TECHNICAL SPECIFICATION

ESTABLISHMENT OF RAIL BALTICA PRIMARY CP0 GEODETIC AND LEVELLING NETWORK BENCHMARKS

RB133-VDC-XX-XX-SPC-R-00002

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ACRONYMS AND ABBREVIATIONS

A full list of acronyms and abbreviations can be found in RBR Glossary of Abbreviations. The following acronyms and abbreviations are used throughout this document:

Abbreviation	Definition
CAD	Computer Aided Design
CP0	RB Primary Geodetic Reference Network Level 0
DS	Design Section
DPS	Design Priority Section
GNSS	Global Navigation Satellite System
MoM	Minutes of Meeting
RAMS	Reliability, Availability, Maintainability and Safety
RBR	RB Rail AS
RFI	Request for Information
TS	Technical Specification
TWG	Technical Working Group
RBGP	Rail Baltica Global Project

DEFINITIONS

The following terms are used throughout this document:

Term	Definition
Affected Parties	RBGP stakeholders – governmental institutions, local authorities, public and/or private enterprises, other legal or private entities (persons) utilities / asset owners and/or managers of the assets (networks and/or objects of power supply, gas, oil, water, drainage etc.) which are directly affected or linked to the designed layout of Rail Baltica railway line and shall be consulted during the provision of Services. The non-exhaustive list of Affected Parties is provided in Clause 1.5.
Agreement	The agreement to be concluded between RBR and the respective Implementing Body on the one hand, and the Contractor on the other for the Scope of Services for establishment of the Rail Baltica Primary CP0 Geodetic and Levelling Network Benchmarks: with respect of the Services in the territory of the Republic of Estonia (LOT No 1), with respect of the Services in the territory of the Republic of Latvia (LOT No 2) and with respect of the Services in the territory of the Republic of Lithuania (for LOT No 3).
Assessment Body	The independent and competent external or internal individual, organization or entity which undertakes investigation to provide a judgement, based on evidence, of the suitability of a system to fulfil its safety requirements.

Benchmark	A special facility installed primarily on the ground, in the soil or in a structure that allows its coordinates, heights and gravity values, determined by means of geodetic measurements, to be used as a reference for subsequent measurements (incl. surveying, mapping, civil engineering, geotechnical monitoring, etc). Either New Benchmark (CP0 or CP0H) to be installed or maintained existing geodetic Benchmark, the latest one being part of national or local (municipal) geodetic and/or height network, and which are required and shall be used for the needs of RB Primary Geodetic Network (CP0).
Building permit	Construction permit issued by a competent authority in accordance with the applicable Law.
Contractor	Service provider with whom an Agreement has been concluded for the provision of the services specified in this Technical Specification and the Agreement.
Deliverables	The Final Report to be prepared by the Contractor upon completion of the Works as defined herein and described in detail in this Technical Specification. Deliverables shall include the Final Report to be delivered to RB Rail as aligned with the Affected Parties and National Institutions for each Phase of the Works completed, as well as all underlying documents included and/or annexed to the Final Report, such as photos, schemes, coordinates, etc. A detailed list of the Deliverables is provided under Clause 3 "Work Process and Deliverables".
Design Guidelines	Set of predefined and standardized technically and economically justified engineering and design solutions for Rail Baltica infrastructure to be applied at design, construction, and operation phases of Rail Baltica Railway, which forms an integral part of this Technical Specification. The Design Guidelines may be changed by the Principal therefore the Agreement always refers to the most current version of the Design guidelines.
Design Priority Section (DPS)	Part of Design Section identified as separate Rail Baltica railway line section for planning of the Design Services, construction and management purposes.
Design Section (DS)	Section (DS) of overall Rail Baltica railway line falling under the scope of the Services.
Final Inspection	Inspection of Works to be carried out following the completion of Works with the presence of representatives of the Contractor, the Infrastructure Manager (For Lot No 1 and Lot No 3), Beneficiary (For Lot No 3) and the Principal.
Galileo	Global navigation satellite system developed and operated by the European Union.
GLONASS	Global navigation satellite system developed and operated by the Russian Federation.
GNSS	Global Navigation Satellite System.
GPS	Global navigation satellite system, developed and operated by the United States.
Geodetic Point	A record on a data medium (often in a structured form in a database) that contains information about a geodetic Benchmark, its coordinates, heights, and gravity values, and, if necessary, additional metadata (Benchmark sketches, photos, etc.). Its location is visualized in a suitable mapping application if required.
Maintenance of existing Benchmarks	Adaptation of national and local (municipal) geodetic and height Benchmarks and their external and related elements for integration into Rail Baltica's primary geodetic (CP0) and levelling (CP0H) network. The Works pertaining to the Maintenance of existing Benchmarks are described in detail in Clause 3.2.
National Geodetic Network	A set of geodetic measurements to determine the coordinates, heights, and gravity values at nationwide geodetic Benchmarks owned by National Institutions.

National Institutions (Competent Public Authorities)	Governmental bodies and/or public enterprises of the respective State as listed in Clause 1.4, which are responsible for the up-to-dateness of the National Geodetic Systems and Networks, and Benchmarks, and the availability of corresponding official information to society.
Infrastructure manager	The Implementing Body – either Osaühing Rail Baltic Estonia (for LOT No 1), or AB "LTG Infra" (for LOT No 3), who shall acquire the ownership rights on the new Benchmarks either on temporary or permanent basis, in its own name or on behalf of the respective State.
Beneficiary	Authority who shall acquire the ownership rights on the new Benchmarks either on temporary or permanent basis, in its own name or on behalf of the respective State. For the sake of clarity, for LOT no 2 (Latvia) the Ministry of Transport of the Republic of Latvia shall acquire the ownership rights of new Benchmarks installed in the territory of the Republic of Latvia.
Pre-design	Design prepared by Principal with pre-defined locations of new Geodetic Reference Network points and with selected existing National Geodetic Network points.
Preliminary Measurements	Determination of coordinates and ellipsoidal heights of New, and maintained, and nearest across border Benchmarks, using network RTK GNSS methodology (RTN). A detailed description of the measurement procedure is provided in Clause 3.5 "Preliminary Measurements".
Principal	RB Rail AS, a joint stock company registered in the Latvian Commercial Register under registration No 40103845025, legal address at Satekles iela 2B, Riga, LV-1050, Latvia (the "Principal").
Rail Baltica Global Project (RBGP)	All the activities undertaken by the Rail Baltica railway implementing parties to build, render operational and commercialize the Rail Baltica railway and related railway infrastructure in accordance with the agreed route, technical parameters and time schedule.
Rail Baltica railway	A new fast, conventional double-track electrified standard gauge (1435 mm) railway line with maximum design speed of 249 km/h on the route from Tallinn through the territory of Latvia to Lithuanian – Polish border, with the connection of Kaunas to Vilnius. The new railway line will be designed with 1435 mm gauge thus confirming to all requirements of the Technical Specifications for Interoperability (TSIs).
Railway infrastructure	Correspond to the Directive 2012/34/EU of the European Parliament and of the Council of 21 November 2012 establishing a single European railway area (recast), as well as it includes freight and passenger terminals and infrastructure and rolling stock maintenance facilities and the ground underneath them and the airspace above them to the extent that the national legislation permits the ownership of the ground and the airspace.
RB Primary Geodetic Network (CP0)	Rail Baltica Level 0 Geodetic Network (CP0), which includes selected National Geodetic Network Benchmarks (Maintained existing Benchmarks) and the Benchmarks to be installed additionally (New Benchmarks).
RB Rail	RB Rail AS, Reg. No 40103845025, a joint stock company registered at the Enterprise Register of the Republic of Latvia.
Reliability, Availability, Maintainability and Safety	As per RAMS requirements and RAMS methods, the obligatoriness Directives, Regulations and Standards following the Directives (EU) 2016/797 and Regulation (EU) 2013/402, the standard EN50126-1, Rail Baltica RAMS Design Guidelines and procedures.
RTK-GNSS	A high-precision satellite positioning technique that uses real-time corrections from a nearby reference station (or network of stations) to significantly improve the accuracy of GNSS (e.g., GPS, Galileo, GLONASS) positioning.

The Services	Services and Works as listed in Clause 1.3 “Scope of Services” and in accordance with the terms and the Scope of the Agreement.
State	Either Republic of Estonia, Republic of Latvia or Republic of Lithuania, as the case may be or all together referred to as “the States” or “Baltic Countries”.
Urban Node	Means part of the railway located in an urban environment in an urban node usually having one or more Local Facilities. For Rail Baltic / Rail Baltica railway there are three urban nodes – Riga (LV), Tallinn (EE), Vilnius (LT) which are listed in regulation 1315/2013 and Kaunas (LT). Railway Urban Node Section borders are defined considering their functionality.
Work Breakdown Structure	A hierarchical framework for organizing and ordering activities that make up the entire scope of Design services. It covers all project scope and breaks down into unique manageable parts that correspond to key deliverables, phases of work, and milestones. They are product (deliverable-based) structures that provide a common frame of reference for managing and reporting project elements (e.g., estimating, scheduling, etc.) to RBGP stakeholders.
The Works	All activities of the Contractor, including the preparatory, auxiliary and of either temporary or permanent character to complete either (1) Maintenance of existing Benchmarks as per Clause 3.2 or (2) installation of New Benchmarks, or both (1) and (2) together.

1. GENERAL

1.1. INTRODUCTION

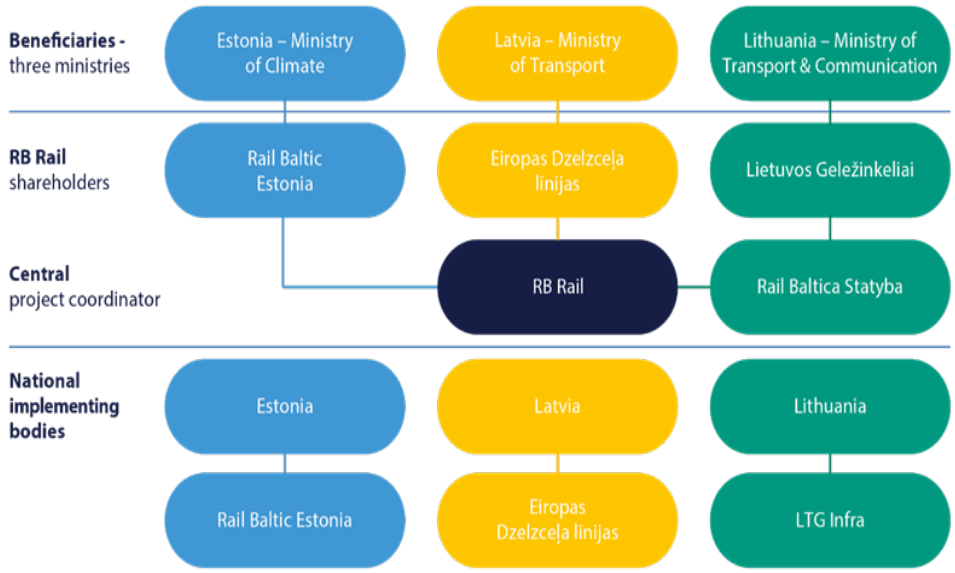
The Baltic countries – Republics of Estonia, Latvia and Lithuania ("the States") have historically been linked to the east-west railway transport axis using the 1520 mm gauge railway system. Because of the existing historical and technical constraints, the existing rail system is incompatible with mainland European standards, thus there is a consensus that the States need to be fully integrated into the wider European rail transport system. Currently there is no efficient 1435 mm railway connection along the Warsaw - Kaunas - Riga - Tallinn axis, i.e., there are missing links or significant bottlenecks. Thus, there are no direct passenger or freight services along the railway axis as the existing infrastructure does not allow for competitive services compared to alternative modes of transport. Thus, most of the North-South freight is being transported by road transport and the overall accessibility in the region is low.

RBGP is already designed to become a part of the EU TEN-T North Sea – Baltic Core Network Corridor, which links Europe's largest ports of Rotterdam, Hamburg, and Antwerp – through the Netherlands, Belgium, Germany and Poland – with the States, further connecting to Finland via the Gulf of Finland short sea shipping connections with a future fixed link possibility between Tallinn and Helsinki.

The contracting authority - RB Rail was established by the Republics of Estonia, Latvia, and Lithuania, which ultimate Beneficiaries are the responsible ministries (Ministry of Climate of the Republic of Estonia, Ministry of Transport of the Republic of Latvia and Ministry of Transport and Communications of the Republic of Lithuania) with the aim to coordinate the development and construction of the fast-conventional standard gauge railway line on the North Sea – Baltic TEN-T Core Network Corridor (Rail Baltica II) linking the States with Poland and the rest of the EU.

The shareholders' structure of RBR is presented in Figure 1.

Figure 1: The shareholders' structure



Rail Baltica is a greenfield rail transport infrastructure project with a goal to integrate the States in the European rail network. The project includes five European Union countries – Poland, Lithuania, Latvia, Estonia

and indirectly also Finland. It will connect Helsinki, Tallinn, Pärnu, Riga, Panevežys, Kaunas, Vilnius, Warsaw. The Baltic part of the Rail Baltica project is referred to as the Rail Baltica Global Project (RBGP).

The expected core outcome of the Rail Baltica project is a European gauge (1435 mm) double-track railway line of 870 km in length meant for both passenger and freight transport and the required additional infrastructure to ensure full operability of the railway. It will be interoperable with the TEN-T Network in the rest of Europe and competitive in terms of quality with other modes of transport in the region.

Figure 2: The basic sketch of the Rail Baltica high-speed railway alignment (http://www.railbaltica.org/)

Further information is available in: http://www.railbaltica.org/.

1.2. LEGAL REFERENCES

The Contractor shall follow EU directives, Country-specific Laws/standards/regulations, EU standards, and other legal acts applicable to the Services. Main applicable Laws (non-exhaustive list) are provided below[1]:

Estonia

- Construction Law of the Republic of Estonia (Est. "Ehitusseadustik ")
  https://www.riigiteataja.ee/akt/105032015001?leiaKehtiv
- Regulations for Geodetic works and for Geodetic Networks (Est. "Geodeetiliste tööde tegemise ja geodeetilise märgi tähistamise kord, geodeetilise märgi kaitsevööndi ulatus ning kaitsevööndis tegutsemiseks loa taotlemise kord ")
  https://www.riigiteataja.ee/akt/103072013014?leiaKehtiv
- Full data base with the Laws can be found on Country's register of legal acts
  https://www.riigiteataja.ee/en/
- On the recognition of the "Rail Baltica" project as a project of special national interest
  https://ttja.ee/e,n/business-Principal/railway/rail-baltic/preliminary-design-and-studies

Latvia

- Regulations of the Cabinet of Ministers of the Republic of Latvia on the engineering research in construction (Lat. Noteikumi par Latvijas būvnormatīvu LBN 005-15 "Inženierizpētes noteikumi būvniecībā")
  https://likumi.lv/ta/id/275007-noteikumi-par-latvijas-buvnormativu-lbn-005-15-inzenierizpetes-noteikumi-buvnieciba
- Regulations of the Cabinet of Ministers on the Geodetic works and for Geodetic Networks (Lat. Noteikumi par Latvijas būvnormatīvu LBN 305-15 "Ģeodēziskie darbi būvniecībā")
  https://likumi.lv/ta/id/274935-noteikumi-par-latvijas-buvnormativu-lbn-305-15-geodeziskie-darbi-buvnieciba-
- Full data base with the Laws and Regulations can be found on Country's register of legal acts
  https://likumi.lv/
- On the recognition of the "Rail Baltica" project as a project of special national interest
  https://www.sam.gov.lv/en/projects/rail-baltica-0?utm_source=https%3A%2F%2Fstatics.teams.cdn.office.net%2F

Lithuania

- Construction Law of the Republic of Lithuania (Lith. "Lietuvos Respublikos Statybos įstatymas")
  https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.26250/asr
- Construction Technical Regulations (Lith. "Statybos techniniai reglamentai")
  https://vtpsi.lrv.lt/lt/teisine-informacija/teises-aktai-2/statybos-techniniai-reglamentai
- Full data base with the Laws and Regulations can be found on Country's register of legal acts
  https://www.e-tar.lt/portal/en/index
- On the recognition of the "Rail Baltica" project as a project of special national interest
  https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.408298

General

- Intergovernmental Agreement on the development of the Rail Baltic / Rail Baltica railway connection
  https://www.railbaltica.org/wp-content/uploads/2017/05/Intergovernmental_Agreement_2017.pdf
- The Contracting Scheme Agreement for implementation of RBGP:
  https://www.railbaltica.org/wp-content/uploads/2017/05/Contracting-Scheme-Rail-Baltica-2016.jpg

[1] The Principal is not responsible for the availability and content of the information (except for www.railbaltica.org website)

1.3. DESCRIPTION OF THE SERVICES

The ultimate need for implementation of RBGP is establishment of a unified RB Primary Geodetic Network (CP0) along the Rail Baltica railway line from Tallinn (EE) to Kaunas (LT).

The RBGP Primary Geodetic Network (CP0) will serve as the reference for all other geodetic networks required for the RB project, both in the railway construction and maintenance phases.

The RB Primary Geodetic Network primarily relies on existing national geodetic Benchmarks. This approach helps to save the costs of establishing New Benchmarks and ensures a good connection with national coordinate and height systems. However, the density of national Benchmarks is not sufficient everywhere to meet the tasks ahead for Rail Baltica railway, or the locations of the markers are not optimal in relation to the railway route. Findings suggest that the optimal solution involves leveraging existing national and local (municipal) geodetic Benchmarks, when available, and installing New Benchmarks in areas with significant caps. In addition, the findings show that some of the national and local geodetic and height Benchmarks to be integrated into the primary geodetic network of Rail Baltica, as well as their external and related elements, require prior adaptation (maintenance).

The Benchmarks of RB Primary Geodetic Network are divided into CP0 and CP0H Benchmarks. CP0 Benchmarks are primarily designed for high-precision GNSS measurements. However, number of them are also included in the levelling network and several more are planned to be included. CP0H benchmarks are primarily designed for high-precision levelling.

As part of this activity, the Services shall include the production and installation of New Benchmarks (for an overview see Figure 3a/b/c and Table 1, for a detailed overview see the following sections), Maintenance of existing Benchmarks at selected locations (for an overview see Figure 4a/b/c and Table 2, for a detailed overview see the following sections), preliminary measurements of New and Maintained existing Benchmarks, and preparation of the corresponding work report.

Establishment of Rail Baltica Primary Geodetic Network (CP0) is a multi-phase geodetic activity where current Procurement includes the following phases (hereinafter referred to as “the Phase” or all together – “the Phases”) in accordance with Annex 13 - 15:

Preparatory Phase – Obtaining approvals and permits required for the installation of New Benchmarks and/or the maintenance of existing Benchmarks, and preparing and delivering samples of Benchmark sketches, photos and panoramas to the Principal, and coordination of the production and installation methodology of Benchmarks and their external elements with the Principal.

Phase 1 – Production of New Benchmarks and external elements of Benchmarks.

Phase 2 – Maintenance of existing Benchmarks, collection of in situ information describing the locations of the Benchmarks, and the preliminary measurements of Maintained Benchmarks.

Phase 3 – Installation of New Benchmarks, collection of in situ information describing the locations of the Benchmarks, and the preliminary measurement of installed Benchmarks.

Phase 4 – Preparation and delivery of the Final Deliverable – a Final Report describing the works performed under the Agreement, approved by the Principal.

Detailed descriptions of Phases are given in Clauses 2 and 3.

