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Sustainable Urban Transport Investment Program
Tbilisi – Rustavi Urban Road Link Project

Ecological Sensitivity of Mtkvari River and Impact of Section 2 on River Biodiversity

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Contents

Appendices

1. Introduction

1. The Asian Development Bank (ADB) is assisting the Government of Georgia in upgrading the Tbilisi-Rustavi Highway. **Figure 1-1** shows the regional location of the Project in the Kura-Aras Basin. The total length of the highway is 17.4 km which is being constructed in three sections. Section 1 and 3 are already constructed while the construction of the 6.8-km, Section 2, is to commence soon. A 3.65 km segment of Section 2 will be a new road, bypassing the existing alignment of the Tbilisi-Rustavi Highway. As shown in **Figure 1-2**, part of the proposed new alignment of the highway will be constructed over reclaimed land from the Mtkvari River.[1] Reclamation of land from the river will result in some loss of aquatic habitat as well as alteration of hydraulic and morphological characteristics of the river (as detailed in the engineering report for the proposed road), which can impact the ecology of the river. This report has been prepared to assess the significance of this impact by providing the following information and analysis.

- A baseline of ecological resources of the river with focus on fish fauna
- An overview of impact of existing economic activities in the river basin on the river ecology
- Assessment of the impact of the Project on river ecology

1.1 Ecological Setting

2. Georgia has a large number of rivers and lakes and is rich in hydrobiological resources. Some major rivers of Georgia include Alazani, Kura (Mtkvari), Rioni, Enguri, Khrami, Tskhenistsqali, Iori, Qvirila, Supsa and Chorokhi. Important lakes and reservoirs include Lake Paravani (3,700 ha), Khrami reservoir (2,770 ha), Lake Kartsakhi (2,650 ha), Lake Tabatskuri (1,452 ha), Sioni reservoir (1,280 ha), Lake Jandari (1230 ha), Tkibuli reservoir (1,210 ha), Shaori reservoir (1,022 ha) and Lake Saghamo (458 ha).

3. The project highway is located along the River Mtkvari, which is the main waterway of South Caucasus. Having a total catchment area of 188 thousand square kilometers in the territories of Turkey, Georgia, Armenia and Azerbaijan, it is an east-flowing river south of the Greater Caucasus Mountains. It drains the southern slopes of the Greater Caucasus east into the Caspian Sea. Starting in northeastern Turkey, it flows through Turkey to Georgia, then to Azerbaijan where it receives the Aras as a right tributary, and enters the Caspian Sea. The river has a total length of 1,515 kilometers of which about 174 kilometers is in Turkey, 435 kilometers in Georgia, and 906 kilometers in Azerbaijan. Approximately 52% of the River Mtkvari's flow comes from snowmelt and glaciers, 30% comes from groundwater seepage, and roughly 18% from precipitation.

1.2 Study Area

4. The Study Area extends from the confluence of Aragvi River and Mtkvari River at Mstkheta to Pirveli Kesalo Town just upstream of Rustavi. This area includes two barriers

[1] The Mtkvari River is known as Kura River in Azebaijan and Turkey. It is referred to as Mtkvari/Kura River in this report when the extended length of the river across the countries is the subject.

as shown in **Figure 1-3**, the diversion weir of Mstkheta HPP near Zahesi, and the Rustavi Barrage just upstream on Mtkvari River just upstream of Rustavi. **Figure 1-2** shows the 'Zone of Impact' where the proposed highway is aligned along the bank of the river. This segment of the river is of special concern and the subject of this study as the Project will directly impact riparian biodiversity in the construction as well as operation phases due to loss of aquatic habitat.

1.3 Methodology and Sampling Plan

5. **Figure 1-3** shows the sampling locations for the study. Sampling was conducted at points upstream of the Zone of Impact, at the Zone of Impact, and downstream of Zone of Impact. Data collected and analyzed included the following:

- Fish and fish tissue contamination
- Macro-invertebrates
- River dependent birds
- Water quality

6. **Appendix A** includes survey methodology and sampling plan for the study.

1.4 Timing of the Study

7. Data was obtained in mid-May (15 – 30) 2017 (see **Figure 1-4**). This is an active period for fish in terms of feeding, movement, and breeding. Cast netting produced good results, electrofishing and sampling for macroinvertebrates was done in a side stream at one location only. It is believed that a representative sample was taken for the icthyofauna of the river and this along with data from the literature made it possible to complete an impact assessment that meets the objectives of the study.

