# Section IV
# Subbasins
# Table of Contents

**ESTUARY SUBBASIN** ..... **1**

GEOLOGY ..... 1
*Streamside Landslides* ..... *3*
VEGETATION ..... 3
LAND USE ..... 4
*Timber Harvest* ..... *5*
*Roads* ..... *5*
FIRE AND FUELS ..... 5
FLUVIAL GEOMORPHOLOGY ..... 7
*Sediment Storage and Transport* ..... *11*
WATER QUALITY ..... 11
*Temperature, Salinity and Dissolved Oxygen* ..... *11*
*Water Column Chemistry* ..... *12*
*In-Channel Sediment* ..... *12*
SALMONID HABITAT ASSESSMENT ..... 12
SALMONID FISHERY RESOURCES ..... 14
*Chinook Salmon* ..... *14*
*Steelhead* ..... *14*
*Coastal Cutthroat* ..... *15*
*Coho Salmon* ..... *15*
ESTUARY SUBBASIN GENERAL ISSUES ..... 15
INTEGRATED ANALYSIS AND CUMULATIVE EFFECTS ..... 16
*EMDS Stream Reach Condition and Limiting Factors Analysis* ..... *18*
*Refugia Areas* ..... *18*
RESPONSES TO ASSESSMENT QUESTIONS ..... 19
SUBBASIN CONCLUSIONS ..... 23

**PRAIRIE CREEK SUBBASIN** ..... **24**

GEOLOGY ..... 24
*Streamside Landslides* ..... *26*
VEGETATION ..... 27
*Land Use* ..... *27*
*Timber Harvest* ..... *27*
*Roads* ..... *29*
FIRE AND FUELS ..... 30
FLUVIAL GEOMORPHOLOGY ..... 30
*Stream Disturbance* ..... *31*
WATER QUALITY ..... 31
*Temperature* ..... *31*
*Water Column Chemistry* ..... *32*
*In-Channel Sediment* ..... *32*
SALMONID HABITAT ASSESSMENT ..... 33
*Stream Reach Characteristics* ..... *34*
*Pool Depth* ..... *35*
*Pool Shelter* ..... *36*
*Streamside Canopy Density* ..... *37*
*Spawning Cobble Embeddedness* ..... *38*
SALMONID FISHERY RESOURCES ..... 39
*Coho Salmon* ..... *40*
*Chinook Salmon* ..... *41*
*Steelhead* ..... *41*
*Coastal Cutthroat* ..... *42*

*Prairie Creek Hatchery* ... *42*
PRAIRIE CREEK SUBBASIN GENERAL ISSUES ... 43
INTEGRATED ANALYSIS AND CUMULATIVE EFFECTS ... 44
*EMDS Potential Sediment Model Results* ... *46*
*EMDS Stream Reach Condition Results and Limiting Factors Analysis* ... *48*
*Refugia Areas* ... *49*
RESPONSES TO ASSESSMENT QUESTIONS ... 50
SUBBASIN CONCLUSIONS ... 53

**LOWER SUBBASIN ... 54**

GEOLOGY ... 54
*Streamside Landslides* ... *56*
VEGETATION ... 57
LAND USE ... 57
*Timber Harvests* ... *58*
*Roads* ... *60*
FIRE AND FUELS ... 60
FLUVIAL GEOMORPHOLOGY ... 61
*Stream Disturbance* ... *62*
WATER QUALITY ... 62
*Temperature* ... *62*
*Water Column Chemistry* ... *64*
*In-Channel Sediment* ... *64*
SALMONID HABITAT ... 65
*Fish Habitat Relationship* ... *65*
*Past Surveys* ... *65*
*Present Surveys* ... *66*
*Stream Reach Characteristics* ... *67*
*Pool Depth* ... *68*
*Pool Shelter* ... *69*
*Streamside Canopy Density* ... *70*
*Spawning Cobble Embeddedness* ... *71*
SALMONID FISHERY RESOURCES ... 72
*Chinook Salmon* ... *72*
*Steelhead* ... *72*
*Coho Salmon* ... *72*
LOWER SUBBASIN GENERAL ISSUES ... 74
INTEGRATED ANALYSIS AND CUMULATIVE EFFECTS ... 74
*EMDS Potential Sediment Production Results* ... *78*
*Stream Reach Condition EMDS Results and Limiting Factors* ... *79*
*Refugia Areas* ... *81*
RESPONSES TO ASSESSMENT QUESTIONS ... 81
SUBBASIN CONCLUSIONS ... 85