Figure 3a/b/c: Locations of Rail Baltica Primary Geodetic Network Benchmarks to be established, a-Estonia, b-Latvia, c-Lithuania

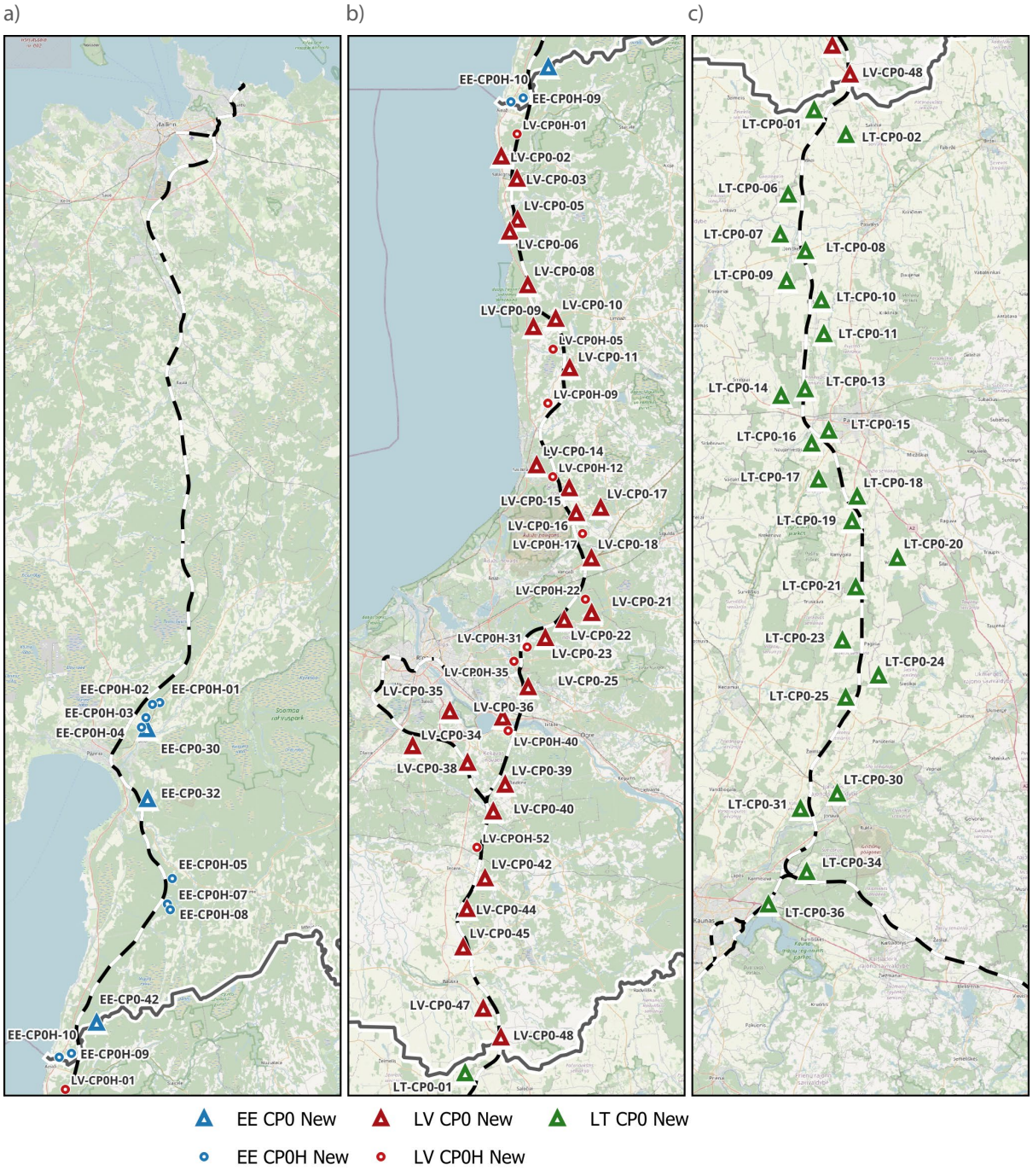


Table 1: Amount of RB CP0 Benchmarks to be established

Country	BM to be established
EE	12
LV	38
LT	24
TOTAL	74

Figure 4a/b/c: Locations of RB CP0 Benchmarks to be maintained, a-Estonia, b-Latvia, c- Lithuania

a) b) c)

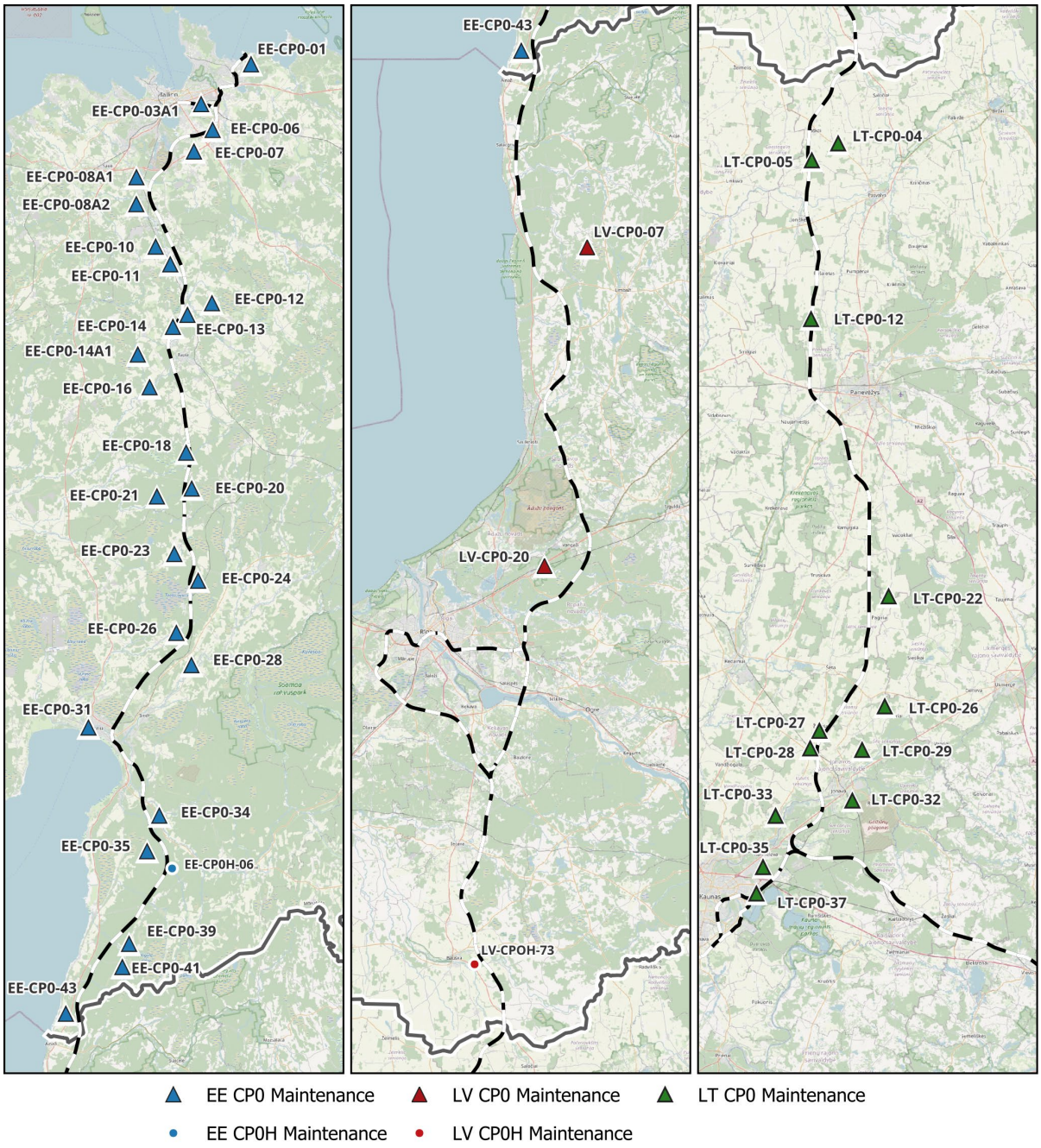


Table 2: Amount of RB CP0 Benchmarks to be maintained

Country	No of BM	Cover hatch	Cover plate	Protective dome	Concrete collar	Sign post	Identification label	Earthworks mound	Fence
EE	26	2	8	2	1	11	12	3	6
LV	3		1	1	1	2	2	1	1
LT	11					5	10	2	
TOTAL	40	2	9	3	2	18	24	6	7

1.4. NATIONAL INSTITUTIONS (COMPETENT PUBLIC AUTHORITIES)

The Contractor shall take into account the guidance by the following (non-exhaustive list) main National institutions (competent public authorities) throughout the implementation of the Agreement:

- Estonian Land and Spatial Development Board (Est. "Maa- ja Ruumiamet") www.maaruum.ee;
- Latvian Geospatial Information Agency (Latv. "Latvijas Ģeotelpiskās informācijas aģentūra") www.lgia.gov.lv;
- Lithuanian Ministry of Environment (Lith. "Lietuvos Respublikos aplinkos ministerija") www.am.lrv.lt.

1.5. AFFECTED PARTIES

The Contractor is responsible for coordinating activities with Affected Parties within the scope of the Services. An indicative, non-exhaustive list of Affected Parties is as follows:

- transport infrastructure operators/owners: railways, roads, airports;
- power transmission operators (high voltage) and power suppliers (low and medium voltage);
- oil/gas transmission operators;
- state/municipal institutions;
- landowners and land managers;
- State Forest Service;
- telecom (communication cable lines, mobile operators);
- fire/rescue services and military authorities;
- private enterprises;
- railway authorities;
- state/municipal service companies (water supply, heat supply, etc.);
- environmental monitoring institutions;
- culture heritage monitoring institutions;
- melioration and land drainage authorities and owners / managers;
- any other institutions involved.

2. SCOPE OF THE SERVICES

2.1. MAIN TASKS

2.1.1. In accordance with the applicable Law and the requirements of RBGP, the Contractor shall perform all of the following tasks:

a) obtaining necessary approvals for New Benchmark installation and Maintenance of existing Benchmarks;

b) production of New Benchmarks and external elements of Benchmarks;

c) maintenance of existing Benchmarks listed in this TS;

d) installation of New Benchmarks listed in this TS;

e) preliminary measurements and determination of coordinates and ellipsoidal heights of New and Maintained existing Benchmarks;

f) preparation of a Final Report containing all approvals, information and an overview of the Maintenance of existing Benchmarks, information on the production and installation of New Benchmarks, and descriptions of construction materials used, and descriptions of the Benchmarks locations.

2.1.2. The Contractor shall review and analyse all references and annexes necessary for the provision of Services under the Scope of the Agreement.

2.1.3. The Contractor shall analyse all the requirements for the installation of New Benchmarks and Maintenance of existing Benchmarks specified in this TS, prepare and submit all necessary information and permit applications to the relevant National Institutions and/or Affected Parties.

2.1.4. The Contractor shall obtain all permits, qualification certificates, licenses required to implement and complete the Services.

2.1.5. The Contractor shall cooperate with the Principal, National Institutions and Affected Parties and shall obtain all required approvals.

2.1.6. The Contractor shall carry out all necessary work for Site Investigation where New Benchmarks will be installed, including land ownership, soil condition and suitability to ensure stability for a specific Benchmark type, etc.

2.1.7. The Contractor is obliged to immediately inform the Principal of any deficiencies and errors in the TS discovered during the provision of the Services and of any problems in obtaining approvals.

3. WORK PROCESS AND DELIVERABLES

3.1. GENEREL REQUIREMENTS

3.1.1. The project and its parts under the Agreement must be managed by a person who holds the relevant geodetic certificate in accordance with the applicable Laws of each State.

3.1.2. The Contractor shall prepare and submit all necessary information and permit applications to the relevant National Institutions and/or Affected Parties, following, but not limited to, the instructions set out in Annex 1.

3.1.3. The Contractor shall submit the Final Report upon completion of the Services in their entirety (Phase 4 as per Clause 1.3). The Final Report shall be prepared in English, following the generally accepted requirements for Technical Reports.

3.1.4. The Contractor shall submit the Deliverables to Affected Parties and National Institutions in the format and by means of electronic transmission as requested by the respective party (coordinating these activities with the Principal), which may include hard-copy materials, CDs, USB sticks, combined PDF files of limited size, etc.

3.1.5. The Contractor shall engage with the Principal and, where necessary, with National Institutions and Affected Parties to ensure that all necessary native-editable and non-editable files are provided.

3.1.6. The Principal's representative reserves the right to be present on production and/or installation sites at the times agreed with the Contractor during the production and installation of the Benchmarks and during the Maintenance of the existing Benchmarks. The Contractor shall submit the corresponding

schedule to the Principal at least two weeks in advance, so that the representative of the Principal has enough time to organize the visit.

3.1.7. The Contractor shall ensure that the surrounding area is maintained in accordance with the specified requirements and good working practices during and after the installation and maintenance of the Benchmark.

3.1.8. The Contractor ensures that all persons participating in the work processes are informed of the technical requirements specified in these Technical Specifications and if necessary, prove it to the Principal in a documented manner.

3.1.9. The Contractor ensures Health and Safety at work, and traffic safety, in all phases of work.

3.1.10. The Contractor shall comply with the Principal's health and safety (RBGP-HSD-STN-Z-00001), and environmental standards (RBDG-MAN-027-0106) to the extent set out in the Agreement between the Parties.

3.2. MAINTENANCE OF EXISTING BENCHMARKS

3.2.1. The list of existing Benchmarks to be maintained together with the description of the work to be performed is given in Annex 2 (CP0) and 3 (CP0H) and in the file Maintenance.xlsx.

3.2.2. In general terms, the Maintenance of existing Benchmarks includes the cutting of trees, bushes, etc. from around the mark and the installation of external elements of the benchmarks. Certain existing Benchmarks require special maintenance - the top of flat-top markers must be sanded from flat to spherical, and in the absence of a center hole, it must be drilled with a diameter of 2 to 3 mm and a depth of 2 mm. Note that for the EE-CP0-12, these operations require measuring of the reference position with a total station before and after Maintenance of existing Benchmarks.

3.2.3. The Contractor shall provide all materials as may be reasonably required for the Maintenance Works. The description of the external elements of the Benchmarks is given in Annex 4.

3.2.4. The Contractor collects the relevant product specifications or certificates for the construction materials used for the Works during the Maintenance of the existing Benchmarks.

3.2.5. During the Maintenance of existing Benchmarks, photos are taken of the Works stages on each of the Benchmark, incl. photos before and after Maintenance Works (at least 3 pcs., incl. all covered works).

3.2.6. During Maintenance of existing Benchmarks, in situ information describing the locations of the Benchmarks is collected. Based on information, the Benchmark location schemes are updated or new schemes are compiled. The corresponding list is given in Annex 2 (CP0), 3 (CP0H) and in the file Maintenance.xlsx. The requirements for the schemes are listed in Annex 5. To facilitate the preparation of location schemes, the Principal shall submit to the Contractor draft schemes compiled during the design phase.

3.2.7. During the fieldwork, the height of the sign above the ground is measured and reported in the table of points.

3.2.8. Panoramas will be updated for Benchmarks around which trees, bushes, etc. were removed, the requirements for panoramas are described in Annex 6.

3.2.9. After Maintenance of existing Benchmarks is completed, geotagged photos shall be taken of each installed Benchmark in accordance with the requirements of Annex 7. The following photos will be taken:

- photo of Benchmark marker;
- close-up photo of the Benchmark location;
- photos of the Benchmark from a distance (view photo), at least 4 pcs (approx. North/East/South/West direction).

3.2.10. The Contractor, following all quality requirements, provides a minimum 1-year warranty for the Maintenance Works.

3.3. PRODUCTION OF BENCHMARKS

3.3.1. The technical specifications of the Benchmark types and the methods of their production are described in Annex 8.

3.3.2. Benchmarks shall be produced in stationary conditions (in the workshop).

3.3.3. The Contractor shall produce all external elements of the Benchmarks in accordance with instructions provided by in Annex 4.

3.3.4. Corresponding product specifications or certificates shall be collected for the construction materials used in the production of the Benchmarks and their external elements and shall be maintained during the Warranty period (see Clause 3.3.6 below), and shall be made available for inspection upon request by the representatives of the Principal and/or the Infrastructure Manager (For Lot No 1 and Lot No 2) and/or Beneficiary (For Lot No 2).

3.3.5. During the production of Benchmarks and their external elements, photos of the Works stages are taken (at least 3 pcs., incl. all covered works).

3.3.6. The Contractor shall at all times ensure compliance with the quality requirements and shall provide a warranty applicable to the Benchmarks of at least 1 year (the Warranty period).

3.4. BENCHMARK INSTALLATION

3.4.1. The Contractor install New Benchmarks and their external elements in the nature at designed locations listed in Annex 9 and 10 and listed in file NewBenchmarks.xlsx.

3.4.2. The technical specifications of the Benchmark installation are described in Annex 8.

3.4.3. As an exception, before installing Benchmarks EE-CP0-30 and LV-CP0H-40, existing Benchmarks in the same location must be removed. The types of the existing Benchmarks are given in Annex 11.

3.4.4. The Contractor can obtain geotechnical information about the soil characteristic of designed Benchmarks locations from Annex 12, and, if desired, from relevant national databases or carry out the corresponding studies by themself.

3.4.5. If during the installation of Benchmark turns out that for some reasons (due the difficult geotechnical conditions, etc.) it is not possible to install designed Benchmark type, a new Benchmark type or a completely new location design must be proposed by the Contractor to the Principal. The proposed solution must be approved with all Affected Parties before the commencement of installation.

3.4.6. Geotagged photos (at least 3 pcs) of each stage of the installation of each Benchmark shall be taken on site. When taking pictures, a measuring scale is used as an aid, e.g. a measuring tape, etc., which enables the identification of the dimensions and installation depth of the Benchmark in the photos.

3.4.7. During the Benchmark installation, in situ information describing the locations of the Benchmarks is collected. Based on information, the Benchmark location schemes are updated or new schemes are

compiled. To facilitate the preparation of location schemes, the Principal shall submit to the Contractor draft schemes compiled during the design phase.

3.4.8. After Benchmark installation, geotagged photos shall be taken by the Contractor of each installed Benchmark in accordance with the requirements of Annex 7 and to be sent to the Principal's Representative. The following photos will be taken:

- photo of Benchmark marker;
- close-up photo of the Benchmark location;
- photos of the Benchmark from a distance (view photo), at least 4 pcs (approx. North/East/South /West direction).

3.4.9. The Contractor shall provide a warranty of at least 1 (one) year for the work performed, which shall begin with the Final Inspection of the Works.

3.5. PRELIMINARY MEASUREMENTS

3.5.1. Coordinates and ellipsoidal heights are determined in the respective national coordinate system.

3.5.2. Preliminary measurements are carried out using the Network RTK GNSS method (RTN).

3.5.3. National RTN services EstPos, LatPos and LitPos RTN are used for measurement (when measuring across the border, the RTN service is not exchanged for the corresponding service of the neighbouring country).

3.5.4. Preliminary measurements are carried out on New Benchmarks, maintained existing Benchmarks and on the 3 nearest Benchmarks across the border.

3.5.5. The RTK rover instruments used must be capable to receive signals from at least the GPS, Galileo and GLONASS satellite systems.

3.5.6. A pole tripod is used in measurements.

3.5.7. Each Benchmark is measured with at least 3 initializations, and the length of each measurement session is at least one minute. When interpreting the results, care must be taken to ensure that their differences compared to the expected measurement precision, about 1 cm horizontally and 3 cm in height, are reasonable.

3.5.8. For Benchmarks with closed horizons, coordinates are determined using line sections (with measuring tape) or total station measurements combined with GNSS measurements, or total station measurements based on known points. In the absence of known geodetic points located nearby, the coordinates of at least three auxiliary points are determined using the GNSS RTK method.

3.5.9. The metadata of measurements (no. of satellites, used mountpoint, precision estimates etc.) are collected and stored in the native format of the RTK device (if any) and ASCII format.

3.5.10. The results, coordinates and ellipsoidal heights, differences between measurements and corresponding mean values are compiled into an MS Excel table (Clause 3.6.2. (p)).

3.6. FINAL REPORT

3.6.1. After the completion of installation of New Benchmarks, and the Maintenance of existing Benchmarks, the Contractor shall prepare a Final Report.

3.6.2. The Final Report shall contain:

a) explanatory letter with the reference to the Agreement, specifying the date of the Agreement and Number, the content and purpose of the work, the time when the work was performed, the scope of the work, names of the Contractor/Sub-Contractor that performed the work (noting the corresponding stage of the work in case they differ between stages), names and professional qualifications of the responsible executors, list of legislative acts (Laws, Regulations and Standards) applied in the performance of the work, volumes of work performed, the source materials used, other relevant data describing the work;
b) overview of the approvals (see Annex 1) obtained;
c) a detailed description of the stages of production the external elements of the Benchmarks, incl. all relevant data such as specifications of the materials used (incl. certificates) and machinery, the amount of work, etc;
d) a detailed description of the stages of Maintenance of existing Benchmarks, incl. all relevant data such as used materials (incl. certificates) and machinery, the amount of work, etc;
e) a detailed description of the stages involved in production of the Benchmarks, incl. all relevant data such as specifications of the materials used (incl. certificates) and machinery, the amount of work, etc;
f) a detailed description of the stages of installation of Benchmarks, incl. all relevant data such as specifications of the materials used (incl. certificates) and machinery, the amount of work, etc;
g) description of preliminary measurements;
h) results of preliminary measurements: table containing point names, coordinates, ellipsoidal heights and absolute heights (calculated from ellipsoidal heights using the official geoid model) of the points, differences from the corresponding values in geodetic point databases for National and Local Network points;
i) approvals obtained;
j) general map (scheme) showing the locations of maintained Benchmarks;
k) general map (scheme) showing the locations of installed New Benchmarks;
l) drawings of the Benchmark types of installed New Benchmarks and maintained Benchmarks;
m) drawings of external elements of the Benchmarks;
n) the metadata of preliminary measurements (no. of satellites, used mountpoint, precision estimates etc.) presented in the native format of the RTK device (if any) and ASCII format, and metadata of other measurement techniques, if used;
o) results of preliminary measurements, point names, coordinates and ellipsoidal heights, mean values calculated from a series of measurements presented in an MS Excel table;
p) results of preliminary measurements: table containing point names, coordinates, ellipsoidal heights and absolute heights of the points, differences from the corresponding values in geodetic point databases for national and local network points in MS Excel format;
q) summary table of maintained Benchmarks in MS Excel format, the table template is provided by the Principal;
r) summary table of installed New Benchmarks in MS Excel format, the table template is provided by the Principal;
s) photos of the maintenance Works stages for each Benchmark, incl. photos before and after the completion of maintenance Works (at least 3 pcs., incl. all covered works);

t) photos of the production stages of each Benchmark in stationary conditions (at least 3 pcs., incl. all covered works);

u) geotagged photos of the installation stages of each Benchmark on site (at least 3 pcs., incl. all covered works);

v) individual location schemes of Benchmarks;

w) panoramas of New Benchmarks and panoramas of maintained existing Benchmarks if their horizons were cleaned;

x) geotagged photos of maintained existing and installed New Benchmarks as follows:

- photo of Benchmark marker;
- close-up photo of the Benchmark location;
- photos of the Benchmark from a distance (view photo), at least 4 pcs (approx. North/East/South/West direction).

3.6.3. The textual part of the Final Report as provided in Clauses 3.6.2 a) – g) shall be prepared in separate chapters and combined into one file. Drawings of Benchmark types and external elements, and certificates are grouped into annexes. The file shall be provided in MS Word and in PDF format.

3.6.4. The information specified in Clauses 3.6.2 h) – w), as well as textual part of the Final Report, shall be uploaded to the Principals' server. All the files must be logically catalogued according to work stages and point numbers.