Figure 1-1: Regional Location of Project and Study Area

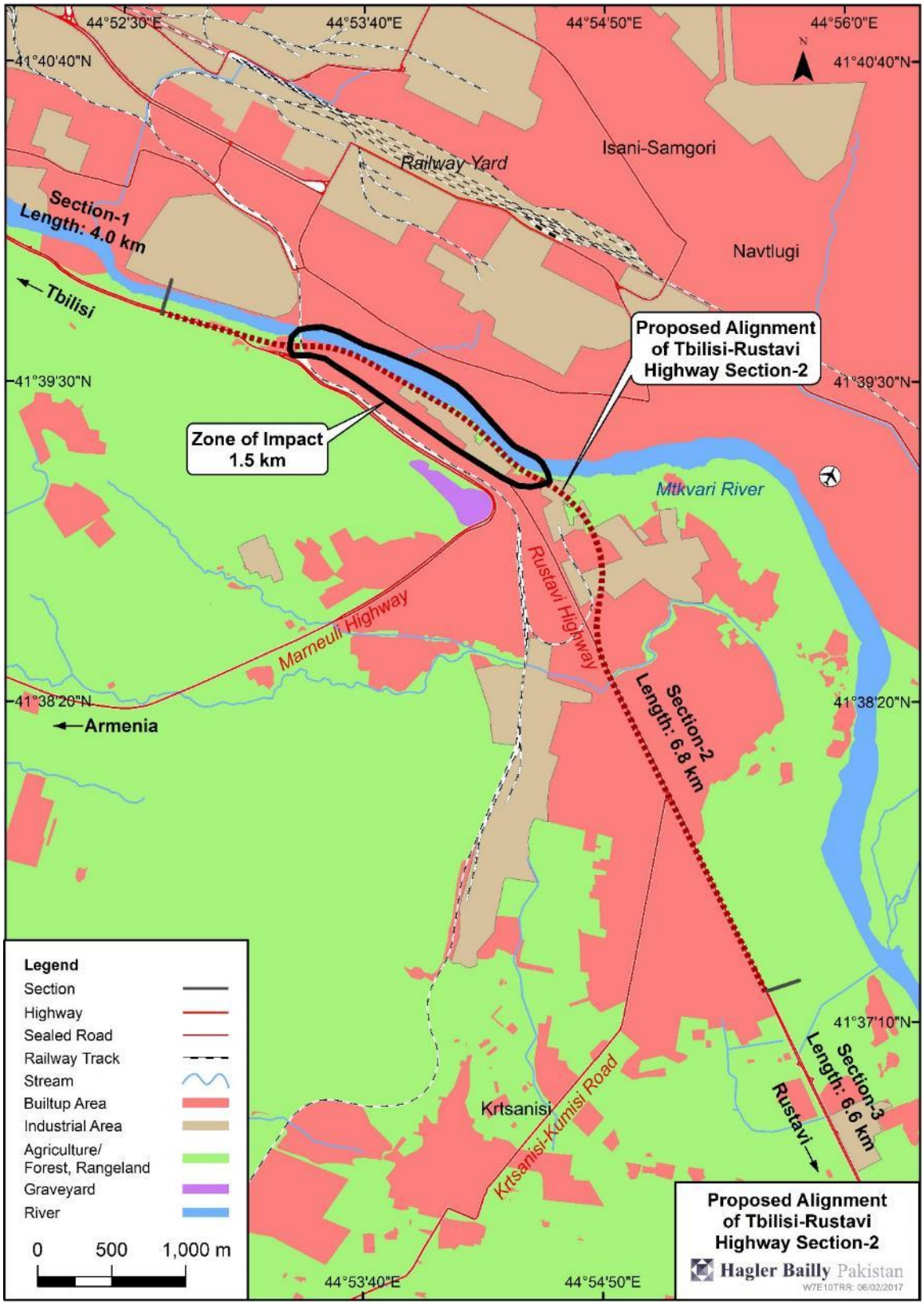

Figure 1-2: Proposed Alignment of Tbilisi-Rustavi Highway Section-2

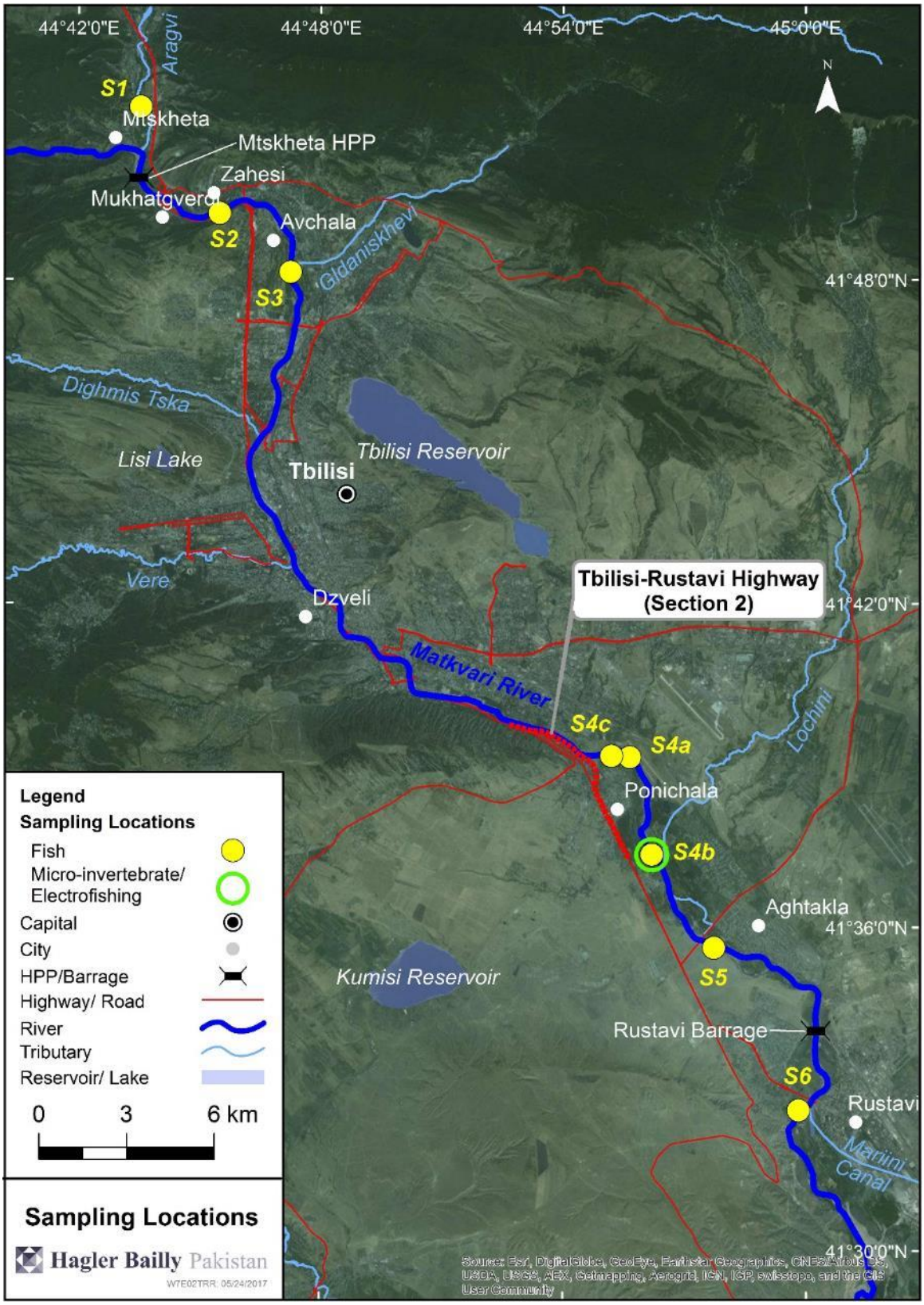

Figure 1-3: Sampling Locations for Fish and Macroinvertebrates

River Condition at Sampling Location S4b at Time of Sampling

River Condition at Sampling Location S3 at Time of Sampling

River Condition at Bridge between Sampling Locations S5 and S6 at Time of Sampling

River Condition at Sampling Location S5 at Time of Sampling

Figure 1-4: Conditions at Sampling Locations at Time of Sampling

2.2 Habitats

14. Inspection at the points in which sampling was conducted indicated cobble/gravel beds with low level of embeddedness[3] moving away from the river bank. A muddy bed was observed along the bank at most locations, such as Sampling Location S1 where clay was deposited by a receding river following high flow on the preceding day. Overall, the river bed appears to be healthy in terms of productivity of macroinvertebrates.

15. Significant modification of river habitat has taken place in Tbilisi (see **Figure 2-3**) where embankments have been constructed along 16 km of the length of the river. Confining the river to a single channel with constructed embankments on both sides has altered the hydraulics of the river in terms of depth of water and velocity profile. In addition, natural banks and side channels which are spawning grounds for fish and provide refuge to the young have been lost. Consequential impacts are presumed to have occurred for the river dependent birds in this segment, particularly fish eating birds that find prey in shallow waters, and require vegetation along the banks for refuge and nesting.

16. In addition to changes in the river morphology, deposition of solid waste along the river banks is of concern. While not at serious level at present, it is apparent that land along the river bank that is not privately owned is being used as dumping ground for construction and demolition waste. Such practices, if continued, will result in loss of aesthetic value, as well as loss of spawning and feeding areas for fish, and loss of shelter and feeding areas of fish eating birds. There are laws that protect the land along the river from non-conforming land use and disposal of solid waste, but lapses can be seen particularly near the urban areas, as was observed along the river, including Sampling Location S4c just downstream of the point where the alignment of the proposed highway runs along the river bank (See **Figure 2-4**).

[3] Exposed cobbles and gravel, as opposed to embeddedness with clay or sand.