**MIDDLE SUBBASIN ... 86**

*GEOLOGY* ... 86
*Streamside Landslides* ... *88*
VEGETATION ... 90
TIMBER HARVEST ... 90
ROADS ... 94
FIRE AND FUELS ... 95
FLUVIAL GEOMORPHOLOGY ... 96
*Stream Disturbance* ... *98*
WATER QUALITY ... 99
*Temperature* ... *99*
*Water Column Chemistry* ... *100*
*In-Channel Sediment* ... *100*
SALMONID HABITAT ... 101
*Stream Surveys 1966–1995* ... *102*
*Stream Surveys 2001* ... *104*

*Pool Characteristics* ..... *106*
*Pool Depth* ..... *106*
*Pool Frequency* ..... *107*
*Pool Shelter Complexity* ..... *108*
*Pool Shelter Composition* ..... *109*
*Spawning Cobble Embeddedness* ..... *109*
*Streamside Canopy Density* ..... *110*
*Barriers to Fish Passage* ..... *111*
SALMONID FISHERY RESOURCES ..... 112
*Coho Salmon* ..... *112*
*Chinook Salmon* ..... *113*
*Steelhead* ..... *113*
*Summer Steelhead* ..... *113*
*Coastal Cutthroat* ..... *114*
MIDDLE SUBBASIN GENERAL ISSUES ..... 114
INTEGRATED ANALYSIS ..... 115
*Integrated Analysis and Cumulative Effects* ..... *115*
*EMDS Potential Sediment Production Results* ..... *121*
*EMDS Stream Reach Condition Results and Limiting Factors Analysis* ..... *122*
*Stream Habitat Improvement Recommendations* ..... *124*
*Refugia Areas* ..... *125*
RESPONSES TO ASSESSMENT QUESTIONS ..... 126
SUBBASIN CONCLUSIONS ..... 132

**UPPER SUBBASIN ..... 133**

GEOLOGY ..... 135
*Streamside Landslides* ..... *135*
VEGETATION ..... 138
TIMBER HARVEST ..... 140
ROADS ..... 141
FIRE AND FUELS ..... 142
FLUVIAL GEOMORPHOLOGY ..... 143
WATER QUALITY ..... 145
*Water Column Chemistry* ..... *145*
*Temperature* ..... *145*
*In-Channel Sediment* ..... *146*
SALMONID HABITAT ..... 146
*Fish Habitat Relationships* ..... *146*
*Past Surveys* ..... *147*
*2001 Surveys* ..... *148*
*Pool:Riffle:Run Ratios* ..... *148*
*Pool Depth* ..... *148*
*Pool Shelter* ..... *149*
*Streamside Canopy Density* ..... *150*
*Spawning Cobble Embeddedness* ..... *150*
SALMONID FISHERY RESOURCES ..... 151
*Coho Salmon* ..... *151*
*Chinook Salmon* ..... *151*
*Steelhead* ..... *151*
*Summer Steelhead* ..... *151*
*Coastal Cutthroat* ..... *152*
UPPER SUBBASIN GENERAL ISSUES ..... 152
INTEGRATED ANALYSIS AND CUMULATIVE EFFECTS ..... 152
*EMDS Potential Sediment Production Results* ..... *158*
*EMDS Stream Reach Condition Results and Limiting Factors Analysis* ..... *159*
*Refugia Areas* ..... *161*
RESPONSES TO ASSESSMENT QUESTIONS ..... 161
SUBBASIN CONCLUSIONS ..... 165