3.6.5. Photos shall be submitted in JPG format.

3.6.6. General schemes showing the locations of maintained existing and installed New Benchmarks shall be submitted in CAD format, and they shall include all styles and external references to allow the Principal to completely recreate the drawings, if needed, and in PDF format at the appropriate scale.

3.6.7. A relevant background maps must be added to the general schemes showing the locations of maintained existing and installed New Benchmarks, which enables determination of Benchmark locations but at the same time would not overload the drawing with both elements and colours.

3.6.8. Benchmark location schemes are submitted in CAD, PDF and JPG formats. Schemes in CAD format shall include all styles and external references to allow the Principal to completely recreate the drawings, if needed.

3.6.9. The Contractor must take into account the need, if any, to change point numbers during the Works process.

3.6.10. When naming files, the Principal's document numbering system shall be used. Rules applicable to the numbering of documents and drawings shall be provided by the Principal after the Agreement has been signed and becomes effective.

4. PRINCIPAL'S REVIEW AND APPROVAL PROCESS

4.1. MEANS OF VERIFICATIONS

4.1.1. Before preparing sketches, photographs and panoramas of the Benchmarks, the corresponding samples shall be accepted by the Principal. All Deliverables shall l be delivered to the Principal in digital form in a special shared folder. Acceptance will be made via email within 3-5 business days, depending on the quantity of documents and data included in and/or attached to the Deliverables.

4.1.2. The produced Benchmarks and their external elements shall be verified and accepted by the Principal before their installation at the Contractor's production site. Verifications are carried out on workshop with the prior notice by the Principal to the Contractor. Acceptance of a Technical Report following the completion of the production Phase will be made via Deed of Acceptance.

4.1.3. The installation methodology of the Benchmarks and their external elements shall be verified by the Principal during the field inspection before the commencement of installation. Acceptance will be made via email within 3-5 business days.

4.1.4. The Final Report shall be accepted by the Principal at the times as agreed under the Agreement between the parties and after completion of Services in their entirety, and successful inspection of each CP0 point on site by the Principal.

4.1.5. After the end of the Warranty Period (2 years), the Contractor will conduct a Warranty Period Inspection with the representatives of the Principal and Infrastructure Manager (For Lot No 1 and Lot No 3) and Beneficiary (For Lot No 2). The Warranty Period Inspection results will be submitted to the Principal together with a plan and a timetable for eliminating deficiencies, if any. Following the Warranty Period inspection the Deed of Acceptance shall be signed within 4 weeks, which shall confirm the approval of the Warranty Period Inspection results with zero (0) defects or alternatively shall include the agreement on rectification of the defects identified during the Warranty Period Inspection.

4.2. CONFIDENTIALITY / SECURITY CLAUSE

4.2.1. This Technical Specification and its annexes and underlying documents (attached files, document folders) shall be treated as Limited Access Information as defined and the usage of which being regulated by the Principal.

4.2.2. Limited Access Information is intended only for the purposes of fulfilling the assigned professional duties and tasks to the extent necessary for the performance of their duties and tasks, and the unauthorised disclosure or loss whereof due to the nature or content of such information may have a detrimental effect on the functioning or legitimate interests of RBR, its associated companies or Affected Parties .

4.2.3. When handling the limited access information and circulating documents with marked as "Limited Access Information", the "need-to-know" principle must be followed, i.e. limited work-related information may only be accessed and may be used by the employee to whom it concerns.

4.2.4. Dissemination of information without the written permission of RBR is strictly forbidden and may be subject to penalties.

Annex 1. Approvals by the Affected Parties

Estonia

- EE-CP0-30 is intended to replace an existing sign in the same location, this activity has been coordinated with the Estonian Land and Spatial Development Board (formerly the Land Board).
- Approvals and/or permits required for the execution and completion of the maintenance works have been obtained from all landowners (including state and/or local authorities, private and/or publicly owned companies and individuals), the Land and Spatial Development Board as the owner of the National Geodetic Network Benchmarks, and municipalities as the owners of the local geodetic network Benchmarks.

- Note that the Land and Spatial Development Board agrees to change the marker EE-CP0-12 to a spherical shape and drill a central hole, provided that the position of the marker is checked before and after maintenance work with a total station.
- For the Benchmarks EE-CP0-30 and EE-CP0-39 on Transport Administration (TRAM) lands, the Contractor must complete the corresponding form. The forms, together with the instructions, are available on the website https://www.transpordiamet.ee/taotlused-blanketid#liikluskorraldus-maa. The completed form must be sent, as approved, before maintenance work is carried out to karl.oigus@transpordiamet.ee, tel. +372 5863 1396.
- Before starting maintenance work on Benchmarks EE-CP0-03A1, EE-CP0-08A1, EE-CP0-08A2 and EE-CP0-14A1, a corresponding approval must be obtained from the Land and Spatial Development Board.
- To install EE-CP0H-01, EE-CP0H-03 and EE-CP0H-10, it is necessary to complete the TRAM maintenance form. The forms, along with instructions, are available on the website https://www.transpordiamet.ee/taotlused-blanketid#liikluskorraldus-maa. The completed form must be sent to karl.oigus@transpordiamet.ee, tel. +372 5863 1396, prior to the start of the work. Additionally:
  - when establishing the Benchmarks, it must be taken into account that their locations are within the maintenance work zone of the transport area (mowed areas, snowdrifts after snow removal), therefore, the Benchmarks must be covered with soil after installation and must not obstruct the movement of maintenance machinery in the transport area;
  - where possible, the Benchmarks should be placed near the boundary of the transport area to minimize potential hazards from maintenance equipment;
  - Installation works must be aligned and coordinated with the owners of utility networks, where required;
  - after the completion of the installation works, the land plot, where the Benchmark is situated, as well as any adjacent area shall be restored in its previous condition, and the TRAM must be notified of the completion of the work and shall be invited for inspection.
- The State Forest Agency (RMK) approves establishment of EE-CP0H-02, EE-CP0H-05 and EE-CP0H-07 with the remarks:
  - the Contractor of construction works is responsible for good order on the site, and if necessary, also handles waste management;
  - RMK is immediately informed of natural disasters and other accidents, and if necessary, the Rescue Board's emergency center and the Environmental Board.
- The landowner of the existing geodetic Benchmark EE-CP0H-06, Kevere OÜ, has approved the maintenance of the mark. In this case, written approval is not required due to the existing protection zone of the Benchmark.
- When establishing a New Benchmarks, all local government regulations on digging must be followed, in particular:
  - EE-CP0-30 (Pulli replacement), EE-CP0H-01, EE-CP0H-02, EE-CP0H-03, EE-CP0H-04: Tori Parish (Tori vald): no digging permit necessary until such regulation is not described at Parish website https://www.torivald.ee/majadnusvaldkonna-eeskirjad-ja-korrad;
  - EE-CP0-32: the city of Pärnu requires an digging permit, the regulations are described at https://www.riigiteataja.ee/akt/429122011042;

- EE-CP0-42, EE-CP0H-09, EE-CP0H-10: Häädemeeste Parish (Häädemeeste vald) requires to follow municipality regulation https://www.riigiteataja.ee/akt/406102023031 § 7 - Ehitus-, remondi- ja kaevetöö tegija kohustused heakorra tagamisel (Obligations of those performing construction, repair and excavation work in ensuring good order), no digging permit required;
- EE-CP0H-05, EE-CP0H-07, EE-CP0H-08: Saarde Parish (Saarde vald) requires to follow municipality regulations: Saarde valla kaevetööde eeskirjad–Riigi Teataja § 3. Kaeveloa väljastamine, § 4. Nõuded kaevetöödel ja avariikaevetöödel and § 5. Kaevetööde lõpetamine. An digging permit is required according to the application form of the aforementioned regulation, which is available at https://www.riigiteataja.ee/aktilisa/4280/9201/2002/vorm2.pdf#.

A low-voltage electric cable is located in the neighbourhood of location EE-CP0H-10, approx. 4.5 meters away (Figure A1-1). Therefore, before the start of Benchmark installation, a representative of the utility owner (Elektrilevi OÜ) has to be invited to the site to check the correctness of the cable location and avoid its potential collision caused by the digging works.

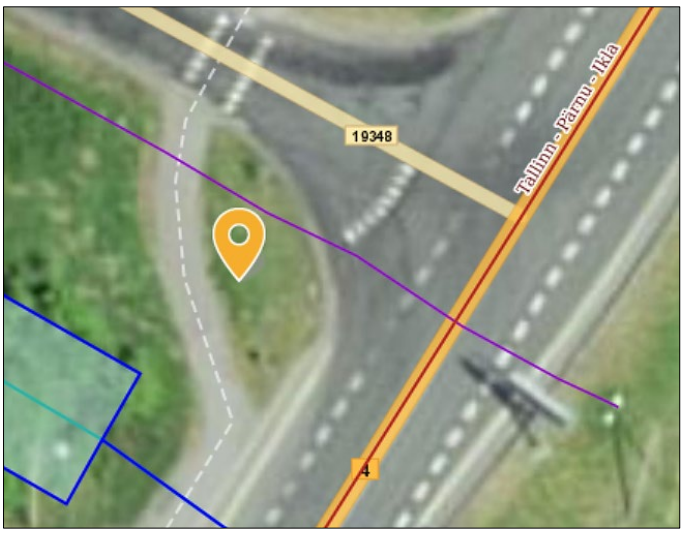


Figure A1-1. Scheme of the EE-CP0H-10 location

- All affected parties have to be informed before starting any maintenance and installation works. Contact details of affected companies and institutions will be made available after the conclusion of the Agreement. and inform landowners about the current time of works.

Latvia

According to Regulation No. 500 of 19 August 2014 "General Building Regulations" (https://likumi.lv/ta/id/269069), no building permit procedure is required for the construction of geodetic Benchmarks in Latvia.

- The necessary permits for the installation and maintenance of all geodetic Benchmarks located on land plots owned by local authorities or publicly owned companies have been received. However, one month before commencement of installation works of Benchmarks, the Contractor must notify the respective land wner. The contact information of the representatives of the landowners can be found in the confirmation letters, which will be made available by the Principal after the Agreement is signed and becomes effective.
- Regarding Benchmarks designed on land plots possessed by Latvian State Roads (in Latvian – *VSIA "Latvijas Valsts ceļi"*), the Contractor should submit an application for the work permit one month before the installation of the Benchmarks shall commence. The application template is available on the web-page https://lvceli.lv/pakalpojumi/saskanojumi-un-atlaujas/darbu-veiksanas-saskanosana-autocelu-tikla/ (file "*Iesniegums*"). Additional activities before installation of Benchmarks on the land plots possessed by Latvian State Roads:
  - For the Benchmark LV-CP0-08 in the territory of local authority of Limbažu novads a tree (birch) has to be removed, therefore Contractor's application form "Par koku ciršanu ārpus meža" should be downloaded https://www.limbazunovads.lv/lv/pakalpojumi/koku-cirsana-arpus-meza, duly signed and submitted to the local authority of Limbažu novads . Approval should be annexed to application for the work permit in the land division zone of the State motorway.
  - For the Benchmark LV-CP0-21 in the territory of local authority of Ropažu novads bushes have to be removed. For removal of bushes the application for the work permit (please refer to previous indent above) in the land division zone of the State motorway has to be submitted.
- In all cases, the Contractor must request the up-to-date information about location utilities in the vicinity of the designed geodetic Benchmarks before commencement of installation works. Approvals have been requested and received for four locations near underground utilities:
  - LV-CP0-14 from SIA "Tet". Utility of SIA "Latvijas Mobilais Telefons" has to be located on site before installation.
  - LV-CP0-18 from VAS "Latvijas Valsts radio un televīzijas centrs" and AS "Sadales tīkls".
  - LV-CP0-21 from SIA "Tet".
  - LV-CP0-22 from AS "Sadales tīkls".
- The Contractor must request a work permit one month before commencement of the installation works of the Benchmark. Note that the permit is valid for one (1) calendar month.

All the above mentioned requirements for CP0 Benchmarks on land plots owned and/or possessed by the local authorities and Latvian State Roads also apply to CP0H Benchmarks.

LV-CP0H-01 (work no. LV-CP0H-01) is located in the Northern Biosphere Reserve ("the Reserve"). Installation works shall be carried out in accordance with the individual protection regulations applicable to any works carried out at the Reserve.

- The general requirements for the installation of CP0H Benchmarks designed on the land plot possessed by Latvian State Forests (in Latvian – AS "Latvijas valsts meži" (LVM)), i.e. LV-CP0H-01, LV-CP0H-09, LV-CP0H-12, LV-CP0H-35, LV-CP0H-40, LV-CP0H-52 are listed below.

- During installation works, it shall be prohibited to cut down and collect growing and dried trees and damage new growth.
- If the planned Benchmark is located closer than 5 m from the objects of the forest infrastructure, it must be ensured that there will be no restrictions regarding the use of the forest infrastructure (forest roads, ditches and their litters).
- If the planned location of the Benchmark is located in the protection zone of any engineering networks, the installation of the Benchmark must also be coordinated with the owner of the specific engineering structure, in whose protection zone it is planned to be installed.
- Before commencement of installation works, LVM must be informed about the planned works, by sending the written notification shall to the following e-mail address: lvm@lvm.lv.
- If it is planned to move by road transport through forest, land outside of roads and natural roads, the activities shall be coordinated with the senior forester of the station.
- During installation, care must be taken to avoid damaging growing trees and covering the roots of neighbouring trees with soil.
- If one of the instrumentally measured border marks is damaged or destroyed, the Contractor shall ensure its restoration in accordance with 27.12.2011 LR CM regulations No. 1019 "Regulations of land cadastral surveying" at its own expense.
- If the LVM border identification plate is damaged or destroyed, the Real Estate Specialist must be informed about it: Anita Luca at West Vidzeme region, phone no. 26436101, e-mail: a.luca@lvm.lv; Sanita Vitola at Zemgale region, phone no. 29161172, e-mail: s.vitola@lvm.lv; Vilma Malašenoka at Vidusdaugava region, phone no. 29394401, e-mail: v.malasenoka@lvm.lv.
- Forest fire safety regulations must be followed, forest soil and forest infrastructure must not be damaged, and the requirements of applicable environmental protection and occupational safety regulations must be followed. LVM's requirements are available on the website: http://www.lvm.lv/biznesa-partneriem/iepirkumi/liguma-pielikumi/contractadd/35,32.
- When carrying out work on the site, the Contractor must comply with the requirements set out in the forest management certification standards. Certification standards are available on the LVM website: https://www.lvm.lv/biznesa-partneriem/profesionaliem/sertifikacija.
- Upon request, the Contractor must provide information about the installation process to the authorized representative of the LVM and/or the representative of an accredited certification institution that performs the LVM audit as part of the forest management certification process.
- Upon completion of the installation work, the territory must be cleaned up without leaving any waste or any residual materials.
- After completion of the works, information on the performed works and volumes, as well as the exact coordinates of the installed Benchmark, must be sent to LVM. LVM reserves their rights to inspect the installed Benchmark on site and assess its compliance with the LVM regulations on the protection of forest land.

Lithuania

Coordination process with affected parties is completed for all New Benchmark locations and existing Benchmarks used in the CP0 network.

According to the Law on Geodesy and Cartography, all owners and tenants of land plots where New Benchmarks will be installed will be notified about the planned installation of New Benchmarks. Their consent is not necessary, as they are required by law to allow the installation of geodetic Benchmarks.

- Before commencing work near the existing railway, the Contractor must obtain a legal work permit, the Deed on applicable safety measures (the Deed). In order to obtain the Deed, the Contractor must complete the application form available on the website https://infrago.ltginfra.lt/lt-LT. When carrying out work in the protection zone of railway and their facilities, the employees responsible for technical supervision at AB "LTG Infra", as indicated in the Deed, must be notified three days before the start of the work. Before obtaining the Dees, an agreement must be concluded with AB "LTG Infra" regarding the payment for the services of specialists (if the following services are required: cable routing, cable switching and inspection work, work supervision). Contact by e-mail: pardavimai@ltginfra.lt.
- Before commencement of Benchmark installation Works, the National Land Service and the respective owners or lessors of the land plots must be informed about the Works in advance. For this purpose, the Contractor must contact the National Land Service by e-mail at nzt@nzt.lt, and the Land Service will in turn inform the tenants.
- In case of LT-CP0-012, a written notification of the construction or maintenance work to be started must be sent to AB "Via Lietuva", joint-stock company responsible for restoration, maintenance and development of state roads to the email address: info@vialietuva.lt.

Annex 2. List of Benchmarks to be maintained, CP0

Queue No	RB Point Number	Geodetic Point Database No/ID	Point No	*L-EST97*		*EUREF-EST97*		Installable external elements								Notes on benchmark maintenance	Sketch	
				x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	cover plate	concrete collar	protective dome	sign post	identification label	earthworks mound	fence		update	new
1	EE-CP0-01	223879	5683	6594607.24	558250.65	59.485155	25.027993	*				*	*				*	
2	EE-CP0-03A1	48910	537	6587245.96	549024.69	59.420253	24.863523		*									*
3	EE-CP0-06	49079	1272	6582467.43	551151.23	59.377112	24.899846								*		*	
4	EE-CP0-07	42929	1308	6578484.83	547697.85	59.341767	24.838226		*						*		*	
5	EE-CP0-08A1	213455	204	6573731.20	537060.20	59.300158	24.650487		*									
6	EE-CP0-08A2	39486	1002	6568747.00	537037.86	59.255420	24.649248		*									*
7	EE-CP0-10	39628	1403	6560895.25	540617.65	59.184613	24.710537									bush cutting (permitted by the landowner, contact the owner before maintenanace)		
8	EE-CP0-11	37514	1402	6557631.34	543318.02	59.155049	24.757127					*	*		*		*	
9	EE-CP0-12	37692	1460	6550440.97	551028.07	59.089655	24.890203		*							the marker needs spherical grinding, the marker hole needs to be drilled; before and after the maintenance control measurements must be carried out	*	
10	EE-CP0-13	35201	2742	6548288.00	546494.00	59.070846	24.810652		*							tube above benchmark + insulation inside tube		
11	EE-CP0-14	35079	1488	6546063.30	543808.90	59.051157	24.763405								*	fence permitted by landowner, contact owner before maintenance	*	
12	EE-CP0-14A1	34675	4123	6540953.61	537305.18	59.005902	24.649218							*				*
13	EE-CP0-16	32296	4205	6534906.30	539493.93	58.95141898	24.686230		*			*	*		*		*	
14	EE-CP0-18	30265	2650	6522806.36	546251.59	58.842123	24.801127					*	*			update earthworks mound, replace sign post		
15	EE-CP0-20	28397	2670	6516171.36	547280.90	58.782448	24.817553	*								the position of the hatch and the collar need correction		
16	EE-CP0-21	28267	4313	6514713.36	540851.75	58.770014	24.706128					*	*					*
17	EE-CP0-23	34128	1001	6504072.86	544058.98	58.674174	24.759478				*							*
18	EE-CP0-24	10900	2734	6499136.11	548469.97	58.629384	24.834448						*					
19	EE-CP0-26	10134	2791	6489489.10	544445.50	58.543207	24.763280					*	*			tree cutting, a plastic tube must be placed, as the mark is quite deep	*	
20	EE-CP0-28	10094	3447	6483522.75	547226.72	58.489351	24.809801					*	*			update earthworks mound	*	
21	EE-CP0-31	8438	91080	6471991.70	528189.40	58.387471	24.481961					*	*				*	
22	EE-CP0-34	6736	1001	6455707.65	541286.27	58.240232	24.702950			*				*		add soil		*
23	EE-CP0-35	5967	2999	6449125.52	539038.39	58.181343	24.663571					*	*					
24	EE-CP0-39	5557	3178	6431995.25	535700.09	58.027829	24.604207									correct installation of the post	*	
25	EE-CP0-41	5339	3237	6427708.77	534457.93	57.989444	24.582555					*	*		*		*	
26	EE-CP0-43	5249	3249	6419084.08	524003.56	57.912700	24.404936									bush cutting, correct installation of the post	*	
							Total	2	7	1	1	10	11	2	6		**Total**	13	6

Queue No	RB Point Number	Database No/ID	Point No	*LKS-92 TM*		*LKS-92*		**Installable external elements**								**Notes on benchmark maintenance**	**Sketch**	
				x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	cover plate	concrete collar	protective dome	sign post	identification label	earthworks mound	fence		update	new
1	LV-CP0-01	11681	1323b	414150.31	533493.54	57.867966	24.564566										*	
2	LV-CP0-04	11759	8248	397426.22	521689.29	57.718476	24.364084										*	
3	LV-CP0-07	-	Rustūži	382746.60	536174.50	57.585691	24.605027					*	*				*	
4	LV-CP0-12	11187	0964	358443.76	526276.73	57.368074	24.436878										*	
5	LV-CP0-13	13181	Āģe	354310.62	529427.76	57.330755	24.488771										*	
6	LV-CP0-19	10518	2109	327259.27	533092.15	57.087507	24.546031										*	
7	LV-CP0-20	10148	183	323845.28	528284.61	57.057160	24.466324								*		*	
8	LV-CP0-24	11932	6330	314367.74	520772.87	56.972420	24.341700										*	
9	LV-CP0-26	10654	6475	311460.49	509386.06	56.946674	24.154288										*	
10	LV-CP0-27	10577	5715	306898.39	512854.69	56.905606	24.211073										*	
11	LV-CP0-28	3694	4407	313573.79	503478.28	56.965741	24.057205										*	
12	LV-CP0-29	13023	1885	312890.53	493405.97	56.959569	23.891570										*	
13	LV-CP0-30	11159	Skujas	305290.14	501559.95	56.891334	24.025604										*	
14	LV-CP0-31	11546	3389	305254.96	504592.87	56.890998	24.075385										*	
15	LV-CP0-32	10451	Tīrumnieki	303285.68	494833.67	56.873301	23.915242										*	
16	LV-CP0-33	11424	Bērzpils	299404.11	501995.35	56.838454	24.032705										*	
17	LV-CP0-37	13001	Daugmale	294670.70	523610.93	56.795336	24.386553										*	
18	LV-CP0-41	11286	Dimza	279607.31	514242.55	56.660390	24.232342									need to cut down the bushes	*	
19	LV-CP0-43	11267	Zorģi	268624.50	510649.46	56.561816	24.173275										*	
20	LV-CP0-46	10930	1031b	254032.91	524222.51	56.430221	24.392757										*	
							Total					1	1		1		**Total**	20