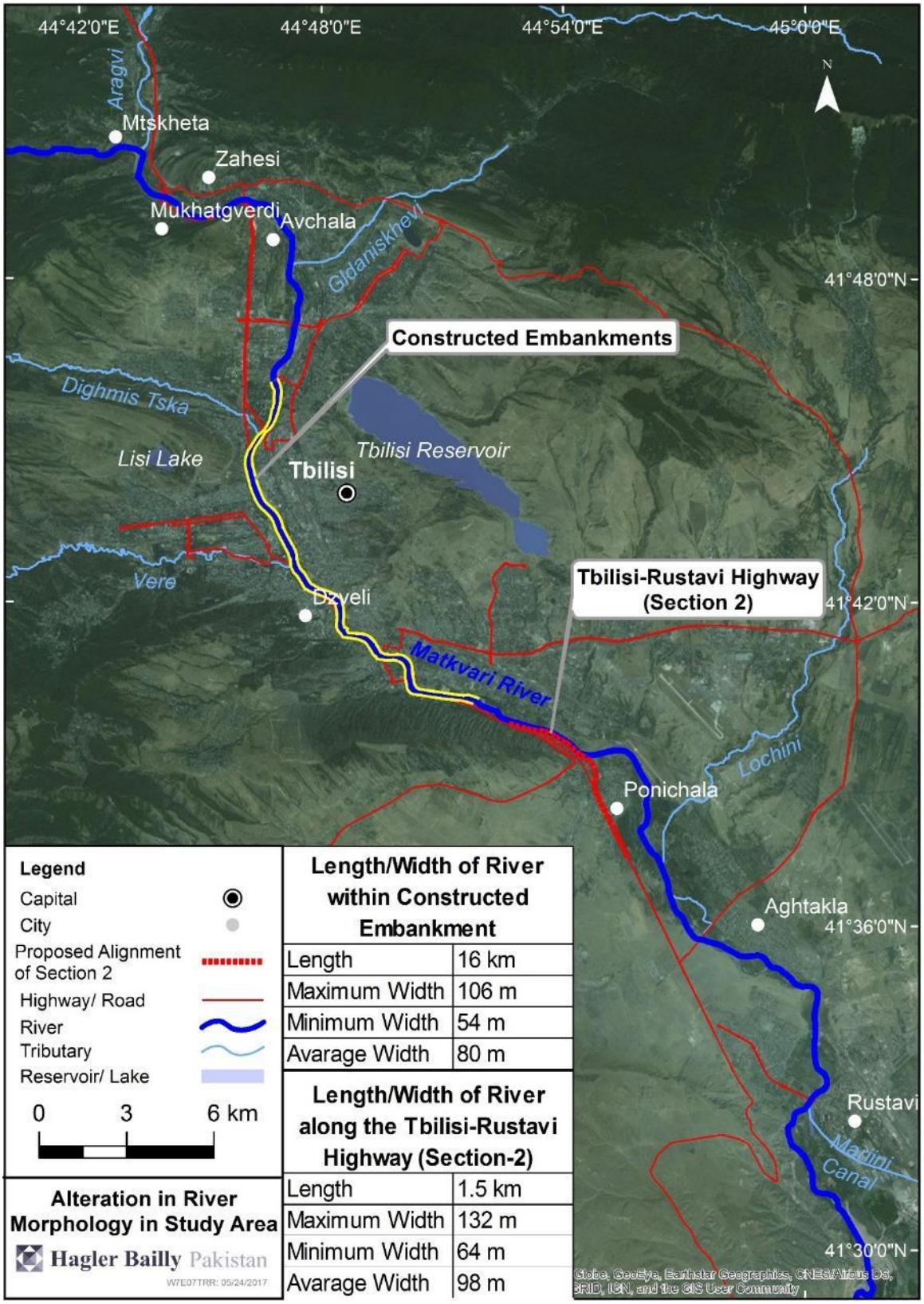

Figure 2-3: Alteration in River Morphology in Study Area

Garbage Deposited by River at Sampling Location S5

3. Impacts and Recommenations for Management

3.1 Assessment of Impacts

48. The following is an assessment of impacts of construction of Section 2 of the proposed highway on Mtkvari River. As indicated in **Section 1** of this report, the project comprises of a 1.5 km section of proposed highway aligned along the bank of the river. A conservative assumption made in this assessment is that half of the habitat in the river in this section will be seriously impacted.[33] The reasons for this assumption are:

- Natural river banks are the most productive habitats, where shallow and slower waters with cobble beds provide feeding, breeding, and nesting areas for the fish, particularly the non-migratory fish.
- Construction of embankments and encroachments into the river beds takes away the most productive habitat in the river, and modifies the hydraulics in terms of depth of water and velocities that alter habitat characteristics.

