant Site Plan	3-11
3-7	Central Street Wellfield and Pumping Station Site Plan	3-14
3-8	Town Water Production vs. Purchased Water	3-19
3-9	Water Quality Complaints	3-24
3-10	Well Users	3-26
5-1	System Improvements	5-22
6-1	Type of Treatment System	6-4
6-2	Septic System Rehabilitations	6-8
7-1	Lot Size	7-6
7-2	Ponding and Flooding	7-8
7-3	Septic System Age	7-10
7-4	Zone 1 and Outstanding Water Resources	7-12
7-5	Depth to Water Table	7-14
7-6	Depth to Restrictive Layer	7-16
7-7	Water Use *Gal/Day/Acre)	7-18
7-8	Wastewater Risk Mapping	7-23
7-9	Needs Study Areas	7-26
7-10	Proposed Collection System	7-38

TABLE OF CONTENTS (CONT.)

8-1	Septic System Age	8-6
8-2	Proposed Collection System.....	8-2
8-3	Potential Onsite Disposal Options	8-3
8-4	Potential Onsite Disposal Centralized town Owned Options.....	8-15
8-5	Andover Sewer System.....	8-26
8-6	Town Center Sewer Expansion	8-31
9-1	North Reading Impacts.....	9-11
9-2	Reading Impacts	9-12
9-3	Andover Impacts.....	9-13
9-4	General Plan MWRA Water System	9-41
9-5	MWRA Watersheds	9-41
9-6	Inflows and Outflows.....	9-42
9-7	Quabbin Reservoir Configuration.....	9-44
9-8	Withdrawals and Yield.....	9-52
9-9	Quabbin's Max Pool Descent	9-57
9-10	MWRA Annual Average System Demand	9-59
9-11	Reservoir Pattern Level.....	9-59
9-12	Nashua River Daily Releases	9-61
9-13	Quabbin Reservoir	9-63
9-14	Wachusett Reservoir/Nashua River Discharges	9-63