# Table of Figures

Figure IV- 1. Estuary Subbasin. ..... 2
Figure IV- 2. Estuary vegetation map showing cover types. ..... 4
Figure IV-3. Estuary Subbasin timber harvest. ..... 6
Figure IV- 4. Estuary Subbasin fuel ranking map. ..... 7
Figure IV- 5. Redwood Creek estuary in 1936. ..... 8
Figure IV- 6. Redwood Creek estuary in 1948. ..... 8
Figure IV- 7. Redwood Creek estuary in 1965, after the flood of 1964. ..... 9
Figure IV- 8. Redwood Creek estuary in 1988. ..... 9
Figure IV- 9. Redwood Creek mouth, 2000. ..... 10
Figure IV- 10. Prairie Creek Subbasin and its tributaries. ..... 25
Figure IV- 11. Prairie Creek vegetation map showing cover types. ..... 28
Figure IV- 12. Prairie Creek Subbasin timber harvest. ..... 29
Figure IV- 13. Fuel ranking map of the Prairie Creek Subbasin. ..... 31
Figure IV- 14. Prairie Creek Subbasin Instream habitat sampling point. ..... 35
Figure IV- 15. Percent of sample reaches in pools grouped by maximum pool depth. ..... 36
Figure IV- 16. Prairie Creek Subbasin average pool shelter ratings from CDFG sample reaches. ..... 37
Figure IV- 17. Prairie Creek percent canopy density measurements and the percent vegetation type contributing to shade canopy. ..... 38
Figure IV- 18. Prairie Creek Subbasin average cobble embeddedness from sample sites. ..... 39
Figure IV- 19. Prairie Creek, 1951 sampling. ..... 40
Figure IV- 20. Prairie Creek live coho, redd, and carcass counts, 1983 to 2000. ..... 41
Figure IV- 21. Prairie Creek live Chinook, redd, and carcass counts 1983 to 2000. ..... 42
Figure IV- 22. Prairie Creek Subbasin EMDS map results for selected stream reach factors. ..... 49
Figure IV- 23. Map of the Lower Subbasin of Redwood Creek. ..... 55
Figure IV- 24. Lower Subbasin vegetation map showing cover types. ..... 58
Figure IV- 25. Lower Subbasin timber Harvest. ..... 59
Figure IV- 26. Lower Subbasin fuel ranking map. ..... 60
Figure IV- 27. Lower Subbasin instream habitat sampling points. ..... 67
Figure IV- 28. Lower Subbasin percent of sample reaches in pools. ..... 69
Figure IV- 29. Average pool shelter ratings. ..... 70
Figure IV- 30. Lower Subbasin percent stream canopy density and percent vegetation type contributing to shade canopy. 71
Figure IV- 31. Lower Subbasin cobble embeddedness categories measured at pool tail crests, sampling sites. ..... 72
Figure IV- 32. Lower Subbasin EMDS results for selected stream reach factors. ..... 80
Figure IV- 33. Middle Subbasin and its tributaries, Redwood Creek. ..... 87
Figure IV- 34. Middle Subbasin map showing vegetation cover types. ..... 92
Figure IV- 35. Middle Subbasin multiple timber harvest entry map. ..... 93
Figure IV- 36. Middle Subbasin timber harvest from 1977 to 2000. ..... 94
Figure IV- 37. Middle Subbasin classification of roads. ..... 95
Figure IV- 38. Middle Subbasin miles of roads constructed by years. ..... 95
Figure IV- 39. Middle Subbasin fuel ranking map. ..... 96
Figure IV- 40. Comparison of habitat conditions in lower Lacks Creek 1995 and 2001. ..... 103
Figure IV- 41. Comparison of habitat conditions in upper Lacks Creek 1995 and 2001. ..... 103
Figure IV- 42. Comparison of amount of pool habitat for survey years 1995 and 2001 in tributary streams. ..... 104
Figure IV- 43. 2001 Middle Subbasin habitat survey reaches are shown in dark blue. ..... 105
Figure IV- 44. Middle Subbasin percent stream lengths at various pool depths surveyed, 2001. ..... 107
Figure IV- 45. 2001 Middle Subbasin mainstem Redwood Creek maximum residual pool depths. ..... 107
Figure IV- 46. Middle Subbasin average pool shelter ratings from 2001 CDFG Stream Surveys. ..... 108
Figure IV- 47. Percent cobble embeddedness in Middle Subbasin streams. ..... 110
Figure IV- 48. Middle Subbasin percent canopy density and percent vegetation type contributing to stream shade cover. 111
Figure IV- 49. Example of perched delta at mouth of Panther Creek, summer 2004. ..... 112
Figure IV- 50. Middle Subbasin EMDS map results for selected stream reach factors. ..... 124
Figure IV- 51. Upper Subbasin and its tributaries. ..... 134
Figure IV- 52. Upper Subbasin relative density of active streamside landslides by Planning Watersheds (PWs) 1984 and 2000. ..... 137
Figure IV- 53. Number of active streamside landslides mapped from 1984 and 2000 Aerial Photographs. ..... 137
Figure IV- 54. Streamside slides in Upper Basin. ..... 138
Figure IV- 55. Upper Subbasin vegetation map showing cover types. ..... 139