3.1.1 Overall Characterization of Present Ecological Conditions

49. The ecological conditions in the Mtkvari River can be considered as 'Slightly Modified' from natural state, with most of the ecosystem functions intact for the following reasons:

- As indicated by low levels of BOD, water quality has only slightly been impacted by the urban effluents, and possibly by residues and runoffs from agricultural activities. The level of industrial activity remains low. Turbidity levels in flood season are of potential concern.
- Habitat alteration has taken place in heavily urbanized areas such as Tbilisi where embankments have been constructed, which have affected the hydraulic characteristics of the aquatic habitats, but remains limited in scale at the basin level. This habitat alteration primarily impacts the non-migratory fish species which include the six loaches that occur in the Study Area.
- Disposal of solid waste in the river as can be observed during floods and deposits left by receding floods on river banks is an emerging threat to habitats. A more serious emerging concern is unregulated disposal of urban and construction and demolition waste along the river banks, which, if left unchecked, could irreversibly affect the habitats in the long term.
- The dams constructed upstream of the Study Area have limited storage capacity. Some alterations in daily flows has most likely taken place, but seasonal variations in flows that are of relevance for the ecosystem functions appear to be intact. Movement of migratory species has been affected by these dams, which in turn has impacted their populations in the Study Area.
- The river supports healthy fish populations and abundance appears to be high.

[33] The remaining half of the habitat lies across the river on the opposite bank which will not be impacted by construction of the road.

The diversity also appears to be largely intact, except for migratory species the movement of which has been restricted by the dams constructed on the main river as well as the tributaries. The species have not been affected to any serious degree as yet. The spatial distribution of the species identified in **Table 2-3** is wide in the region and extends outside the Kura-Aras Basin.

50. The benthic fauna shows some early impacts of urban pollution, but the diversity and productivity appears to be largely intact.

51. The abundance and diversity of fish eating birds appears to be largely intact.

3.1.2 Habitat Classification

52. Given the characterization of habitat included in **Section 3.1.1**, aquatic habitat in the Zone of Impact can be considered as Natural Habitat according to ADB SPS and IFC PS6.[3435] While the continuity of the river has been affected by construction of barriers, the river ecosystem is largely intact as the hydrology, water quality, habitats, and diversity and abundance of fish fauna has largely remained unaffected.

53. The habitat cannot be considered as Critical Habitat[3637] as it is not home to any Critically Endangered, Endangered, or restricted range species, does not support globally significant populations of migratory species, and does not constitute a unique or threatened ecosystem.

3.1.3 Loss of Habitat

54. The Project will result in a loss of habitat corresponding to 1.5 km of the river bank (see **Figure 1-2**) that will be modified as a part of the project, resulting in an alteration of hydraulic characteristics of the habitat. The length of the river of 44 km in the segment from the diversion of weir of Mtkvari dam to the barrage upstream of Rustavi can be

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[34] According to ADB SPS 2009 Natural Habitat is defined as: Land and water areas where the biological communities are formed largely by native plant and animal species, andwhere human activity has not essentially modified the area's primary ecological functions.

[35] According to IFC PS6, Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

[36] According to ADB SPS 2009 Critical habitat is defined as a subset of both natural and modified habitat that deserves particular attention. Critical habitat includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic, or cultural importance to local communities. Critical habitats include those areas either legally protected or officially proposed for protection, such as areas that meet the criteria of the Word Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites.

[37] According to IFC PS6, Critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.

considered as a 'Discrete Management Unit'[38] (DMU) as these barriers restrict the movement of fish populations outside this zone. As can be seen in **Figure 2-3**, 32 km of river bank corresponding to a 16 km length of the river has already been modified by construction of embankments,[39] which corresponds to 36% of the bank of the river in the DMU. The Project will increase this habitat loss in the DMU by an additional 1.8% only.

3.1.4 Impact on Fish Populations

55. A very conservative estimate for the loss of population of fish in eth DMU in which the Zone of Impact is located can be prepared on the basis of habitat loss. On this basis, loss of fish population could be estimated at less than 1.8% of population in the DMU. Actual loss is likely to be much lower as the river flows in a single channel in the Zone of Impact, as compared to other segments where the river flows in multiple channels which provide more suitable habitat for non-migratory fish. On a regional scale, the impact on fish populations will be insignificant as the fish fauna present in the river has wider distribution in the region.

56. The impact of the Project on migratory fish species that require deeper water in comparison to resident species is expected to be negligible, as the modification in hydraulic characteristics of the habitat by the Project will not have any significant impact on their movement, and access to alternative breeding and feeding areas.

3.1.5 Other Impacts

57. The impacts from road run-off and spills resulting from accidents are not considered significant as potential impacts will be managed through design of the road to include a retention basin and oil separator with capacity to store the content of a full fuel tanker volume (approx. 45 m^3).