Queue No	RB Point Number	Database No/ID	Point No	*LKS-94 TM*		*LKS-94*		**Installable external elements**								**Notes on benchmark maintenance**	**Sketch**	
				x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	cover plate	concrete collar	protective dome	sign post	identification label	earthworks mound	fence		update	new
1	LT-CP0-04	10303	66V10303	6223793.88	517509.87	56.147653	24.281771						*			need to cut down the bushes	*	
2	LT-CP0-05	36615	66S36615	6220666.94	512642.13	56.119717	24.203291						*				*	
3	LT-CP0-12	9229	65S9229	6191323.28	512500.82	55.856124	24.199656					*	*				*	
4	LT-CP0-22	20230	64V20230	6140072.75	526842.90	55.395133	24.423718					*	*	*			*	
5	LT-CP0-26	169	64S0169	6119736.96	526126.50	55.212476	24.410519									need to cut down the bushes	*	
6	LT-CP0-27	168	64S0168	6115221.32	514046.41	55.172397	24.220486					*	*				*	
7	LT-CP0-28	10179	64V10179	6111964.75	512337.86	55.143184	24.193525						*			need to cut down the bushes	*	
8	LT-CP0-29	1335	64S1335	6111689.77	521939.52	55.140382	24.344108											*
9	LT-CP0-32	10005	64V10005	6102323.98	520131.99	55.056313	24.315096						*			need to cut down the bushes	*	
10	LT-CP0-33	1432	64S1432	6099497.90	505943.55	55.031294	24.092967					*	*					*
11	LT-CP0-35	10031	63V10031	6090021.91	503620.43	54.946178	24.056510					*	*	*			*	
12	LT-CP0-37	-	LG1129041	6085136.35	502402.54	54.902290	24.037460						*				*	
							Total					5	10	2		**Total**	10	2

Annex 3. List of Benchmarks to be maintained, CP0H

Queue No	RB Point Number	Point Name	*L-EST97*		*EUREF-EST97*		**Installable external elements**								Notes on benchmark maintenance	**Sketch**	
			x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	cover plate	concrete collar	protective dome	sign post	identification label	earthworks mound	fence		update	new
1	EE-CP0H-06	Kõveri	6445954.23	543653.35	58.152437	24.741413			*	*	*	*	*		restore the earthworks mound to its former size	*	

Queue No	RB Point Number	Point Name	*LKS-92 TM*		*LKS-92*		**Installable external elements**								Notes on benchmark maintenance	**Sketch**	
			x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	concrete collar	protective dome	base plate	sign post	identification label	earthworks mound	fence		update	new
1	LV-CP0H-73	Pēterkalns	250234.79	515368.47	56.396469	24.248972		*	*	*	*	*	*		grinding the concrete layer on the top of the mark so that the levelling rod can be placed		*

Annex 4. External elements of Benchmarks

The Benchmarks will be equipped with one or combination of the following types of external elements, depending on the situation in the area.

Sign post

- The sign post is installed at a distance of one meter from the geodetic mark towards the mark with the identification label (if possible, towards the north). If there is a earthwork mound or protective fence, the sign post is installed in its northeast corner if possible. If there is a road closer than 50 meters to the sign, the sign post is installed so that its front faces the direction of the road.
- In Estonia and Lithuania, the sign post of the geodetic mark (Figure A4-1) is made of reinforced concrete grade C20/25. Sign post is made in stationary conditions (in a workshop), during which the concrete mix is compacted by vibration and the upper surface of the post in the casing is smoothed.
- In Estonia, the identification label to be attached to the post is made of anodized aluminium (dimensions 110 x 150 mm), the text "Eesti Vabariigi kaitse all olev geodeetiline punkt" is written on the plate (Figure A4-2). The label can be obtained from the Estonian Land and Spatial Development Board. Note that the text on the label used in Lithuania will be further specified.

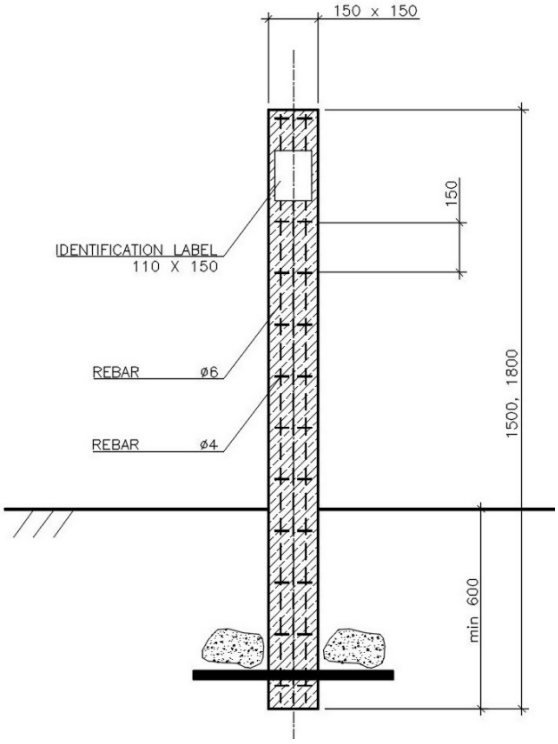


Figure A4-1. Sign post, Estonia and Lithuania

Figure 4-2. Identification label, Estonia

- In Latvia, the plastic signal pole is used. Examples of a signal pole and identification label are shown in Figure A4-3. Note that the text on the label will be further specified.

Figure A4-3. Identification label, Latvia

Concrete collar

- The concrete collar (Figure A4-4) is made in stationary conditions, in a specialised workshop, during which the concrete mix is compacted by vibration and the upper surface of the collar in the casing is smoothed.
- The collar is made of reinforced concrete grade C20/25 or, alternatively of concrete C30/37 xf4+kk4 with steel fibre bt-he75/50 40kg/m^3.
- The soil under the concrete collar must be compacted, in the case of clay and other weak soils, they are replaced with sand and/or gravel.
- The concrete collar is placed above the Benchmark so that its lower surface remains approx. 5 cm above the mark and the cover plate placed on the collar would be approx. 5 cm below the ground level.
- When using a cast iron cover hatch, the installation depth of the collar must be taken into account so that the top surface of the hatch remains at the same level as the ground.

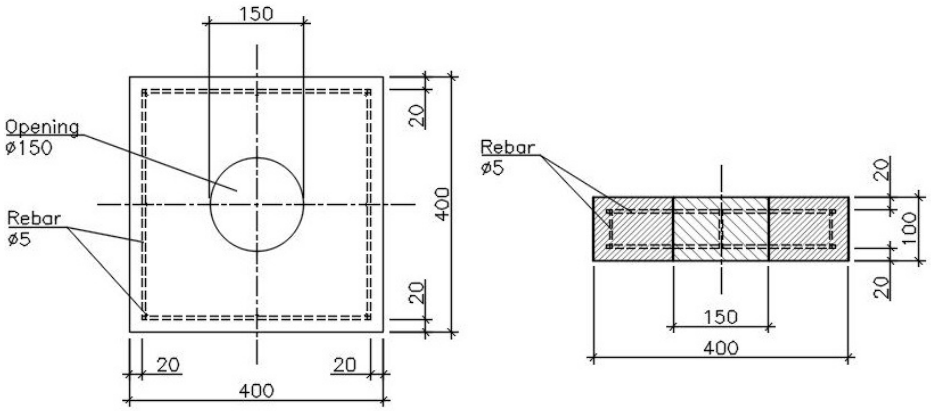


Figure 4-4. Concrete collar

Cover hatch

Cover hatch (Figure A4-5) is made of cast iron and is placed on a concrete collar. For installation depth see previous section.

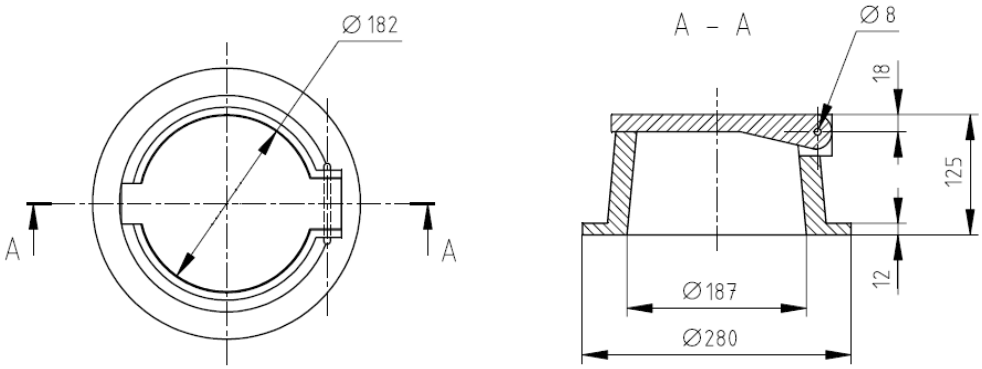


Figure A4-5. Cover hatch

Cover plate

- The cover plate (Figure A4-6) is made of steel, concrete or weatherproof solid PE plastic.
- In case of steel and plastic plates, two Ø10 mm holes must be drilled in the plate.
- Steel plate with dimensions 250 x 250 x 6 mm is coated with "Epitar" (or similar) epoxy paint. Before coating, the steel surface must be cleaned of rust and dirt.
- In the case of concrete plates, industrially produced plates of suitable size have been considered. The plate to be used must be coordinated with the Principal in advance. These plates are primarily intended for use in locations where the preservation of a steel or plastic plate is uncertain.

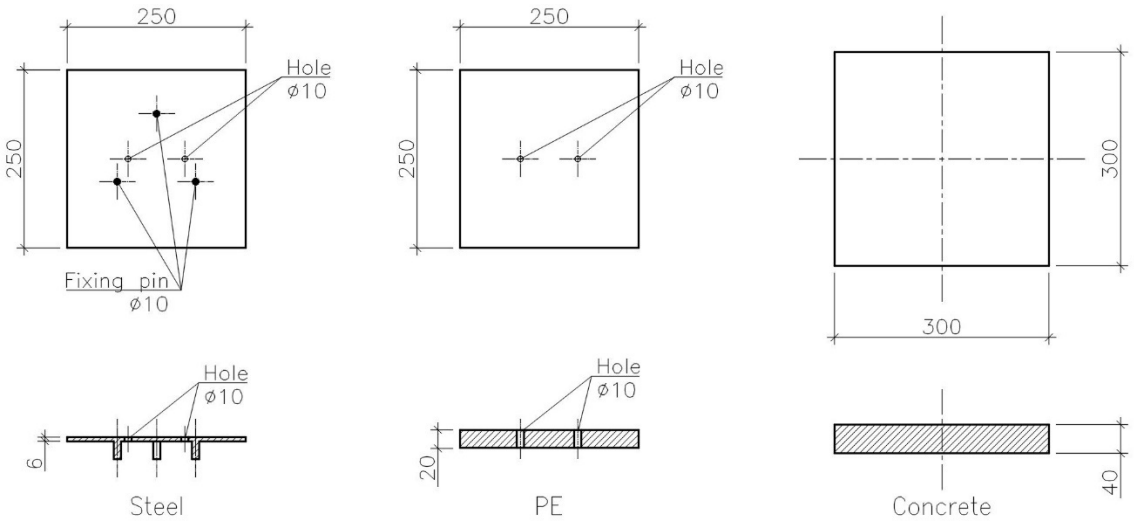


Figure A4-6. Cover plate

Earthworks mound

The mound, Figure A4-7, is a square pile of fill on the ground surrounded by a ditch.

- In Estonia, the side length of the mound is at least 3 meters, in Latvia and Lithuania 2.2 meters (if a fence is installed on the mound, the side lengths of the mound given for Estonia shall be used).
- The sides of the mound are oriented according to quarters of the earth. If there is a road, ditch, border or other such facility closer than 50 meters to the mound, the side of the mound is oriented according to this facility.

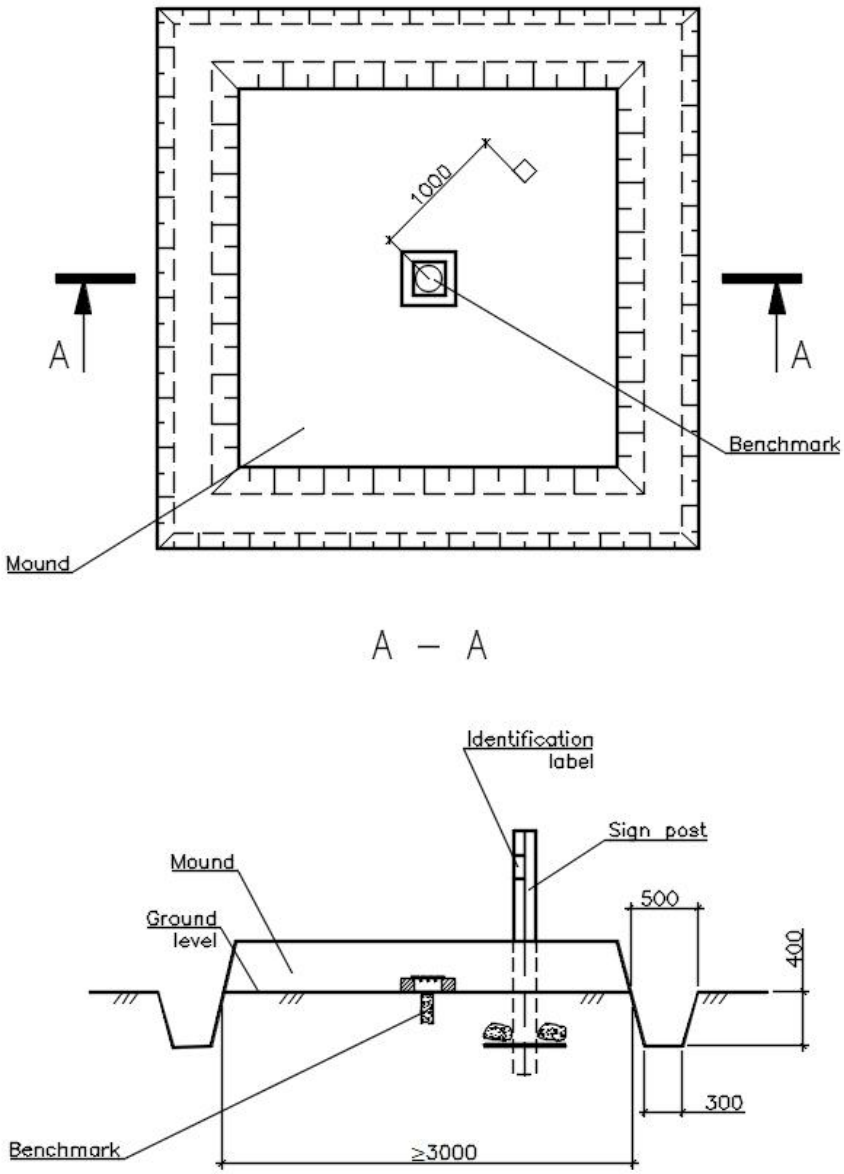


Figure A4-7. Earthworks mound, Estonia

Protective fence

The geodetic Benchmark protective fence is shown in Figure A4-8.

- The protective fence is made of steel and is painted with a weather-resistant paint in a yellow shade (RAL 1023 or equivalent).
- The sides of the fence are oriented according to quarters of the earth. If there is a road, ditch, border or other such facility closer than 50 meters to the fence, the sides of the fence are oriented according to this facility. If there is a earthwork mound, the fence is oriented according to the sides of the mound.
- The fence is anchored during installation.

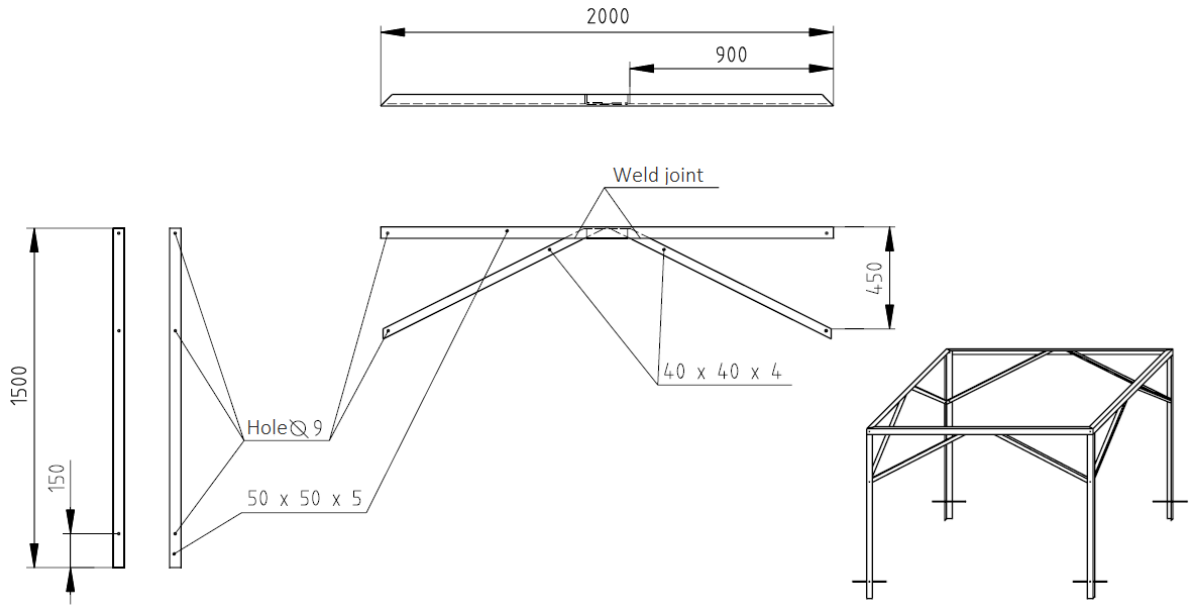


Figure A4-8. Protective fence

Annex 5. Benchmark location schemes

- During the fieldwork, the line ties are measured for the Benchmark location schemes from at least three permanent, unambiguously definable situational elements. It must be clearly distinguished whether the distance is measured to the situational element or to its center. If there is a sign post, the distance to the marker of the Benchmark is measured from the front surface of it. In the case of a geodetic mark installed in a building, line ties are taken from its unambiguously defined elements, e.g. the corners of the building.
- The scale of the drawing is chosen based on the location distance of nearby perceptible objects (buildings, roads, etc.) which make it easier to find the location of the Benchmark. In general, Benchmark location schemes cover an area of approx. 40 m around the Benchmark.
- Schemes shall be drawn within a 210 x 180 mm (H x W) frame.

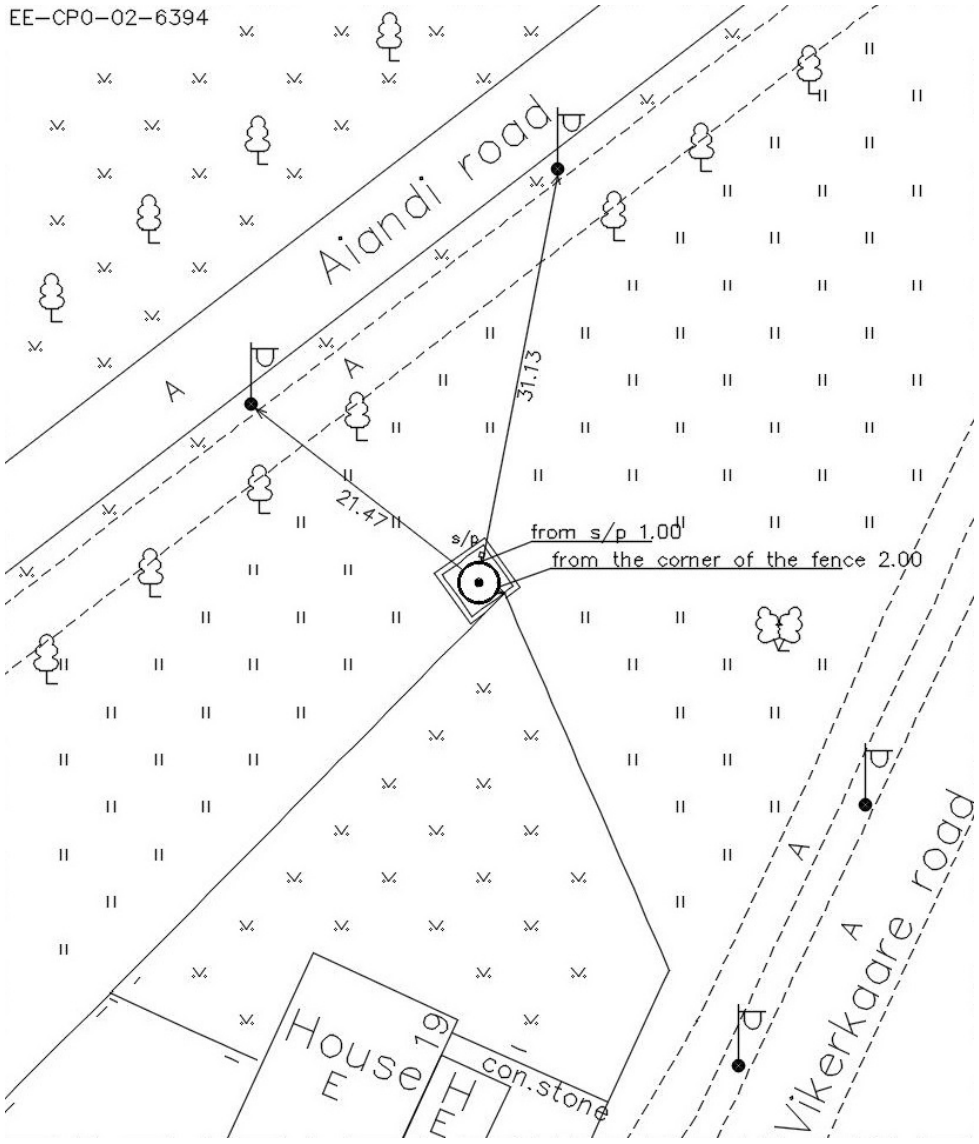


Figure A5-1. Sample of Benchmark location scheme

- The drawings are oriented in the North direction.