Figure IV- 56. Upper Subbasin multiple timber harvest. 141
Figure IV- 57. Upper Subbasin miles of road construction by period. 142
Figure IV- 58. Upper Subbasin fuel ranking map. 143
Figure IV- 59. Upper Subbasin percent survey reach in pools, grouped by maximum depth. 149
Figure IV- 60. Upper Subbasin mean shelter rating for pools surveyed. 149
Figure IV- 61. Upper Subbasin mean canopy density and canopy vegetation types from streams surveyed. 150
Figure IV- 62. Cobble embeddedness in Upper Subbasin streams. 150
Figure IV- 63. Upper Subbasin EMDS results. 160

# List of Tables

Table IV- 1. Estuary Subbasin summary, Redwood Creek. 1
Table IV- 2. Estuary Subbasin summary of relative landslide potential and landslide features. 3
Table IV- 3. Estuary Subbasin number and indices of streamside slides. 3
Table IV- 4. Estuary Subbasin generalized vegetation cover type. 3
Table IV- 5. Estuary Subbasin timber harvest history 1950-2000. 5
Table IV- 6. Estuary Subbasin fuel ranks summary. 5
Table IV- 7. Estuary Subbasin length of negative stream features, negative stream feature index, and percent change 1984 to 2000. 11
Table IV- 8. Estuary Subbasin species present, and number of stream miles accessible to anadromous salmonids. 13
Table IV- 9. Juvenile steelhead and Chinook population estimates. 14
Table IV- 10. Historically active landslide features and relative landslide potential by land type or land use. 17
Table IV- 11. Estuary Subbasin integrated information summary. 18
Table IV- 12. Prairie Creek Subbasin summary. 24
Table IV- 13. Prairie Creek Subbasin summary of relative landslide potential and landslide features. 26
Table IV- 14. Prairie Creek Subbasin number and indices of streamside slides by subbasins and planning watersheds in 1984 and 2000. 27
Table IV- 15. Generalized cover type by subbasin and planning watershed. 27
Table IV- 16. Prairie Creek Subbasin timber harvest history, 1950-2000. 28
Table IV- 17. Fuel ranks summary for Prairie Creek Subbasin and planning watersheds. 30
Table IV- 18. Percent of stream length by stream gradient classes. 30
Table IV- 19. Length of negative stream features, negative stream feature index, and percent change for 1984 to 2000. 31
Table IV- 20. Prairie Creek Subbasin MWATs recorded between 1997 and 2001. 32
Table IV- 21. Prairie Creek Subbasin streams, species present, and number of stream miles accessible to anadromous salmonid. 33
Table IV- 22. Prairie Creek Subbasin bank full width (BFW) measured from sampling, site. 35
Table IV- 23. Prairie Creek Subbasin mean maximum pool depths for sample reaches 2001 and Godwood Creek (2002). 36
Table IV- 24. Summary of mean percent cover. 37
Table IV- 25. Adult salmonid counts at Prairie Creek Weir. 40
Table IV- 26. Acres and percent of area by relative landslide potential and land use or type classes. 45
Table IV- 27. Historically active and dormant landslides and selected geomorphic features[1] within 180' of a blue line stream. 45
Table IV- 28. Prairie Creek Subbasin integrated information summary. 46
Table IV- 29. EMDS ratings for potential sediment inputs to streams; top three levels of model. 47
Table IV- 30. Potential sediment input to streams from management-related surface erosion sources. 47
Table IV- 31. Potential stream sediment production from management-related streamside erosion sources. 47
Table IV- 32. Potential stream sediment production from management-related mass wasting sources. 48
Table IV- 33. Summary of the results from the Prairie Creek Subbasin EMDS Stream Reach Evaluation. 48
Table IV- 34. Prairie Creek Subbasin anadromous salmonid refugia designations for streams. 50
Table IV- 35. Lower Subbasin notable features. 54
Table IV- 36. Lower Subbasin summary of relative landslide potential and landslide features. 56
Table IV- 37. Lower Subbasin active streamside slides, slide index, and change in index, 1984 and 2000. 57
Table IV- 38. Generalized cover type by subbasin and planning watershed. 57
Table IV- 39. Lower Subbasin timber harvest history, 1950-2000. 59
Table IV- 40. Lower Subbasin fuel ranks summary for planning watersheds. 60
Table IV- 41. Lower Subbasin planning watershed area and miles of blue line streams. 61
Table IV- 42. Length of negative stream features, negative stream feature index, and percent change for 1984 to 2000. 63