58. There will be some loss in habitat for river dependent birds, but this will be minor as the birds can utilize a wider area and alternative sources such as pondages created around the river course available for feeding and resting.

3.2 Recommendations for Management

59. The impact of the Project as designed on the river ecosystem is estimated as very minor and insignificant. However, recognizing that a part of the Project, albeit minor, is located in Natural Habitat, the following measures are recommended:

3.2.1 Good Practice Measures

60. According to ADB SPS, "Mitigation measures should be designed to achieve at least no net loss of biodiversity. The alignment of the proposed highway has largely been maintained away from the river bank and has been placed on the existing alignment.

61. The impact of the Project on biodiversity of Mtkvari River are insignificant. However, to mitigate residual impacts and to set a precedent that would help in protection

[38] IFC Performance Standard 6, Guidance Note 6 paragraph 65. A Discrete Management Unit (DMU) is an area with a clearly demarcated boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas

[39] The length of river on which embankments have been constructed is estimated at 16 km. The length of embankments constructed corresponds to twice this length for the two banks of the river.

of habitats of Mtkvari River in future, restoration of degraded river bank on government owned land[40] adjacent and downstream of the Zone of Impact as shown in **Figure 3-1** is recommended. The river bank should be restored as a park for public use. The activity can be included in the existing construction package as part of the urban boulevard restoration along the right of way (RoW) of the proposed highway. A restoration plan should be prepared to guide the work and should include the selection of appropriate native plant species. Opportunities for habitat creation such as the selection of suitable species to provide nest trees should be considered.

3.2.2 Environmental Management in Construction Phase

62. The recommended management measures for the construction phase are as follows:

- Construction should be carried out in the low flow season and should be planned in such a manner that all works related to construction of embankment are completed in one low flow season.
- The river bed that is to be used for construction and included in construction Right of Way (RoW) should be kept at a minimum. Any construction activity or movement of machinery and personal beyond the demarcated construction RoW should be prohibited.
- Riparian habitat in the construction zone should be preserved as far as possible to ensure connectivity is restored as fast as possible after construction and to retain habitat for species.
- Disposal of any construction or construction related waste in the river bed should not be allowed.
- Construction techniques should produce the minimal possible amount of sediment into the river. A coffer dam may be the most appropriate technique in this case.
- Sediment should be mitigated by use of silt curtains or other appropriate sediment control measure during construction.
- Laydown areas should be set away from the banks of the river to ensure that further degradation of the river does not occur and accidental spills will not end up in the river. The site picked should also have minimal flood risk so should be well above the maximum flow level for the river.
- Fuel, oil and chemicals supplied in drums will be stored in an impermeable lined and bunded designated storage area and / or in the metal drip trays capable of holding 110% of the volume stored.
- A spill response plan will need to be developed with specific equipment present on site to deal with any spills and appropriately trained staff must also be present.

[40] The cadastral information indicates that the marked land is government owned. Further verification is recommended as a part of restoration planning.

- Refuelling should take place at least 50m from the river and vehicles should be regularly checked for leaks before entering the river.
- A Site Specific Environment Management Plan (SSEMP) should be prepared for the Zone of Impact following ADB guidelines prior to the start of construction activities in the zone. This plan will include, but not be limited to all the measures listed here.
- As part of the implementation of the SSEMP strict independent monitoring should be carried out, and heavy penalties should be imposed on the construction contractor in case of violations of the SSEMP.
- All of the above conditions should be included in the contract with the construction contractor.