- If topographic plans are used in the preparation of the schemes, it is ensured that the schemes are not overloaded with unnecessary elements for finding the Benchmark and that the scale factors of symbol elements and lines are preserved when the scale of the topographic plans is changed.
- In the case of nearby Benchmarks, the schemes are prepared for each Benchmark separately, while showing the locations of other, nearby Benchmark. The number/name of the Benchmark to be displayed is highlighted, e.g. in bold.
- Schemes are presented in vector format (dgn, dwg) and in JPG and PDF formats.
- File names consist of a RB Rail CP0 point number followed by the letter L and sequence number 1, 2…, for example, for EE CP0 No 1: EECP01_L1.

Annex 6. Panoramas

- The vertical angles and azimuth of the obstacles are measured and marked on the panoramas. If the obstacle is located closer than 30 m to the sign, the distance to it is also recorded on the panorama.
- Panoramas shall be drawn within a 210 x 180 mm (H x W) frame.
- Panoramas are presented in vector format (dgn, dwg) and in JPG and PDF formats (cut to frame size).
- File names consist of a RB Rail CP0 point number followed by the letter P and sequence number 1, 2…, for example, for EE CP0 No 1: EECP01_P1.

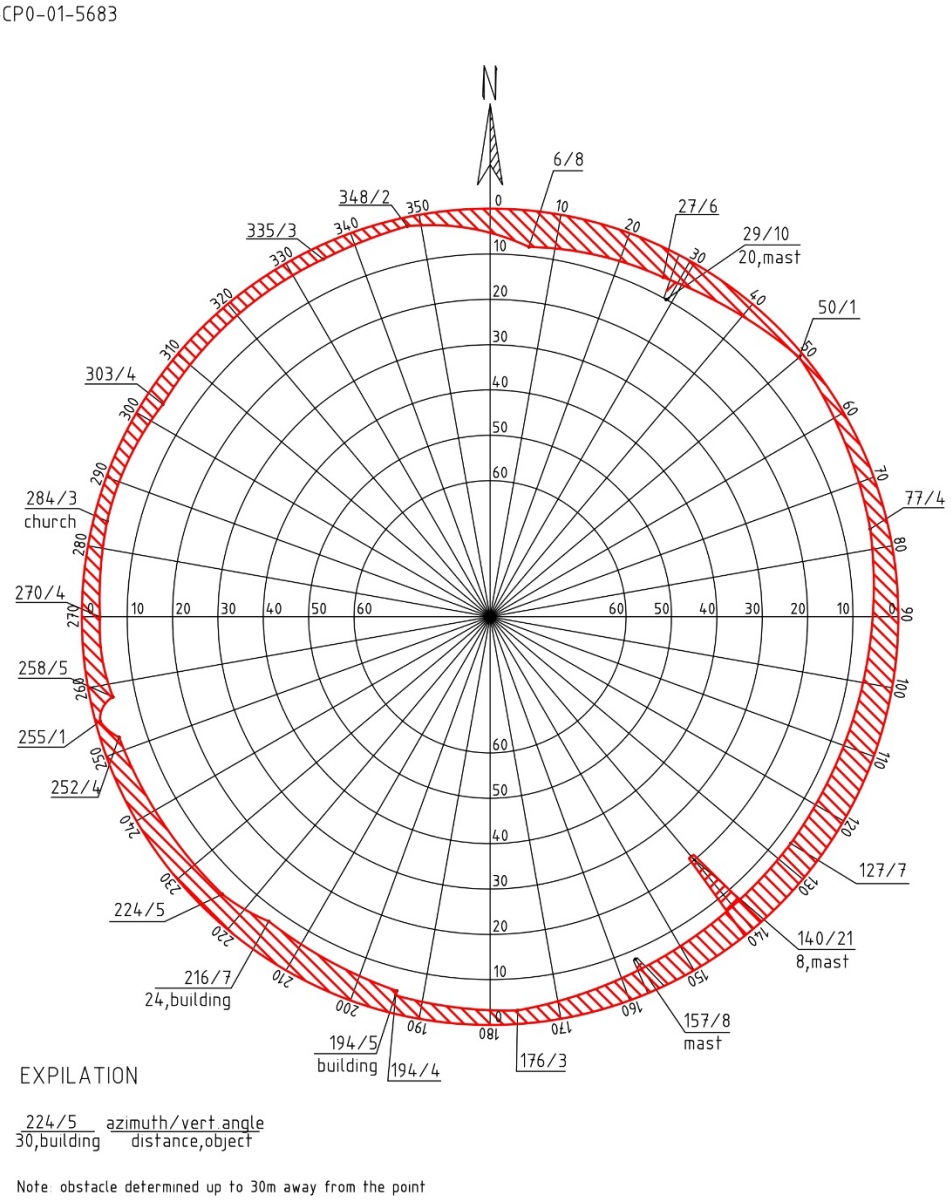


Figure A6-1. Sample of panorama

Annex 7. Photos of Benchmarks

- Photos are taken in good lighting conditions.
- Photos are taken in a landscape orientation.
- The file type for photos is JPG.
- The resolution of the photos must allow them to be printed in A4 format without loss of quality, i.e. 300 dpi and 2480x3300 pix.
- In the case of a view photo of a geodetic Benchmark, the direction of the photo is chosen in such a way that the photo describes the location of the mark in as much detail as possible (in the case of marks built into the earth's crust, e.g. road crosses, nearby buildings, etc., and in the case of marks built into a building, e.g. the facade of a building or its fragment).
- If the Benchmark does not have a protective fence or an identification post that would allow the location of the Benchmark to be clearly identified in the view photo, a sign is placed on the Benchmark, or the location of the Benchmark is marked with an arrow on the photo (see sample Photos 6-1).
- In the case of a close-up photo, it is ensured that the Benchmark marker is in the focus of the photo. In the case of marks built into the building, a side view of it is also taken. If the sign has a marker number, it is ensured that it is also clearly visible in the photo. Prior to taking pictures, the marker of the Benchmark is cleaned of soil, etc.
- When taking pictures, it is ensured that the Contractor's means of transport, employees and the photographers shadow are not in the frame.
- File names consist of a RB Rail CP0 point number followed by the letter V (view) or C (close-up) and sequence number 1, 2…, for example, for EE CP0 No 1: EECP01_V1, EECP01_C1.

Photo A7-1. Sample of view photo

Annex 8. Benchmark types

Type 2

According to results of the Benchmark location design and agreements with landowners, ground Benchmark Type 2 (Figure A8-1) is selected as most suitable for the RB CP0 and CP0H networks. In Lithuania, the use of a similar type 2-LT (Figure A8-2) is permitted instead of type 2.

This Benchmark type enables high precision GNSS and levelling measurements and its stability ensures the long-term preservation of measurement results.

Production of Benchmarks, technical specifications

- The Benchmark consists of a casing pipe, marker and an anchor.
- To ensure homogeneous quality, the Benchmark must be produced under stationary conditions, in the specialised workshop.
- The casing pipe is made of a calvinized steel pipe with an outer diameter of 76 mm, the length of the casing pipe is 1.8 m. In the case of a casing pipe, care is taken to ensure that the pipe cut is perpendicular to the pipe axis and that the cut edge is smooth.
- The casing pipe is attached to the anchor with two fixing irons (reinforcing iron Ø 16 mm, L = 420 mm). The diameter of the circular anchor is 480 - 500 mm, height 200 mm. The reinforcement of the anchor is passivated with a concrete layer at least 20 mm thick. Rebar loops with a diameter of 5 mm are installed in the anchor. During manufacture, it must be ensured that the anchor and the casing pipe are perpendicular.
- The casing pipe is filled with non-shrinking concrete mix, M300 or similar. The casing pipe and the anchor are concreted together, the concrete mixture is compacted by vibration.
- During concreting, a marker (GOECKE GmbH & Co MESSUNGS-PUNKT, Article-No. 11) or similar marker made of corrosion-resistant material (brass, stainless steel), is placed at the top of the casing pipe so that the top surface of the dial is flush with the edge of the casing pipe. The marker is installed in place during the concreting of the casing pipe. Note that the outer diameter of the marker must cover the casing pipe, but its diameter must not be larger than the outer diameter of the pipe.
- Monument shall be constructed in such way to be well anchored in soil below the freezing layer of soil practically not affected by this phenomenon.

Installation methodology

- Benchmark can be installed by both digging (preferred) and drilling methods.
- When digging, care is taken to ensure that the marker anchor is placed on unaffected soil. The given soil layer must be levelled.
- When drilling, it must be ensured that the soil under the anchor is compacted and levelled. The methodology to be used must be coordinated with the Principal in advance.
- The verticality of the casing pipe must be ensured.
- The installation depth of the Benchmark is chosen so that the upper end of it remains approx. 5 cm below the bottom surface of the concrete collar (see Annex 4).
- The excavated soil must be compacted in layers during backfilling, in case of clays and stony soil, sand is used for backfilling.
- To speed up the process of installing the Benchmarks and ensure appropriate quality, the preferred installation time is the dry season of the year - summer and early autumn.

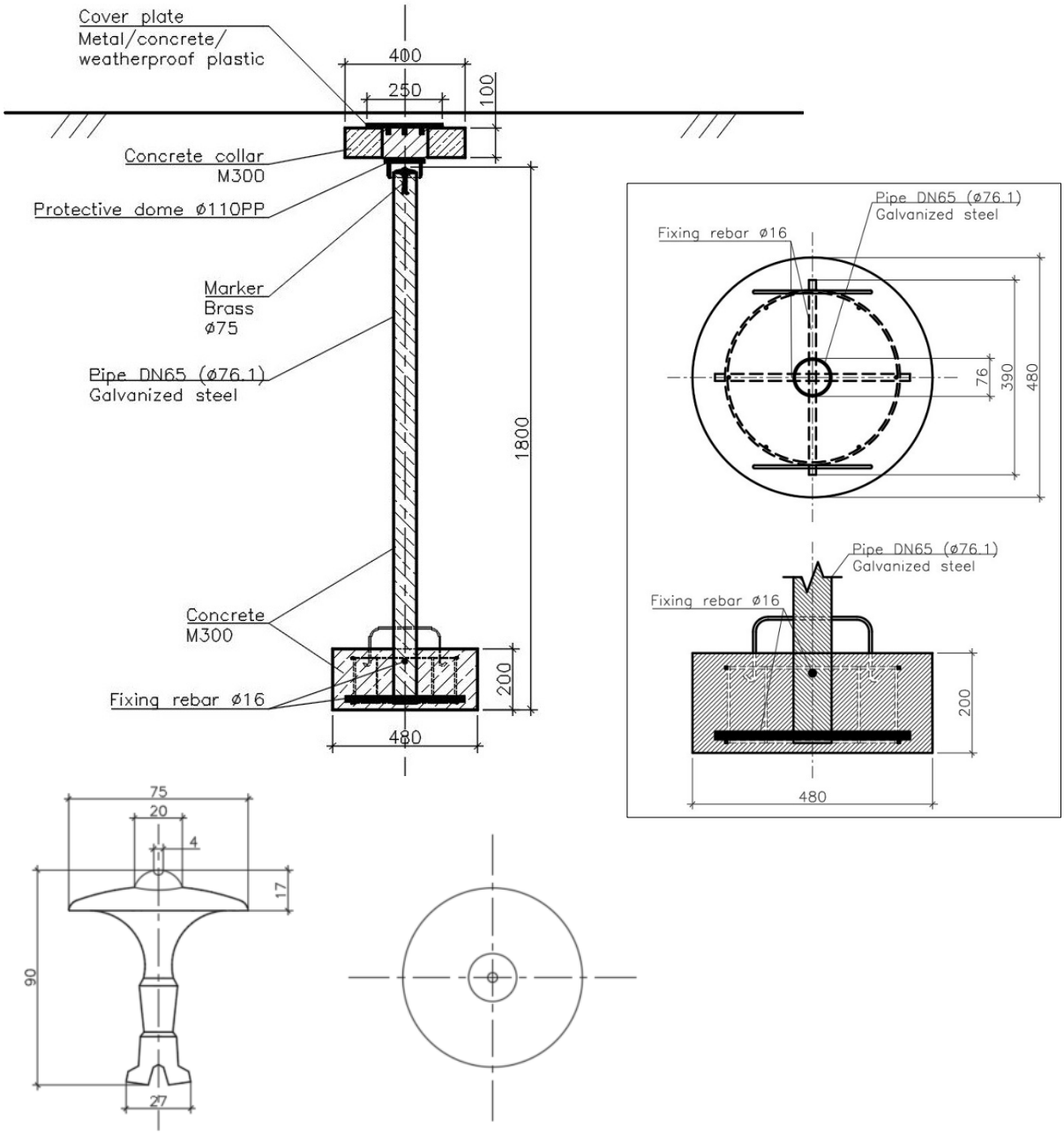


Figure A8-1. Benchmark type 2, Estonia and Latvia

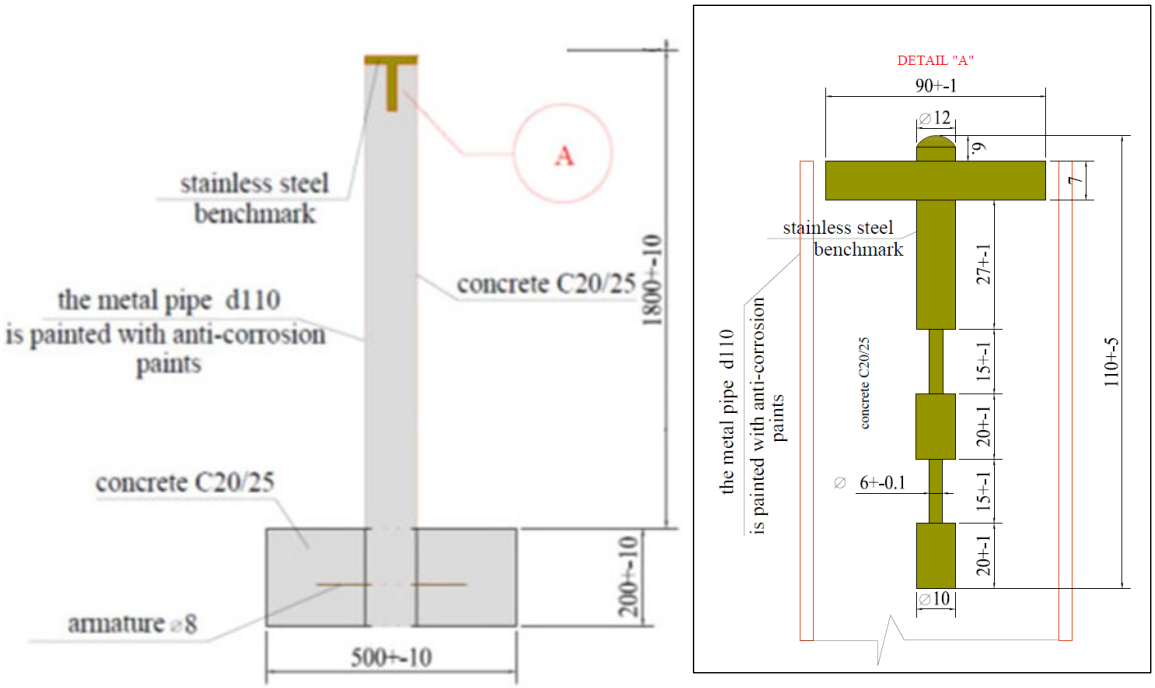


Figure A8-2. Benchmark type 2-LT, Lithuania

Type 4

This Benchmark type (Figure A8-3) is used in places where Type 2 cannot be placed due to weak soil (for EE-CP0-32 and EE-CP0H-04). It is estimated that the thickness of the soft layers in the selected locations is 5...6 meters, but this needs to be specified.

Production of Benchmarks, technical specifications

- The Benchmark consist of Benchmark pipe, drilling crown and marker
- The Benchmark pipe is made of a steel pipe with an outer diameter of 89 mm and a wall thickness of 6 mm.
- The junction of the crown and the Benchmark pipe and the joints of the links of the Benchmark pipe are threaded with a trapezoidal thread.
- The length of the marker pipe is chosen in such a way that the pipe passes through soft soil layers and reaches 1...1.5 meters into hard layers.

Installation methodology

- The joint of the crown and the central tube and the joints of the links of the central tube are connected with a trapezoidal thread and welding. Note that the drilling crown is left at the bottom of the Benchmark.
- Core drilling is used for Benchmark installation using suitable drilling machine.
- The last part of drilling has to be performed with vibration to ensure better stability of the Benchmark.
- In case of any obstacle for core drilling that doesn't allow to reach necessary depth, the auger drilling with similar diameter can be used before mounting of the pipe with core drilling.
- The pipe is filled with non-shrinking concrete M300 or equivalent.
- The Principal representative has to be invited to observe the Benchmark installation process.

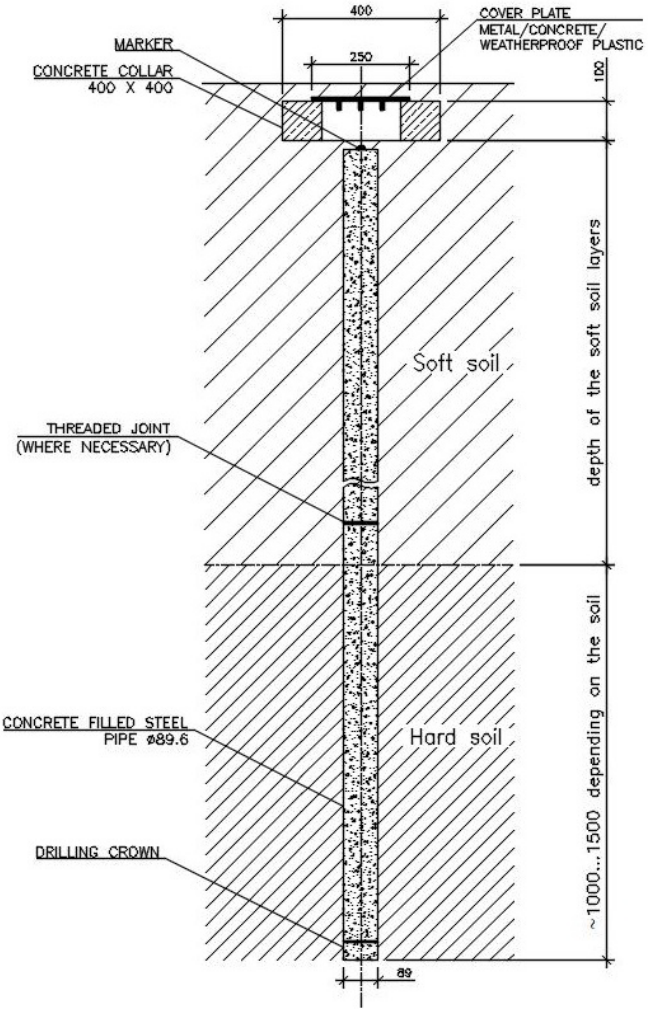


Figure A8-3. Benchmark Type 4

Crown

Annex 9. Locations of designed CP0 Benchmarks

Queue No	RB Point Number	Benchmark type	*L-EST97*		*EUREF-EST97*		Installable external elements								Notes on benchmark maintenance	Sketch	
			x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	cover plate	concrete collar	protective dome	sign post	identification label	earthworks mound	fence		update	new
1	EE-CP0-30	type No 2	6476349.22	539242.72	58.425740	24.671677		*	*	*	*	*	*		the existing benchmark must be removed prior to installation	*	
2	EE-CP0-32	type No 5	6463317.00	539349.00	58.308727	24.671264		*	*	*	*	*	*	*	deforestation on the northern side of the northern ditch	*	
3	EE-CP0-42	type No 2	6421651.00	529850.00	57.935391	24.503886		*	*	*	*	*	*	*		*	
						Total		3	3	3	3	3	3	2	**Total**	3	