Table IV- 43. Lower Subbasin streams MWATS. 64
Table IV- 44. Lower Subbasin stream species present, and number of stream miles accessible to anadromous salmonids. 65
Table IV- 45. Lower Subbasin percent occurrence and percent by length of pool, run, riffle, and dry habitats in the. 68
Table IV- 46. Lower Subbasin mean maximum pool depths for sample reaches 2001. 69
Table IV- 47. Summary of mean percent cover. 70
Table IV- 48. Bridge Creek spawning survey results 1982-1994. 73
Table IV- 49. Spawning survey results for Tom McDonald Creek, 1982-1994. 73
Table IV- 50. Acres and percent area of historically active landslide features associated with land type or use. 75
Table IV- 51. Lower Subbasin acres and percent of area by relative landslide potential and land use or type classes. 75
Table IV- 52. Lower Subbasin integrated information summary. 77
Table IV- 53. EMDS ratings for potential stream sediment production; top three levels of model. 78
Table IV- 54. Potential stream sediment production from management related surface erosion sources. 78
Table IV- 55. Potential stream sediment production from management related streamside erosion sources. 78
Table IV- 56. Potential stream sediment production from management related mass wasting sources. 79
Table IV- 57. Summary of results from the Lower Subbasin EMDS stream reach evaluation. 80
Table IV- 58. Lower Subbasin anadromous salmonid refugia designations. 81
Table IV- 59. Middle Subbasin summary. 86
Table IV- 60. Middle Redwood Subbasin active streamside slides, slide index, and change in index, 1984 and 2000. 88
Table IV- 61. Middle Subbasin summary of relative landslide potential and landslide features. 89
Table IV- 62. Generalized cover type by subbasin and planning watershed. 90
Table IV- 63. Timber harvest history for the Middle Subbasin planning watersheds, 1950-2000. 91
Table IV- 64. Middle Subbasin multiple harvest acres. 91
Table IV- 65. Fuel ranks summary for the Middle Subbasin and its planning watersheds. 96
Table IV- 66. Middle Subbasin stream miles by planning watersheds. 97
Table IV- 67. Length of observed stream disturbance features and percent change in planning watershed streams 1984 to 2000. 98
Table IV- 68. Middle Subbasin maximum MWATs and seasonal maximum temperatures. 99
Table IV- 69. Middle Subbasin annual maximum temperatures from 1994-2001. 100
Table IV- 70. Middle Subbasin streams, species present, and number of stream miles accessible to anadromous salmonids. 101
Table IV- 71. Middle Subbasin percent by occurrence and length of pool, run, riffle, and dry habitats in anadromous fish reaches summer 1995. 104
Table IV- 72. Middle Subbasin percent by occurrence and length of pool, run, riffle, and dry habitats in anadromous fish reaches summer 2001. 106
Table IV- 73. Stream order, pool frequency, and mean residual pool depths in Middle Subbasin tributaries. 108
Table IV- 74. Middle Subbasin summary of shelter composition. 109
Table IV- 75. Acres and percent area of historically active landslide features associated with recent land use and vegetation type 116
Table IV- 76. Middle Subbasin acres and percent of area by relative landslide potential and land use or type classes. 118
Table IV- 77. Middle Subbasin integrated information summary. 119
Table IV- 78. EMDS Ratings for potential sediment production and delivery to streams; top three levels of model. 121
Table IV- 79. Potential stream sediment production from management-related surface erosion sources. 121
Table IV- 80. Potential stream sediment production from management-related streamside erosion sources. 122
Table IV- 81. Potential stream sediment production from management related mass wasting sources. 122
Table IV- 82. Summary of the results from the Middle Subbasin EMDS Stream Reach Evaluation. 123
Table IV- 83. Top three ranking recommendation categories by number of tributaries and mainstem reaches in the Redwood Creek basin. 125
Table IV- 84. Prioritization of steps to address limiting factors. 125
Table IV- 85. Middle Subbasin anadromous salmonid refugia designations for streams. 126
Table IV- 86. Upper Subbasin summary. 133
Table IV- 87. Upper Subbasin summary of relative landslide potential and landslide features. 136
Table IV- 88. Number and indices of streamside slides by watershed, subbasins, and planning watersheds. 136
Table IV- 89. Upper Subbasin generalized cover type. 139
Table IV- 90. Upper Subbasin timber harvest history, 1950-2000. 140
Table IV- 91. Upper subbasin multiple harvest acres. 140
Table IV- 92. Upper Subbasin fuel ranks summary. 142
Table IV- 93. Upper Subbasin stream miles. 143
Table IV- 94. Upper Subbasin negative stream features, negative stream feature index, and percent change for 1984 to 2000. 145
Table IV- 95. MWATs for Upper Subbasin sites. 146