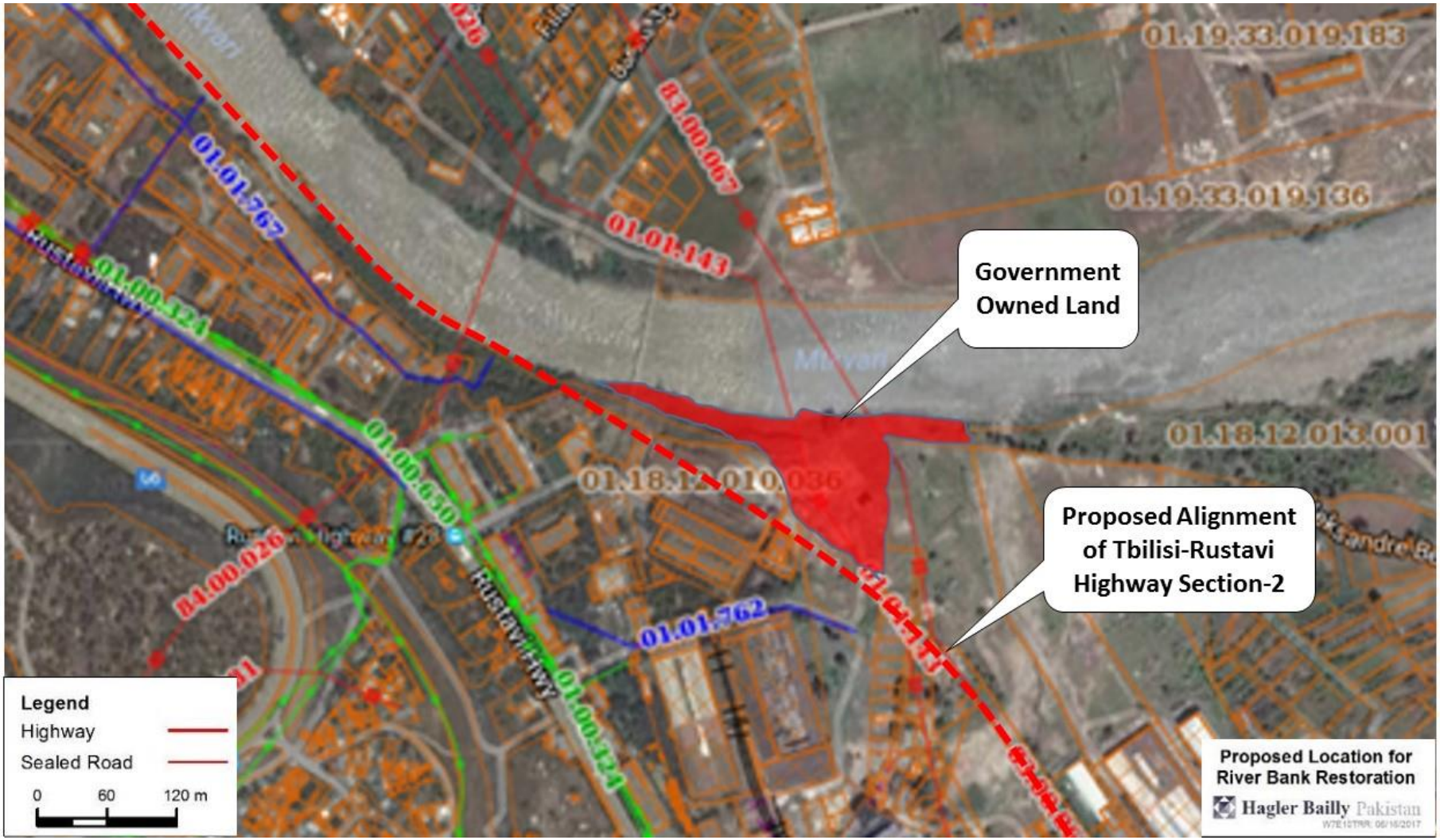

Figure 3-1: Land Ownership

Appendix A: Survey Methodology and Sampling Plan

A.1 Objectives

63. The objective of the field surveys was to collect data for establishing the ecological baseline for the length of the Kura River that could potentially be impacted by the project. Specifically the objectives include:

- Qualitative and quantitative assessment of fish, macro-invertebrates, periphyton and river dependent birds.
- Identification of key species, their relative abundances and their conservation status.
- Analysis to further develop the basis for evaluating the potential impacts of Project-related activities on the biodiversity.

A.2 Study Area and Sampling Locations

64. The Study Area included the Kura River from the confluence of Aragavi River to Pirveli Kesalo Town. Proposed sampling locations are shown in **Figure A-1**. The biological resources to be studied included:

- Fish
- Macro-invertebrates
- Periphyton
- River Dependent Birds
- Water quality

65. The justification for selection of the sampling locations is provided in **Table A-2**. Sampling locations indicated in **Table A-2** were the maximum that could be surveyed. Data to be collected included:

- Fish, focusing on abundance, diversity, distribution, and fish tissue contamination
- Macro-invertebrates, diversity and abundance
- Periphyton biomass growing on cobbles and boulders that is abundant in clear water in low flow conditions with good light penetration
- River dependent birds, diversity and abundance
- Water quality focusing on heavy metals and urban pollutants