Queue No	RB Point Number	Benchmark type	*LKS-92 TM*		*LKS-92*		Installable external elements							Notes on benchmark maintenance	Sketch	
			x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	cover plate	concrete collar	protective dome	sign post	identification label	earthworks mound	fence	update	new
1	LV-CP0-02	type No 2	405017.15	521068.20	57.786689	24.354325		*	*	*	*	*			*	
2	LV-CP0-03	type No 2	400870.75	523997.4	57.749299	24.403172		*	*	*	*	*	*			*
3	LV-CP0-05	type No 2	393248.63	524094.84	57.680830	24.404045		*	*	*	*	*	*		*	
4	LV-CP0-06	type No 2	391011.88	522656.04	57.660813	24.379709		*	*	*	*	*	*		*	
5	LV-CP0-08	type No 2	381044.39	526002.51	57.571101	24.434722		*	*	*	*	*			need to cut down the trees		*
6	LV-CP0-09	type No 2	373242.48	527052.35	57.500959	24.451407		*	*	*	*	*	*				*
7	LV-CP0-10	type No 2	374774.59	531221.44	57.514453	24.521167		*	*	*	*	*	*				*
8	LV-CP0-11	type No 2	365598.25	533819.87	57.431841	24.563269		*	*	*	*	*	*			*	
9	LV-CP0-14	type No 2	347496.89	527654.91	57.269659	24.458565		*	*	*	*	*	*			*	
10	LV-CP0-15	type No 2	343215.03	533726.15	57.230789	24.558649		*	*	*		*				*	
11	LV-CP0-16	type No 2	338582.02	535040.23	57.189074	24.579762		*	*	*	*	*	*			*	
12	LV-CP0-17	type No 2	339565.52	539588.24	57.197538	24.655162		*	*	*	*	*	*				*
13	LV-CP0-18	type No 2	330169.09	537865.50	57.113278	24.625228		*	*	*	*	*	*			*	
14	LV-CP0-21	type No 2	319972.43	537910.91	57.021679	24.624438		*	*	*	*	*	*		need to cut down the bushes	*	
15	LV-CP0-22	type No 2	318701.22	532805.09	57.010651	24.540178		*	*	*	*	*	*			*	
16	LV-CP0-23	type No 2	315315.63	529278.20	56.980474	24.481713		*	*	*	*	*	*			*	
17	LV-CP0-25	type No 2	306162.86	526072.18	56.898444	24.428023		*	*	*	*	*	*			*	
18	LV-CP0-34	type No 2	295167.23	504553.84	56.800373	24.074564		*	*	*	*	*	*				*
19	LV-CP0-35	type No 2	301665.62	511494.70	56.858633	24.188506		*	*	*	*	*	*			*	
20	LV-CP0-36	type No 2	300489.11	521332.56	56.847716	24.349739		*	*	*	*	*	*			*	
21	LV-CP0-38	type No 2	292064.83	514779.28	56.772290	24.241814		*	*	*	*	*	*			*	
22	LV-CP0-39	type No 2	287995.50	521796.42	56.735457	24.356278		*	*	*	*	*	*			*	
23	LV-CP0-40	type No 2	282993.66	519575.71	56.690620	24.319598		*	*	*	*	*	*				*
24	LV-CP0-42	type No 2	270559.38	518041.10	56.578973	24.293675		*	*	*	*	*	*				*
25	LV-CP0-44	type No 2	264844.26	514668.58	56.527746	24.238455		*	*	*	*	*		*			*
26	LV-CP0-45	type No 2	257685.25	513973.42	56.463449	24.226770		*	*	*	*	*	*				*
27	LV-CP0-47	type No 2	246264.12	517703.86	56.360714	24.286537		*	*	*	*	*	*			*	
28	LV-CP0-48	type No 2	240900.39	520996.89	56.312390	24.339406		*	*	*	*	*		*		*	
						Total		28	28	28	27	28	23	2	**Total**	18	10

Queue No	RB Point Number	Bench mark type	*LKS-94 TM*		*LKS-94*		Installable external elements							Notes on benchmark maintenance	Sketch	
			x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	cover plate	concrete collar	protective dome	sign post	identification label	earthworks mound	fence	update	new
1	LT-CP0-01	type No 2	6235489.41	514327.95	56.252817	24.231199		*	*		*	*	*		*	
2	LT-CP0-02	type No 2	6230881.59	520245.90	56.211211	24.326339		*	*		*	*	*		*	
3	LT-CP0-06	type No 2	6219769.95	509484.41	56.111733	24.152482		*	*		*	*	*		*	
4	LT-CP0-07	type No 2	6212326.31	507975.76	56.044894	24.128006		*	*		*	*	*		*	
5	LT-CP0-08	type No 2	6209261.00	512700.34	56.017256	24.203686		*	*		*	*	*		*	
6	LT-CP0-09	type No 2	6203665.03	509189.73	55.967067	24.147193		*	*		*	*	*			*
7	LT-CP0-10	type No 2	6200077.46	515672.78	55.934672	24.250823		*	*		*	*	*		*	
8	LT-CP0-11	type No 2	6193773.51	516128.34	55.878027	24.257738		*	*		*	*	*		*	
9	LT-CP0-13	type No 2	6183503.39	512629.85	55.785872	24.201354		*	*		*	*	*			*
10	LT-CP0-14	type No 2	6182270.44	508165.24	55.774891	24.130139		*	*		*	*	*	*	*	
11	LT-CP0-15	type No 2	6175796.61	517036.53	55.716503	24.271127		*	*		*	*	*		*	
12	LT-CP0-16	type No 2	6173375.84	513848.97	55.694858	24.220277		*	*		*	*	*		*	
13	LT-CP0-17	type No 2	6166670.45	515153.12	55.634581	24.240650		*	*		*	*	*			*
14	LT-CP0-18	type No 2	6163496.97	522331.92	55.605795	24.354398		*	*		*	*	*		*	
15	LT-CP0-19	type No 2	6158918.82	521388.77	55.564709	24.339077		*	*		*	*	*		*	
16	LT-CP0-20	type No 2	6152093.70	529831.61	55.502952	24.472182		*	*		*	*	*		*	
17	LT-CP0-21	type No 2	6146618.22	522082.38	55.454173	24.349093		*	*		*	*	*			*
18	LT-CP0-23	type No 2	6136705.54	519582.06	55.365225	24.308871		*	*		*	*	*			*
19	LT-CP0-24	type No 2	6130176.50	526330.13	55.306254	24.414694		*	*		*	*	*		*	
20	LT-CP0-25	type No 2	6126048.76	520204.48	55.269459	24.317922		*	*		*	*	*		*	
21	LT-CP0-30	type No 2	6108171.34	518623.70	55.108907	24.291872		*	*		*	*	*		*	
22	LT-CP0-31	type No 2	6105320.81	511771.81	55.083506	24.184372		*	*		*	*	*			*
23	LT-CP0-34	type No 2	6093558.57	512930.60	54.977799	24.201988		*	*		*	*	*			*
24	LT-CP0-36	type No 2	6087519.42	505800.90	54.923673	24.090494		*	*		*	*	*		*	
						Total		24	24		24	24	24	1	**Total** 17	7

Annex 10. Locations of designed CP0H Benchmarks

Queue No	RB Point Number	Benchmark type	*L-EST97*		*EUREF-EST97*		Installable external elements								Notes on benchmark maintenance	Sketch	
			x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	cover plate	concrete collar	protective dome	sign post	identification label	earthworks mound	fence		update	new
1	EE-CP0H-01	type No 2	6481313.52	541616.15	58.470088	24.713201		*	*	*	*	*	*	*		*	
2	EE-CP0H-02	type No 2	6480971.33	540251.67	58.467145	24.689759		*	*	*	*	*	*			*	
3	EE-CP0H-03	type No 2	6478501.97	539050.64	58.445084	24.668757		*	*	*	*	*	*			*	
4	EE-CP0H-04	type No 5	6476701.27	538210.11	58.428992	24.654063		*	*	*	*	*	*			*	
5	EE-CP0H-05	type No 2	6448526.61	543958.95	58.175502	24.747090		*	*	*	*	*	*			*	
6	EE-CP0H-07	type No 2	6443783.72	543045.98	58.133011	24.730697		*	*	*	*	*	*			*	
7	EE-CP0H-08	type No 2	6442718.05	543567.77	58.123392	24.739354		*	*	*	*	*	*			*	
8	EE-CP0H-09	type No 2	6415949.09	525157.19	57.884490	24.424062		*	*	*	*	*	*	*		*	
9	EE-CP0H-10	type No 2	6415226.58	522866.59	57.878127	24.385382		*	*	*	*	*		*		*	
						Total		9	9	9	9	9	8	3	**Total**	9	

Queue No	RB Point Number	Benchmark type	*LKS-92 TM*		*LKS-92*		Installable external elements								Notes on benchmark maintenance	Sketch	
			x [m]	*y* [m]	*B* [deg]	*L* [deg]	cover hatch	cover plate	concrete collar	protective dome	sign post	identification label	earthworks mound	fence		update	new
1	LV-CP0H-01	type No 2	409216.03	524007.29	57.824256	24.404175		*	*	*	*	*	*			*	
2	LV-CP0H-05	type No 2	369127.92	530722.57	57.463767	24.512129		*	*	*	*	*				*	
3	LV-CP0H-09	type No 2	359059.37	529749.46	57.373390	24.494688		*	*	*	*	*				*	
4	LV-CP0H-12	type No 2	345365.73	530658.36	57.250324	24.508101		*	*	*	*	*				*	
5	LV-CP0H-17	type No 2	334764.69	536207.16	57.154693	24.598513		*	*	*	*	*	*			*	
6	LV-CP0H-22	type No 2	322542.81	536741.72	57.044863	24.605557		*	*	*	*	*	*			*	
7	LV-CP0H-31	type No 2	313648.48	525888.38	56.965700	24.425771		*	*	*	*	*	*			*	
8	LV-CP0H-35	type No 2	310988.36	523435.84	56.941934	24.385190		*	*	*	*	*	*			*	
9	LV-CP0H-40	type No 2	298048.66	522345.03	56.825745	24.366124		*	*	*	*	*	*		the existing benchmark must be removed prior to installation	*	
10	LV-CP0H-52	type No 2	276340.45	516519.79	56.630966	24.269281		*	*	*	*	*				*	
						Total		10	10	10	10	10	6		**Total**	10	

Annex 11. Types of replaceable Benchmarks

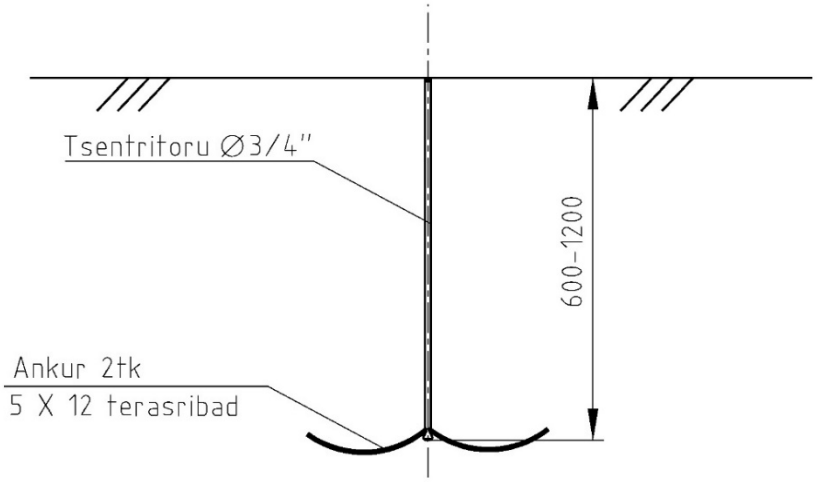


Figure A11-1. Benchmark Type 5071, which must be removed before installing EE-CP0-30

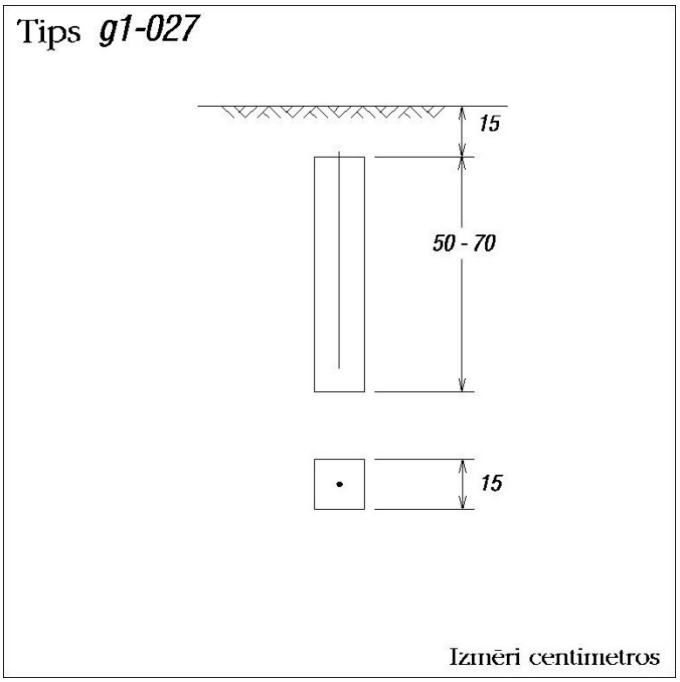


Figure A11-2. Benchmark Type g1-027, which must be removed before installing LV-CP0H-40

Annex 12. Geological conditions at the designed locations of the New Benchmarks

Estonia

CP0

Based on the available geological information, a special geological investigation was considered necessary at the design time for only the EE-CP0-32 location out of the three new CP0 locations.

EE-CP0-30

This New Benchmark will be installed in place of the existing Benchmark Bulli_B, coordinates L-EST97 [m] x =6476349.221 y= 539242.717, height EH2000 [m] = 14.5.

According to the previous studies of the area (REIB, work No. GE-1139, 2009), the geological profile from top to bottom is:

Layer 1 – fill and soil with a thickness of until 1 m

Layer 2 – medium-dense to dense dusty seabed sand, layer thickness approx. 2 m

Layer 3 – hard plastic loam, thickness unknown

Groundwater level is expected to be 1 - 1.5 m below the ground.

EE-CP0-32

Coordinates L-EST97 [m] x = 646331.0 y = 539349.0, height EH2000 [m] = 8.3 - 8.4.

According to the geotechnical survey carried out at the exact installation location (REIB, April 2024), the geological profile from top to bottom is:

Layer 1 – soil with a thickness of 0.6 m
Layer 2 – medium dense to dense fine sand, layer thickness 0.8 m
Layer 3 – tough plastic to soft sandy loam, layer thickness approx. 1.5 m
Layer 4 – tough plastic to semi-hard sandy loam, drilled up to 5m from the ground

Groundwater did not appear during drilling, although it was not dry season (end of April) when drilling was made. In addition, a 5.6 m deep cone penetration test (CPT) was performed, which measures the bearing capacity of the soil on a standard rod with a conical end hammered with a standard strength, the number of hits is determined for every 20 cm of soil penetration. The test shows poor bearing capacity up to 0.6 m (1…2 hits), very good at a depth of 0.8…1.2 m (10…11 hits), weak at a depth of 1.4…2 m (1…3 hits), average at depths of 2.0 to 3.8 m (3…5 hits) and good at depths of 3.8 to 4.6 m (7…8 hits), after that bearing capacity becomes very good (11…15 hits).

EE-CP0-42

Coordinates L-EST97 [m] x = 6421651.0 y = 529850.0, height EH2000 [m] = 21.5.

According to the survey, the sand deposit located less than 1 km from the installation site (Maavarauuringud OÜ work no. 19-254, 2019) and the Estonian geologic quaternary soil map (that confirms similar conditions between the survey location and the point location), the geological profile from top to bottom is:

Layer 1 – soil up to 0.5 m thick
Layer 2 – fine to mixed-grained sand, contains gravel grains, layer thickness 2.3-7.7 m
Layer 3 – dense loam moraine, layer thickness up to 1.0 m

Groundwater level is expected to be 1-1.5 m below the ground level.

CP0H

For the construction of nine New CP0H Benchmarks in Estonia, the geologic conditions were examined. For EE-CP0H-01, EE-CP0H-02, EE-CP0H-05, EE-CP0H-06, EE-CP0H-07, EE-CP0H-08 and EE-CP0H-10 the existing geological data was considered sufficient during the design process to ensure the installation and subsequent stability of the Type 2 Benchmark. For EE-CP0H-03 and EE-CP0H-04 a dedicated geological investigation was performed on 26.11.2024 by SIA VentEco.

EE-CP0H-03

Coordinates L-EST97 [m] x = 6478502.3 y = 539048.3.

From, m	Till, m	Lithological description	Layer thickness, m
0.0	0.2	Topsoil	0.2
0.2	0.7	Sand, coarse grained with pebbles, brown	0.5
0.7	0.9	Moraine (clayey sand), brown	0.2
0.9	1.1	Clay, stiff, brown	0.2
1.1		Silt, firm, gray	

Groundwater level measured immediately after drilling: no groundwater was detected.

Having reached a depth of 1.2 m, it was not possible to drill deeper with a hand auger and gasoline hand drill due to the very dense sediments.

Quaternary cover in the area is rather thin. Accordingly, to description of Estonian landscapes regions after *E.Varep*, the point is located on the border of North and West Estonia. Accordingly, to data from the Republic of Estonia Land and Spatial Development Board, the Quaternary cover in the area of interest is < 1 m. The groundwater depth in this area of distribution of glacial lake sediments (pebbles and cobbles, gravel, sand, siltstone, clay sand, sandy loam, clay) should be 2 - 10 m.

Photo A12-1. *Fieldwork 26.11.2024. (D.Titāns, AS „VentEko")*

EE-CP0H-04

Coordinates L-EST97 [m] x = 6476701.3 y = 538210.1.

From, m	Till, m	Lithological description	Layer thickness, m
0.0	0.2	Topsoil	0.2
0.2	2.2	Clay, stiff, brown	2.0

Groundwater level measured immediately after drilling: 2.0 m from ground surface.

It had recently snowed in the area, the snow had melted on the day of the fieldwork, and therefore groundwater was detected. In warmer period groundwater could be deeper approx. 3 – 4 m from ground surface.

Quaternary cover in the area is rather thin. Accordingly to description of Estonian landscapes regions after *E.Varep*, the point is located on the border of North and West Estonia. Accordingly to data from the Republic of Estonia Land and Spatial Development Board, the Quaternary cover in the area of interest is < 1 m. The groundwater depth in this area of distribution of glacial lake sediments (pebbles and cobbles, gravel, sand, siltstone, clay sand, sandy loam, clay) should be 2 - 10 m. EE-CP0H-04 Benchmark must be constructed using Benchmark Type 4, the depth of the mark is estimated to be 5…6 meters.

Photo A12-2. *Fieldwork 26.11.2024. (D.Titāns, AS „VentEko")*

Latvia

CP0

For designed CP0 Benchmarks LV-CP0-08, LV-CP0-10, LV-CP0-25, LV-CP0-38, LV-CP0-42 and LV-CP0-48, available geological data from generic geological maps of Latvia and from Rail Baltica mainline boreholes in Benchmark vicinity weas used. This data was considered sufficient during the design process to ensure the installation and subsequent stability of the Type 2 Benchmark.

In other locations, where geologic conditions were unknown or doubtful, the site geological investigation has been performed. On 22.04.2024, SIA VentEco performed geotechnical surveys at the locations of LV-CP0-05, LV-CP0-16, LV-CP0-17 and LV-CP0-36. The drilling was performed to a depth of 2 m with an Eijkelkamp hand auger. Based on the results, it can be concluded that the soil layers at the four locations are good enough for the installation of the Benchmarks and their subsequent stability. Recommendation - construction work in some locations should take place during the period July - August, when the groundwater level is lower.

On 10 and 11.07.2024, SIA Geodesists performed geotechnical investigations at locations LV-CP0-11, LV-CP0-21, LV-CP0-22, LV-CP0-18, LV-CP0-47, LV-CP0-44, LV-CP0-42, LV-CP0-40 and LV-CP0-35. The drilling was carried out to a depth of 2.1 m with a hand drill.

LV-CP0-05

Coordinates LKS-92 TM [m] x = 393248.6 y = 524094.8, height LAS-2000,5 [m] = 8.3.

From, m	Till, m	Lithological description	Layer thickness, m
0.0	0.2	Topsoil	0.2
0.2	0.4	Sand, coarse with pebble (diameter 5 mm) content, medium dense, greyish brown with organic content	0.2
0.4	0.8	Sand, coarse, dense, with pebble content, brownish yellow	0.4
0.8	2.0	Moraine, clayey sand, very dense, gravel and minor cobbles, brown	1.2

Groundwater level measured immediately after drilling: 1.88 m from the top of the borehole.

Geomorphologically, the territory is located in Coastal lowland – Vidzeme coast. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the thickness of Quaternary sediments in this area is less than 10 m, but next to *Svētciems* (located ~ 5.5 km north of the study site), the thickness of Quaternary sediments is 77 - 199 m. The Quaternary layer consists predominantly of sand, clayey silt and moraine.

LV-CP0-05 is located between agricultural land and gravel road. Clayey sand (moraine) layer is good enough for installing the Benchmark and ensuring its subsequent stability. Moraine sediments beneath it do not cause the Benchmark to sink.

The groundwater level at the current location is expected to be approximately 20 – 40 % deeper during the warmer period of year. Considering the geological conditions, the territory may be too wet during a period of prolonged precipitation, but the moraine layer, located at a depth of 0.8 m, is considered stable for the

construction of the Benchmark. There is a functioning drainage system nearby - reclamation ditch, built in 1977.

Photo A12-3. *Fieldwork 22.04.2024. (D. Titāns, AS„VentEko")*

LV-CP0-11

Coordinates LKS-92 TM [m] x = 365598.2 y = 533819.9, height LAS – 2000,5 [m] = 40.9.

No groundwater level detected 5 min after completing borehole.

Geomorphologically, the territory is located in Latvian central lowlands – Metsepoles plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the thickness of Quaternary sediments in this area is about 15 – 40 m. The Quaternary layer consists predominantly of sand, gravel moraine and clayey sandy sediments. Clay and sandstone can be found in deeper layers. Metsepoles plain consists of weakly infiltrating sediments.