Table IV- 96. Seasonal maximum temperatures for Upper Subbasin sites 1996-2001. ..... 146
Table IV- 97. Upper Subbasin streams, species present, and number of stream miles accessible to anadromous salmonids. ..... 147
Table IV- 98. Upper Subbasin percent by occurrence, length of pool:run:riffle, and dry habitats in anadromous fish reaches summer 2001. ..... 148
Table IV- 99. Upper Subbasin summary of mean percent cover of dominant (1) and subdominant (2) shelter types in pool and flatwater units. ..... 149
Table IV- 100. Upper Subbasin acres and percent area of historically active landslide features associated with land type or use..... 154
Table IV- 101. Upper Subbasin acres and percent of area by relative landslide potential and land use classes..... 155
Table IV- 102. Upper Subbasin integrated information summary for the. ..... 156
Table IV- 103. Upper Subbasin EMDS ratings for potential stream sediment production; top three levels of model. ..... 158
Table IV- 104. Upper Subbasin potential stream sediment production from management-related surface erosion sources. ..... 158
Table IV- 105. Upper Subbasin potential stream sediment production from management related streamside erosion sources. ..... 159
Table IV- 106. Upper Subbasin potential stream sediment production from management-related mass wasting sources.. 159
Table IV- 107. Summary results from the Upper Subbasin EMDS stream reach evaluation. ..... 160
Table IV- 108. Upper Subbasin anadromous salmonid refugia designations for streams. ..... 161