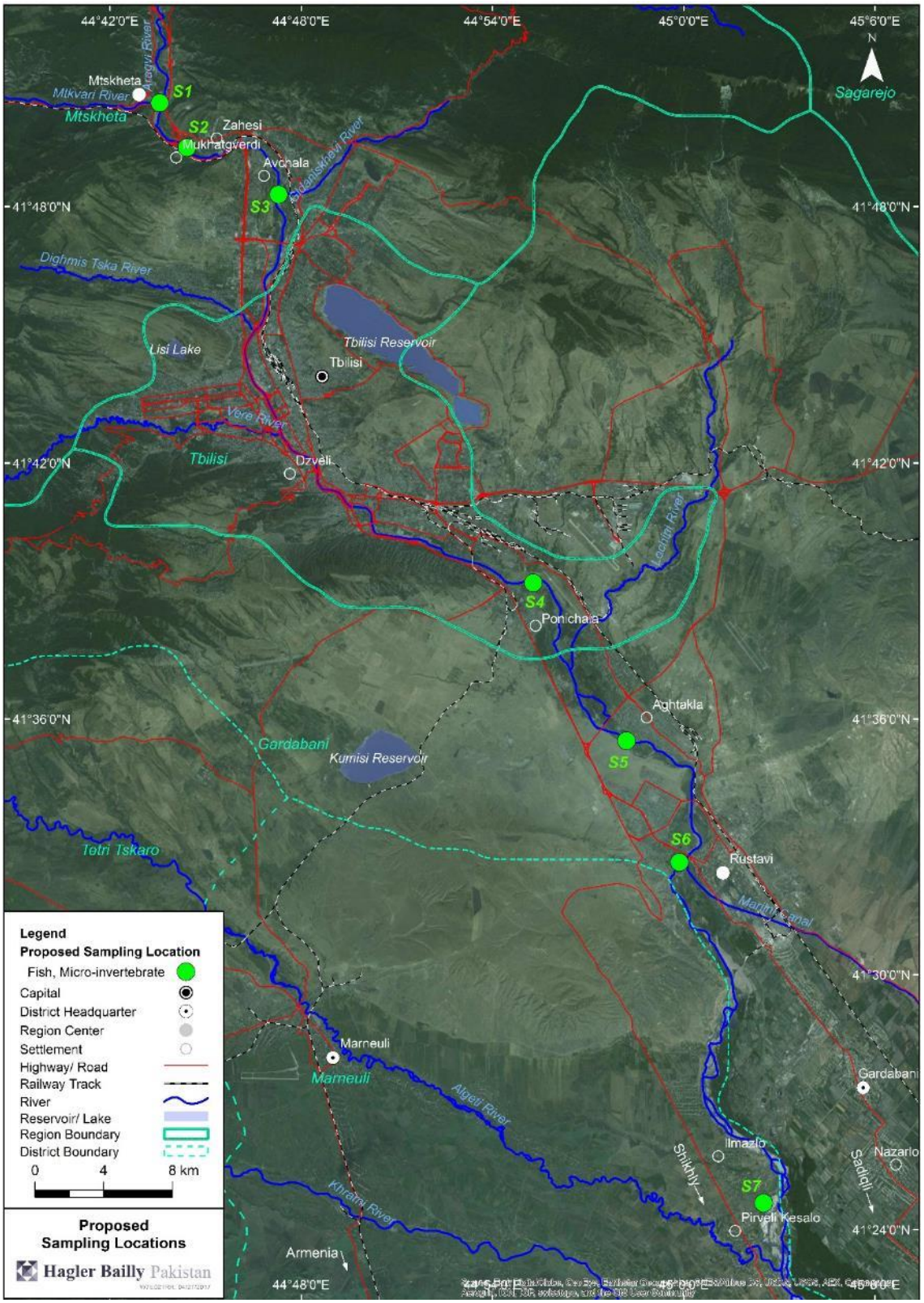

Figure A-1: Proposed Sampling Locations for Fish, Macro-invertebrates, Periphyton and Birds

Table A-1: Justifications for Selection of Sampling Location

Sampling ID	*Co-ordinate*		*Location*	*Expected impacts from the Project*
	X	Y		
S1	44°43'33.455" E	41°50'25.389" N	Confluence of Kura River and Aragavi River	This site is located upstream of the reservoir of Zemo-Avchala hydroelectric power station. Sampling at this will help in assessment of impact of the barrier to fish migration created by the dam. The site location is selected as to observe fish breeding in or near the Aragavi River (a tribuatry of Kura River)
S2	44°44'24.570" E	41°49'22.831" N	Near Mukhatgverdi Town	This site is located in the low flow section of the river created by diversion of water for the Zemo-Avchala hydroelectric power station. Sampling at this location will help in assessment of impacts of lower flow as well as the barrier created by the diversion dam..
S3	44°47'17.057" E	41°48'16.908" N	Confluence of Kura River and Gldaniskhevi River	This site is selected to observe fish breeding in the Gldaniskhevi River (a tribuatry of Kura River)
S4	44°55'16.638" E	41°39'11.372" N	Near Proposed Highway (Section 2)	This site located adjacent to the route of the propsed highway and is near the confluence of Lochini River.Sampling at this site will help in future interpretion of the potential impacts of proposed road. Fish breeding in or near Lochini River will also be observed.
S5	44°58'12.015" E	41°35'29.108" N	Opposite to Aghtakla Town	This site will provide the abundance and richness of river fauna downstream in Kura River
S6	44°59'51.670" E	41°32'38.105" N	Near Rustavi	This site will provide the abundance and richness of river fauna downstream in Kura River
S7	45°02'29.940" E	41°24'37.608" N	Near Pirveli Kesalo	This site will provide the abundance and richness of river fauna downstream in Kura River