LV-CP0-11 is located between agricultural land and road. Clayey sand (moraine) layer is good enough for installing the Benchmark and ensuring its subsequent stability. Moraine sediments beneath it do not cause the Benchmark to sink. The groundwater level during the warmer period of the year is expected to be deeper than 2.15 m. Considering the geological conditions, the territory may be too wet during a period of prolonged precipitation, but the moraine layer, located at a depth of 1.0 m, is considered stable for the Benchmark. There is a functioning drainage system nearby.

From, m	Till, m	Lithological description	Layer thickness, m
0.00	0.20	Topsoil	0.20
0.20	0.60	Fine gravel 	0.40
0.60	1.00	Sand medium grained	0.40
1.00	2.15	Clayey sand, very dense, brownish red 	1.15

Photo A12-4. *Fieldwork 10.07.2024. (I. Nudiens, "SIA Ģeodēzists")*

LV-CP0-16 (No. during design 16_2)

Coordinates LKS-92 TM [m] x = 338582.1 y = 535040.3, height LAS-2000,5 [m] = 32.8.

From, m	Till, m	Lithological description	Layer thickness, m
0.0	0.2	Topsoil	0.2
0.2	0.5	Sand, medium grained, medium dense, brown	0.3
0.5	1.1	Sand, medium grained, dense, brown	0.6
1.1	2.0	Clayey sand, very dense, brown, wet from 1.3 m, water saturated from 1.55 m	0.9

Groundwater level measured immediately after drilling: 1.55 m from the top of the borehole.

Geomorphologically, the territory is located in Seaside lowlands in the Rigava plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 4 - 23 m. It mainly consists of glacial sediments – moraine, clay, sand and loam, with admixture of gravel, pebbles, rubble and interlayers of sand/gravel and glaciolimnic sediments – multi-grained sand.

Hydrogeological conditions are determined by the geological structure of the territory and hypsometric height. Groundwater is mostly tied up in sediments formed by glaciers - moraines in sandy loam and loamy sand (their filtration properties are very low). The static groundwater level is at a depth of 1 - 4 m below the ground surface.

LV-CP0-16_2 is located between agricultural land and gravel road. Dense clayey sand layer is good enough for installing the Benchmark and ensuring its subsequent stability. Clayey sand sediments beneath it does not cause the Benchmark to sink. The groundwater level at the current location is expected to be approximately 10 – 30 % deeper during the warmer period of year. Considering the geological conditions, the territory may be too wet during a period of prolonged precipitation, but the clayey sand layer, located at a depth of 1.1 m, is considered stable for installation of the Benchmark. There is a functioning drainage system, built in 1964, nearby.

The groundwater level (1.55) may cause problems when installing the Benchmark. Recommendation - installation of the Benchmark should take place during the period July - August, when the groundwater level is lower. Subsequent changes in groundwater levels should not affect or cause instability of the Benchmark.

Photo A12-5. *Fieldwork 22.04.2024. (D. Titāns, AS„VentEko")*

LV-CP0-17

Coordinates LKS-92 TM [m] x = 339565.5 y = 539588.2, height LAS-2000,5 [m] = 29.6.

From, m	Till, m	Lithological description	Layer thickness, m
0.0	0.2	Topsoil	0.2
0.2	0.7	Sand, medium grained, medium dense, greyish brown with organic content	0.5
0.7	1.2	Sand, medium grained, dense, brown	0.5
1.2	1.7	Sand, fine grained, dense, brownish yellow, wet ~1.5 m	0.5
1.7	2.0	Sand, medium grained with gravel and pebbles, water saturated, brown	0.3

Groundwater level measured immediately after drilling: 1.53 m from the top of the borehole.

Geomorphologically, the territory is located in Seaside lowlands in the Rigava plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 4 - 23 m. It mainly consists of glacial sediments – moraine, clay, sand and loam, with admixture of gravel, pebbles, rubble and interlayers of sand/gravel and glaciolimnic sediments – multi-grained sand.

Hydrogeological conditions are determined by the geological structure of the territory and hypsometric height. Groundwater is mostly tied up in sediments formed by glaciers - moraines in sandy loam and loamy

sand (their filtration properties are very low). The static groundwater level is at a depth of 1 - 4 m below the ground surface.

LV-CP0-17 is located between agricultural land and gravel road. The anchor of the Benchmark begins to rest on gravely sand. This layer is not the best for installation works, as it consists of sand and fine gravel, and therefore there is a possibility (at a depth of ~ 1.7 m) that the dug hole may overflow, and due to fluctuations in groundwater, the sides and base may not be stable enough.

The groundwater level at the current location is expected to be approximately 10 – 30 % deeper during the warmer period of year. Recommendation – installation of the Benchmark should take place during the period July - August, when the groundwater level is lower.

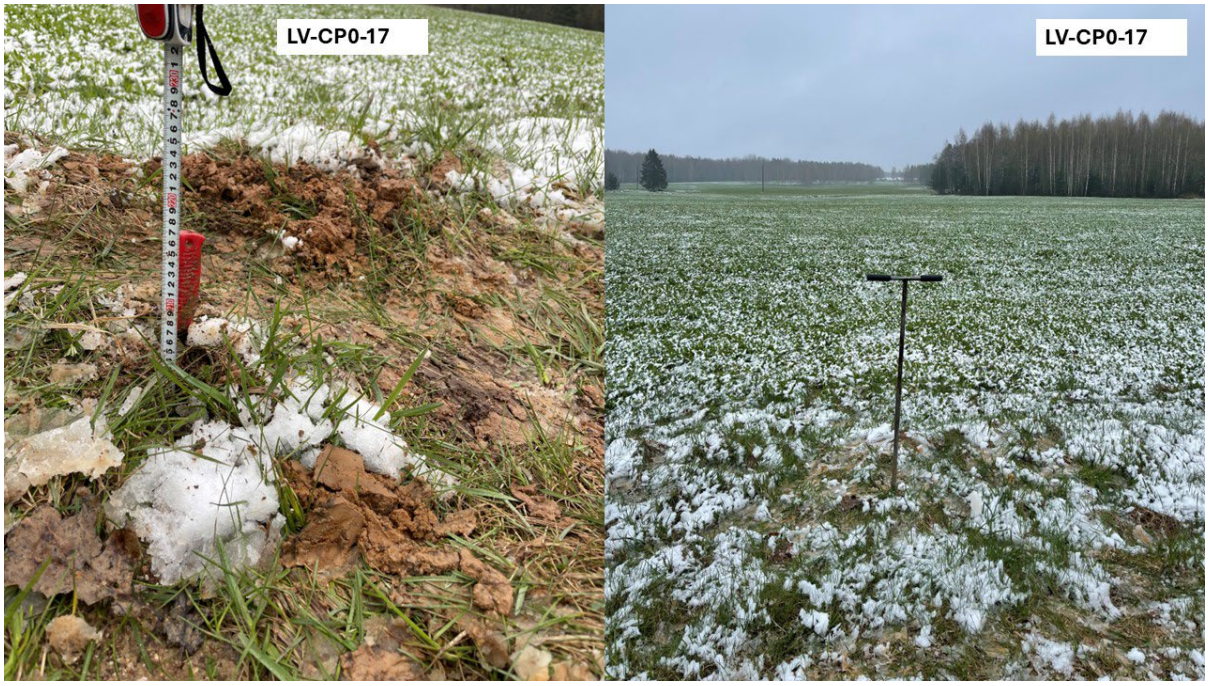


Photo A12-6. *Fieldwork 22.04.2024. (D. Titāns, AS„VentEko")*

LV-CP0-18

Coordinates LKS-92 TM [m] x = 330169.1 y = 537865.5, height LAS-2000,5 [m] = 35.3.

From, m	Till, m	Lithological description	Layer thickness, m
0.00	0.20	Topsoil	0.20
0.20	1.00	Sand, medium grained, loose, rusty brown 	0.80
1.00	2.10	Sand, medium grained, losse, gray, water saturated at ~ 1.9 m depth 	1.10

Groundwater level measured 5 min. after drilling: 1.85 m from the top of the borehole.

Geomorphologically, the territory is located in the Central Latvian lowlands in the Ropaži plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 9 - 20 m. It mainly consists of glacial sediments – sand with gravel, sand and clayey sand. Clay, siltstone silty clay, and sandstone occur in deeper layers.

LV-CP0-18 is located on a strip of land between roads. It should be noted that during long-term summer precipitation, the groundwater level in medium-grained sand may be closer to the ground, about 1.85+20 - 40%. The groundwater level, measured during the warmer part of the year, may be the lowest in the region. Recommendation – installation of the Benchmark should take place during the period July - August, when the groundwater level is lower. If installation is successful, changes in groundwater levels should not affect the stability of the Benchmark. There is a functioning drainage system nearby.

Photo A12-7. *Fieldwork 11.07.2024. (I. Nudiens, "SIA Ģeodēzists")*

LV-CP0-21

Coordinates LKS-92 TM [m] x = 319972.4 y = 537910.9, height LAS-2000,5 [m] = 40.7.

From, m	Till, m	Lithological description	Layer thickness, m
0.00	0.30	Topsoil	0.30
0.30	1.30	Sand, medium grained, dense, brown, wet 	1.00
1.30	2.10	Sand, medium grained, brown, water saturated at ~ 1.0 m depth 	0.80

Groundwater level measured 5 min after drilling: 1.32 m from the top of the borehole.

Geomorphologically, the territory is located in the Central Latvian lowlands in the Ropaži plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 3 - 10 m. It mainly consists of glacial sediments – sand with gravel, moraine, sand and aleurite. Dolomites, clay, marlstone, sandstone occur in deeper layers.

LV-CP0-21 is located between a meadow and road. It should be noted that during long-term summer precipitation, the groundwater level in medium-grained sand may be closer to the ground: 1.32+20 - 40%. The groundwater level, measured during the warmer part of the year, may be the lowest in the region. Recommendation – installation of the Benchmark should take place during the period July - August, when the groundwater level is lower. If installation is successful, changes in groundwater levels should not affect the stability of the Benchmark.

Photo A12-8. *Fieldwork 10.07.2024. (I. Nudiens, "SIA Ģeodēzists")*

LV-CP0-22

Coordinates LKS-92 TM [m] x = 318701.2 y = 532805.1, height LAS-2000,5 [m] = 20.4.

From, m	Till, m	Lithological description	Layer thickness, m
0.00	0.30	Topsoil	0.30
0.30	0.70	Sand, medium grained, rusty brown 	0.40
0.70	2.10	Sand, fine grained, very dense, brown, water saturated at ~ 1.9 m depth 	1.40

Groundwater level measured 5 min. after drilling: 1.80 m from the top of the borehole.

Geomorphologically, the territory of the works is located in the Central Latvian lowlands in the Ropaži plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 5 - 10 m. It mainly consists of glacial sediments – sand with gravel, sandy clay and sandy silt sand. Dolomites, clay, marlstone and sandstone occur in deeper layers.

LV-CP0-22 is located between village (small properties with gardens) and road. It should be noted that during long-term summer precipitation, the groundwater level in medium-grained sand may be closer to the ground:: 1.80+20 - 40%. Recommendation – installation of the Benchmark should take place during the period July - August, when the groundwater level is lower. If installation is successful, changes in groundwater levels should not affect the stability of the Benchmark. There is a functioning drainage system nearby.

Photo A12-9. *Fieldwork 11.07.2024. (I. Nudiens, "SIA Ģeodēzists")*

LV-CP0-35

Coordinates LKS-92 TM [m] x = 301665.2 y = 511494.0, height LAS-2000,5 [m] = 9.8.

From, m	Till, m	Lithological description	Layer thickness, m
0.00	0.30	Topsoil	0.30
0.30	2.10	Sand, fine grained, dense, light brown 	1.80

The groundwater level was not detected 5 minutes after the borehole was completed.

Geomorphologically, the territory of the works is located in Seaside lowlands in the Rigava plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 7 to 20 m. It mainly consists of glacial sediments – sand, moraine and clayey sand. Clay, marlstone and dolomites occur in deeper layers.

LV-CP0-35 is located between unbuilt property and road. Sand layer is good enough for installing the Benchmark and ensuring its subsequent stability. The sandy sediments beneath it do not cause the Benchmark to sink. The groundwater level was not reached on 11.07.2024. In the same time, considering the geological conditions, in a period of prolonged precipitation the groundwater level may be at >1.5 m depth, but the sand layer, located at a depth of 0.30 m, is considered stable enough for the Benchmark.

Photo A12-10. *Fieldwork 11.07.2024. (I. Nudiens, "SIA Ģeodēzists")*

LV-CP0-36 (No. during design 36_2)

Coordinates LKS-92 TM [m] x = 300489.1 y = 521332.56, height LAS-2000,5 [m] = 28.5.

From, m	Till, m	Lithological description	Layer thickness, m
0.0	0.2	Topsoil	0.2
0.2	0.8	Embankment, coarse sand with breakstones, brown	0.6
0.8	1.6	Sand, coarse, dense with pebbles, brown	0.8
1.2	1.7	Sand, fine grained, dense, brownish-yellow, wet ~1.5m	0.5
1.7	2.0	Moraine, clayey sand, very dense, gravel and minor cobbles, brown	0.3

Groundwater level was not detected.

Charcoal was found at a depth of 0.2 to 1.7 m depth (figure A3-11) – this indicates that in previous time, here was a forested area that has burned over time.

Photo A12-11. *Fieldwork 22.04.2024. (D. Titāns, AS„VentEko")*

Geomorphologically, the territory is located in Central Latvian lowlands in the Ropaži plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 4 - 14 m. It mainly consists of glacial sediments – sand, moraine and silty/clayey sediments. Dolomites, clay, marlstone and sandstone occur in deeper layers.

The depth of the groundwater level strongly depends on the geomorphological and runoff conditions, evaporation plays a secondary role. Groundwater could be detected > 2 m deep.

LV-CP0-36_2 is located between highway and dam (Riga hydroelectric power station). The anchor of the Benchmark begins to rest on moraine (clayey sand) at a depth of 2 m. This layer is good enough for installing the Benchmark and ensuring its subsequent stability. The groundwater level does not prevent installation work. During the rainy season, groundwater should not accumulate in the area.

Photo A12-12. *Fieldwork 22.04.2024. (D.Titāns, AS„VentEko")*

LV-CP0-40

Coordinates LKS-92 TM [m] x = 282995.5 y = 519576.7, height LAS-2000,5 [m] = 26.6.

From, m	Till, m	Lithological description	Layer thickness, m
0.00	0.15	Topsoil	0.15
0.15	2.10	Sand, fine, with small pebbles, brown 	1.95

The groundwater level was not detected after the borehole was completed.

Geomorphologically, the territory is located in the Central Latvian lowlands in the Upmales hilly plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 10 - 20 m. It mainly consists of glacial sediments – clayey sand and sand. Clay, marlstone and dolomites occur in deeper layers.

LV-CP0-40 is located between agricultural land (grassland) and road. Fine sand (with pebbles) layer is good enough for installing the Benchmark and ensuring its subsequent stability. Sediments beneath it does not cause the Benchmark to sink. The groundwater level on 11.07.2024. has not been reached. However, during periods of prolonged precipitation, the groundwater level may be greater than 1.5 m, but the sand layer starting at a depth of 0.15 m is considered sufficiently stable for the Benchmark.

Photo A12-13. *Fieldwork 11.07.2024. (I. Nudiens, "SIA Ģeodēzists")*

LV-CP0-42

Coordinates LKS-92 TM [m] x = 270559.4 y = 518041.1, height LAS-2000,5 [m] = 9.8.

From, m	Till, m	Lithological description	Layer thickness, m
0.00	0.20	Topsoil	0.20
0.20	2.00	Sand, fine, rusty brown, dense 	1.80
2.00	2.10	Sand, medium grained with clay admixture, brown, wet at the bottom of the borehole 	0.10

The groundwater level was not detected 5 minutes after the borehole was completed.

Geomorphologically, the territory is located in the Central Latvian lowlands in the Zemgales plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 2 - 10 m. It mainly consists of glacial sediments – moraine, clayey sand and sand. Clay, marlstone, dolomites and sandstone occur in deeper layers.

LV-CP0-42 is located between agricultural land (grassland) and road. Sand layer with clay admixture is good enough for installing the Benchmark and ensuring its subsequent stability. The groundwater level 11.07.2024. has not been reached. However, during periods of prolonged precipitation, the groundwater level may be greater than 2.0 m, but the clayey sand layer starting at a depth of 0.20 m is considered sufficiently stable for the Benchmark. There is a functioning drainage system nearby.

Photo A12-14. *Fieldwork 11.07.2024. (I. Nudiens, "SIA Ģeodēzists")*

LV-CP0-44

Coordinates LKS-92 TM [m] x = 264844.3 y = 514668.6, height LAS-2000,5 [m] = 26.9.

From, m	Till, m	Lithological description	Layer thickness, m
0.00	0.30	Topsoil	0.30
0.30	0.60	Sand, fine, brown 	0.30
0.60	2.05	Clayey sand (moraine), fine, dense, brown 	1.45
2.05	2.10	Clay, dense, brownish gray 	0.05

The groundwater level was not detected 5 minutes after the borehole was completed.

Geomorphologically, the territory is located in the Central Latvian lowlands in the Zemgales plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 3 - 10 m. It mainly consists of glacial sediments – moraine, clayey sand and sand. Clay, marlstone, dolomites and sandstone occur in deeper layers.

LV-CP0-44 is located between dich, agricultural land and road. Clayey sand (moraine) layer is considered stable for the construction of the Benchmark. The groundwater level 11.07.2024. has not been reached. However, during periods of prolonged precipitation, the groundwater level may be greater than 2.0 m, but the clayey sand layer starting at a depth of 0.60 m is considered sufficiently stable for the Benchmark. There is a functioning drainage system nearby.

Photo A12-15. *Fieldwork 11.07.2024. (I. Nudiens, "SIA Ģeodēzists")*

LV-CP0-47

Coordinates LKS-92 TM [m] x = 246264.1 y = 517703.9, height LAS-2000,5 [m] = 28.8.

From, m	Till, m	Lithological description	Layer thickness, m
0.00	0.10	Topsoil	0.10
0.10	1.60	Clayey sand, loose, brown 	1.50
1.60	1.95	Clayey sand (moraine), dense, brown, not possible to drill deeper than 1.95 m with hand auger 	0.35

The groundwater level was not detected 5 minutes after the borehole was completed.

Geomorphologically, the territory is located in the Central Latvian lowlands in the Zemgales plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the upper layer consists of Quaternary sediments with a total thickness of 15 - 25 m. It mainly consists of glacial sediments – moraine and clayey sand. Clay, marlstone, dolomites and sandstone occur in deeper layers.

LV-CP0-47 is located between agricultural land and road. Clayey sand (moraine) layer is good enough for installing the Benchmark and ensuring its subsequent stability. The groundwater level 11.07.2024. has not been reached. However, during periods of prolonged precipitation, the groundwater level may be greater than 2.0 m, but the clayey sand layer starting at a depth of 0.10 m is considered sufficiently stable for the Benchmark.

Photo A12-16. *Fieldwork 11.07.2024. (I. Nudiens, "SIA Ģeodēzists")*

CP0H

For designed CP0 Benchmark LV-CPOH-52, available geological data from generic geological maps of Latvia and from Rail Baltica main line boreholes in Benchmark vicinity were used. These data were considered sufficient during the design process to ensure the installation and stability of the Type 2 Benchmarks.

In other locations, where geological conditions were unknown or doubtful, the geological surveys were carried out by SIA VentEco on 25 and 26.11.2024. The drilling was performed to a depth of 2.2 m with an Eijkelkamp hand auger.

General recommendation – installation of Benchmark in some locations should take place during the period from July to August, when the groundwater level is lower.

LV-CP0H-52 (No. during design LV-CP0H-15-1)

Coordinates LKS-92 TM [m] x = 276367.6 y = 516510.5.

From, m	Till, m	Lithological description	Layer thickness, m
0.0	0.3	Topsoil	0.3
0.3	0.9	Sand, medium grained, brown	0.6
0.9	1.1	Moraine, clayey sand, brown	0.2
1.1	1.7	Sand, medium grained, yellow	0.6

1.7	2.2	Moraine, clayey sand, brown	0.5

Groundwater level measured immediately after drilling: no groundwater was detected.

Geomorphologically, the territory of the works is in Central Latvian Lowland – Upmales hilly plain. According to the Quaternary geological map of Latvia at scales 1:50 000 and 1:200 000, the thickness of the Quaternary sediments in this area ranges from 10 to 20 m. The Quaternary layer consists mostly of sandy loam, loam and clayey moraine.

The depth of the groundwater level strongly depends on the geomorphological and runoff conditions, evaporation plays a secondary role. Groundwater could be detected > 2.5 m deep from ground surface (it depends on season).

LV-CP0H-15-1 is located next to road V9. There is a ditch right next to it. The anchor of the Benchmark begins to rest on moraine (clayey sand). This layer is good enough for installing the Benchmark and ensuring its subsequent stability. The groundwater level will not affect the installation work. During the rainy season, groundwater should not accumulate in the area. There is a functioning drainage system nearby, built in 1972.

Photo A12-17. *Fieldwork 25.11.2024. (D. Titāns, AS„VentEko")*

LV-CP0H-22 (No. during design LV-CP0H-46-1)

Coordinates LKS-92 TM [m] x = 322543.5 y = 536743.3.

From, m	Till, m	Lithological description	Layer thickness, m
0.0	0.1	Topsoil	0.1
0.1	0.3	Sand, medium grained, brownish yellow	0.2
0.3	0.8	Sand, medium grained, gray	0.5
0.8	2.15	Sand, medium grained, brown	1.35

Groundwater level measured immediately after drilling: 1.40 m from ground surface.

Geomorphologically, the territory of the works is in Central Latvian Lowland – Ropažu plain. According to the data from Quaternary – Geological Map of Latvia at a scale of 1:50 000 and 1:200 000 the thickness of the Quaternary sediments in this area is in range from 20 till 35 m. Usually Quaternary layer mostly consist with sand, clayey sand and moraine. The depth of the groundwater level strongly depends on the geomorphological and runoff conditions, evaporation plays a secondary role. The groundwater level in the current place is expected to be deeper in warmer period of year (approximately + 20 – 40 %). Sand layer is good for groundwater infiltration into deeper layers.

LV-CP0H-46-1 is located in a forested area next to forest gravel road. The anchor of the Benchmark begins to rest on sand sediments. This layer is good enough for installing the Benchmark and ensuring its subsequent stability. During the installation of the Benchmark, groundwater can cause problems due to its high level (1.4 m). Recommendation – installation of the Benchmark should take place during the period July - August, when the groundwater level is lower. Subsequent changes in groundwater levels should not affect the stability of the Benchmark.

Photo A12-18. *Fieldwork 26.11.2024. (D. Titāns, AS„VentEko")*

Lithuania

Geological investigation has been done in all 24 new Benchmark locations. The drilling was done to a depth of 2.5 m using motorized hand auger. All the sites are in a dry environment - despite investigation drilling in the spring, no ground water was detected in any of the boreholes.

LT-CP0-01

Coordinates LKS94 TM [m] x = 6235489.4 y = 514327.9.

Photo A12-19. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-1 (from top to bottom):

- Soil, thickness 0.1 m
- Clayey sand, gravel, dense, thickness 1.4 m
- Thick and hard moraine

Groundwater level has not been reached.

According to Quaternary Geological Map of Lithuania, 1:100 000, in this location glacial deposits (main moraine) are present, which corresponds to Nemunas (glacier) age (g III bl).

Geologic conditions in LT-CP0-01 location: the deposits of moraine form thick and hard layers that are good enough for point installation and stability. The moraine beneath clayey gravel layer does not cause any construction point to sink. The groundwater level is unknown, but it's deeper than 2.7 m. The drainage is fine, as there are no interlayers of pure clay; some water could accumulate during the wet season, but it shouldn't cause any issues.

LT-CP0-02

Coordinates LKS94 TM [m] x = 6230881.6 y = 520245.9.

Photo A12-20. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-2 (from top to bottom):

- Soil, thickness 0.20 m
- Clay with some pockets of clayey sand, thickness 0.4 m
- Clay

Groundwater level has not been reached.

According to Quaternary Geological Map of Lithuania, 1:100 000, in this location limnoglacial deposits are present, which corresponds to Nemunas (glacier) age (lg III bl).

Geologic conditions in LT-CP0-02 location: the limnoglacial clay deposits create robust layers suitable for stable point installation. Constructions located on the clay deposits will not result in any sinking of this point. While the groundwater level remains unidentified, it is deeper than 2.7 meters. Drainage is poor since there are almost pure clay layers; some water may collect during the wet season, but it is unlikely to pose any problems after the installation.

Recommendation for construction:

To secure vertical stability for the Benchmark it is recommended to add an additional rubble pad under the cylindric base of Benchmark. Specification of rubble pad:

- Rubble fraction 3-5 cm
- Pad diameter 60 cm, centered
- Hight 30 cm
- Tamped

LT-CP0-06

Coordinates LKS94 TM [m] x = 6219770.0 y = 509484.4.

Photo A12-21. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-6 (from top to bottom):

- Soil, thickness 0.25 m
- Sandy clay with some mixt gravel, thickness 1.2 m
- Clayey moraine

Groundwater level has not been reached.

Based on the Quaternary Geological Map of Lithuania at a scale of 1:100 000, the area in question contains sandy clay marginal glacial formations that corresponding to the Nemunas glacier age (gt III bl3).

Geologic conditions in LT-CP0-06 location: the robust layers formed by the glacial sandy clay deposits are suitable for stable point installation. Structures situated on these deposits are unlikely to experience any movements. Although the groundwater level is not determined, it is known to be deeper than 2.7 meters. Some water accumulation may occur during the wet season, but it is not expected to cause issues after installation.

LT-CP0-07

Coordinates LKS94 TM [m] x = 6212326.3 y = 507975.8.

Photo A12-22. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-7 (from top to bottom):

- Soil, thickness 0.40 m
- Sandy clay with some pockets of gravel and pure clay, thickness 1.0 m
- Clay

Groundwater level has not been reached.

According to Quaternary Geological Map of Lithuania, 1:100 000, in this location limnoglacial deposits are present, which corresponds to Nemunas (glacier) age (lg III bl).

Geologic conditions in LT-CP0-07 location: the sturdy layers formed in glacial lakes are ideal for secure point installation and structures situated on these clay deposits are unlikely to experience any sinking. Though the groundwater level remains unknown, it lies deeper than 2.7 meters. However, drainage may be hindered due to the predominance of nearly pure clay layers. While some water accumulation may happen during the wet season, it shouldn't pose significant issues after point installation.

Recommendation for construction:

To secure vertical stability for the Benchmark it is recommended to add an additional rubble pad under the cylindric base of Benchmark. Specification of rubble pad:

- Rubble fraction 3-5cm
- Pad diameter 60 cm, centered
- Hight 30 cm
- Tamped

LT-CP0-08

CoordinatesLKS94 TM [m] x = 6209261.0 y = 512700.3.

Photo A12-23. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-8 (from top to bottom):

- Soil, thickness 0.2 m
- Clayey sand, thickness 0.7 m
- Sandy clay moraine

Groundwater level has not been reached.

In this point glacial main moraine deposits are present (Nemunas (glacier) age, g III bl, Quaternary Geological Map of Lithuania, 1:100 000).

Geologic conditions in LT-CP0-08 location: the moraine deposits create substantial and durable layers suitable for point installation and stability, no sinking of the construction should be expected. Stability is also increased because of the depth of the groundwater level, which is deeper than 2.7 meters. Drainage is good, some water may accumulate during construction if it happens in the wet season, but it will not create any difficulties.

LT-CP0-09

Coordinates LKS94 TM [m] x = 6203665.0 y = 509189.7.

Photo A12-24. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-9 (from top to bottom):

- Soil, thickness 0.35 m
- Clayey sand, thickness 1.5 m
- Thick and hard clay and sandy clay moraine

According to Quaternary Geological Map of Lithuania, 1:100 000, in this location glacial deposits (main moraine) are present (Nemunas (glacier) age (g III bl)), sandy clay and clayey sand layers could be expected.

Geologic conditions in LT-CP0-09 location. Moraine deposits create dense, sturdy layers suitable for stable point installation. The moraine sediments do not compromise the stability of construction points. Although the groundwater level hasn't been reached and remains unidentified, it is over 2.7 meters. Drainage is effective as there are no pure clay interlayers.

LT-CP0-10

Coordinates LKS94 TM [m] x = 6200077.5 y = 515672.8.

Photo A12-25 *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-10 (from top to bottom):

- Soil, thickness 0.15 m
- Sandy clay, course, thickness 0.5 m
- Gravel rich clay

Groundwater level has not been reached.

Based on Quaternary Geological Map of Lithuania, 1:100 000, in this location limno-glacial (lg III bl) or glacial (main moraine) (g III bl) deposits could be present, both corresponding to Nemunas (glacier) age. In the case of LT-CP0-10 it is expected that origin of main moraine is more likely.

Geologic conditions in LT-CP0-10 location: the glacial (main moraine) sandy clay deposits create strong and stable layers and foundation. The drainage is really good with high content of gravel present, and no water accumulation problems should be expected during or after installation.

LT-CP0-11

Coordinates LKS94 TM [m] x = 6193773.5 y = 516128.4.

Photo A12-26. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-11 (from top to bottom):

- Soil, thickness 0.1 m
- Sandy clay, 0.2 m
- Sand mixt with gravel, 1.0 m
- Sandy clay

Groundwater level has not been reached.

According to Quaternary Geological Map of Lithuania (1:100 000), the area in question contains sandy alluvial formations that corresponds to post-glacial age (a III bl).

Geologic conditions in LT-CP0-11 location: the deposit layers present in the location are stable due to the high content of fine sand and content of clay. Structures situated on these deposits are unlikely to experience any movements as the groundwater level should be expected to be deeper than 2.7 meters and no water accumulation at any point should be present.

LT-CP0-13

Coordinates LKS94 TM [m] x = 6183690.0 y = 517964.5.

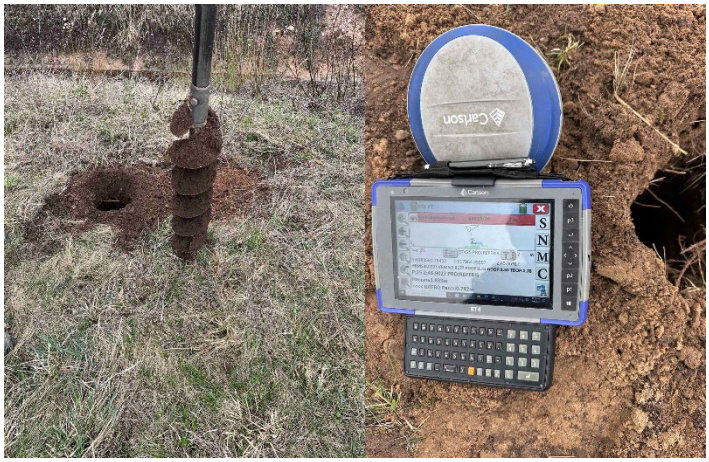


Photo A12-27. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-13 (from top to bottom):

- Soil, thickness about 0.20 m
- Morain rich in gravel, sand, and clay, dense

Based on Quaternary Geological Map of Lithuania, 1:100 000, in this location glacial main moraine deposits rich in sandy and sand are present, which corresponds to Nemunas (glacier) age (g III bl).

Geologic conditions in LT-CP0-13 location: the sturdy and heavy moraine layers are ideal for secure point installation and structures situated on these clay deposits are unlikely to experience any sinking. The groundwater level remains unknown, it lies deeper than 2.7 meters; drainage is fine due to high content of gravel and sand in the moraine, and it shouldn't pose any issues.

LT-CP0-14

Coordinates LKS94 TM [m] x = 6182263.4 y = 508202.7.

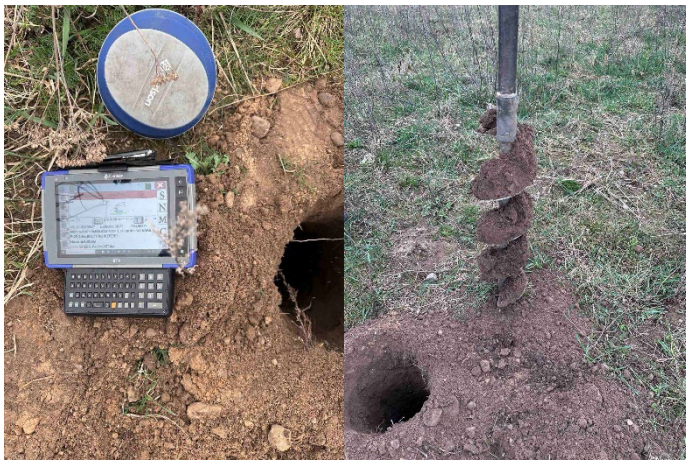


Photo A12-28. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-14 (from top to bottom):

- Soil, thickness 0.15 m
- Sand mixt with gravel, thickness 1.7 m
- Coarse sand

In this point Holocene alluvial sands are present (a IV), which could interlay with peat (Quaternary Geological Map of Lithuania, 1:100 000).

Geologic conditions in LT-CP0-14 location: the alluvial deposits create substantial and durable layers with high stability, no sinking or soil movements of this point should be expected. Stability is also increased because of the depth of the groundwater level, which is deeper than 2.7 meters. Drainage is very good; no water should accumulate through year.

LT-CP0-15

Coordinates LKS94 TM [m] x = 6175796.6 y = 517036.5.

Photo A12-29. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-15 (from top to bottom):

- Soil, thickness 0.3 m
- Sandy clay, course, thickness 1.5 m
- Heavy, gravel rich clay

Based on Quaternary Geological Map of Lithuania, 1:100 000, in this location post-ice age (a III bl) or glacial (main moraine) (g III bl) deposits could be present. In the case of LT-CP0-15 judging by the composition of the deposits, it is more likely the origin of the main moraine.

Geologic conditions in LT-CP0-15 location: the glacial (main moraine) gravel rich clay deposits create strong and stable layers and foundation. The drainage is good, no water accumulation problems should be expected during or after installation. The exact ground water levels are unknown, but it is likely that it's more than 2.7 meters.

LT-CP0-16

Coordinates LKS94 TM [m] x = 6173375.2 y = 513849.0.

Photo A12-30. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-16 (from top to bottom):

- Soil, thickness 0.20 m
- Course sandy clay, thickness 1.4 m
- Clayey sand

The groundwater level has not been reached, so it is deeper than 2.7 m.

According to Quaternary Geological Map of Lithuania (1:100 000) in this location glacial (main moraine) deposits are present, which corresponds to Nemunas (glacier) age (g III bl). Geologic conditions in LT-CP0-16 location: the sturdy layers formed by the moraine clays and clayey sand deposits are ideal for secure point installation. Structures situated on these clay deposits are unlikely to experience any sinking. Drainage is effective due to the significant clay content, although some water may accumulate during the wet season, it shouldn't cause any issues after installation.

LT-CP0-17

Coordinates LKS94 TM [m] x = 6166670.4 y = 515153.1.

Photo A12-31. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-17 (from top to bottom):

- Soil, some content of sand, thickness 1.20 m
- Clayey sand, rich in organic matter

Based on the Quaternary Geological Map of Lithuania at a scale of 1:100 000, the area in question contains clayey sand main moraine formations that corresponds to the Nemunas glacier age (g III bl). Due to the thick coverage of plants and possibly previously agricultural activity the soil layer is rather thick, mixed.

Geologic conditions in LT-CP0-17 location: the sturdy layers composed of clayey and sandy deposits are well-suited for stable point installation. Structures positioned on these deposits are unlikely to undergo any shifts. While the groundwater level remains unspecified, it is established to lie deeper than 2.7 meters. No water should gather during the year in this location.

LT-CP0-18

Coordinates LKS94 TM [m] x = 6163497.0 y = 522331.9.

Photo A12-32. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-18 (from top to bottom):

- Soil, thickness 0.1 m
- Sand with some gravel and clay content, thickness 1.4 m
- Coarse sand

The groundwater level is unknown, but it's deeper than 2.0 m.

According to Quaternary Geological Map of Lithuania, 1:100 000, in this location marginal glacial formations are present, which corresponds to Nemunas (glacier) age, Baltija stage (gt III bl2).

Geologic conditions in LT-CP0-18 location: the sandy deposits form heavy and solid layers that are good enough for suitable stability and ensure no sinking to any construction. The drainage is fine, as there are no interlayers of pure clay, and no water should accumulate during the wet season.

LT-CP0-19

Coordinates LKS94 TM [m] x = 6158918.8 y = 521388.8.

Photo A12-33. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-19 (from top to bottom):

- Soil, thickness 0.2 m
- Sandy clay, some sand and clay interlays

The groundwater level has not been reached, so it's more than 2.7 m.

According to Quaternary Geological Map of Lithuania (1:100 000), the area in question contains glacial deposits (main moraine) that corresponds to Nemunas age (g III bl).

Geologic conditions in LT-CP0-19 location: the deposit layers present in the location are stable due to the high content of clay that forms robust and stable layers. Structures situated on these deposits are unlikely to experience any movements as the groundwater level should be expected to be deeper than 2.7 meters; some small amount of water could accumulate during the wet season, but it should cause any issues.

LT-CP0-20

Coordinates LKS94 TM [m] x = 6152093.8 y = 529831.6.

Photo A12-34. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-20 (from top to bottom):

- Soil, thickness 0.1 m
- Sandy clay and coarse sand interlays, thickness 0.5 m
- Mixed course and fine sand

According to Quaternary Geological Map of Lithuania (1:100 000), the area in question contains clayey sand, clay, or sandy formations of glacial deposits (main moraine) that corresponds to Nemunas age (g III bl).

Geologic conditions in LT-CP0-20 location: as most of the Lithuania's Quaternary glacial deposits, the sandy deposits form heavy and solid layers that are good enough for suitable stability and ensure no sinking to any construction. The drainage is fine, as there are no interlayers of pure clay, and no water should accumulate during the wet season. The groundwater level should be expected to be lower than 2.7 m.

LT-CP0-21

Coordinates LKS94 TM [m] x = 6146618.0 y = 522084.5.

Photo A12-35. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-21 (from top to bottom):

- Soil, thickness 0.5 m
- Sandy clay, thickness 1.5 m
- Thick and hard clay and sandy clay moraine

According to Quaternary Geological Map of Lithuania, 1:100 000, in this location glacial deposits (main moraine) are present Nemunas (glacier) age (g III bl), sandy clay and clayey sand layers could be expected in this moraine complex.

Geologic conditions in LT-CP0-21 location: moraine deposits create dense, sturdy layers suitable for stable point installation. The moraine sediments do not compromise and provide the stability of construction points. Although the groundwater level hasn't been reached and remains unidentified, it is over 2.7 meters. Drainage is effective as there are high content of sand in the moraine deposits; some water accumulation could be expected in spring or autumn during the point installation.

LT-CP0-23

Coordinates LKS94 TM [m] x = 6136705.5 y = 519582.0.

Photo A12-36. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-23 (from top to bottom):

- Soil, thickness 0.40 m
- Clayey sand with some mixt in soil and organics, thickness 0.4 m
- Sandy clay

According to Quaternary Geological Map of Lithuania, 1:100 000, in this location main moraine and marginal glacial formations are present, which corresponds to Nemunas (glacier) age (g III bl ir gt III bl2). Sandy clay and clayey sand could be expected.

Geologic conditions in LT-CP0-23 location: the sturdy mixed layers formed in activity of glacial movements are ideal for secure point installation and structures situated on these clay deposits are unlikely to experience any sinking. Though the groundwater level remains unknown, it lies deeper than 2.7 meters. No water should accumulate during the wet season, and it shouldn't pose any issues after point installation.

LT-CP0-24

Coordinates LKS94 TM [m] x = 6130176.5 y = 526330.1.

Photo A12-37. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-24 (from top to bottom):

- Soil, thickness 0.2 m
- Clayey sand, some mixed sand and soil, thickness 1.0 m
- Thick and hard sandy clay moraine

Groundwater level has not been reached, but it is deeper than 2.0 m.

According to Quaternary Geological Map of Lithuania, 1:100 000, in this location glacial deposits (main moraine) are present, which corresponds to Nemunas (glacier) age (g III bl).

Geologic conditions in LT-CP0-24 location: the deposits of moraine form thick and hard layers that are good enough for point installation and stability. The moraine beneath clayey gravel layer does not cause any construction point to sink. The drainage is fine, as there are no interlayers of pure clay; some water could accumulate during the wet season during the installation of the point, but it shouldn't cause any further issues.

LT-CP0-25

Coordinates LKS94 TM [m] x = 6126048.8 y = 520204.5.

Photo A12-38. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-25 (from top to bottom):

- Soil, some content of sand, thickness 0.1 m
- Sandy clay

Based on the Quaternary Geological Map of Lithuania at a scale of 1:100,000, the area in question contains clayey sand of main moraine and corresponds to the Nemunas (glacier) age (g III bl).

Geologic conditions in LT-CP0-25 location: the sturdy layers composed of clayey and sandy deposits are well-suited for stable point installation. Structures positioned on these deposits are unlikely to undergo any shifts. While the groundwater level remains unspecified, it is established to lie deeper than 2.7 meters. No water should gather during the year in this location.

LT-CP0-31

Coordinates LKS94 TM [m] x = 6105320.8 y = 511771.8.

Photo A12-39. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-31 (from top to bottom):

- Soil, thickness 0.2 m
    a) Sandy clay with some pockets of sand and high content of soil and organic matter, thickness 1.0 m
- Clayey moraine with some mixt sand, soil and pure clay pockets

Based on the Quaternary Geological Map of Lithuania at a scale of 1:100 000, the area in question contains sandy clay and clayey sand marginal glacial formations that corresponding to the Nemunas (glacier) age (gt III bl2). Due to possible past agricultural practices soil possibly was mixt in this location with the deeper layers of deposits.

Geologic conditions in LT-CP0-31 location: the robust layers formed by the glacial clayey deposits are suitable for stable point installation. Structures situated on these deposits are unlikely to experience any movements. Although the groundwater level is not determined, it is known to be deeper than 2.7 meters. Sand and organic content should provide fine drainage.

LT-CP0-34

Coordinates LKS94 TM [m] x = 6093558.6 y = 512930.6.

Photo A12-40. *Fieldwork (UAB "SVA projektai")*

Description of geological profile of LT-CP0-34 (from top to bottom):

- Soil, thickness 0.3 m
- Course sand with some clay content, thickness 1.5 m
- Gravel and sand rich clay

Based on Quaternary Geological Map of Lithuania, 1:100 000, in this location limnoglacial (lg III bl) sands or glacial (main moraine) sandy clay (g III bl) deposits could be present, both corresponding to Nemunas (glacier) age. In the case of LT-CP0-34 it is likely that the point is at the boundary between both, so different sediments appear.

Geologic conditions in LT-CP0-34 location: the glacial (main moraine) sandy clay and limnoglacial sand deposits create strong and stable layers and foundation. The drainage is really good with high content of sand present, and no water accumulation problems should be expected during or after installation.

Annex 13. Time Schedule, Estonia

Stage	Description of activity	Milestones *Weeks from Commencement Date	Achievable result of the activity
1	**Preparation phase** - obtaining approvals and permits required for the installation of New Benchmarks and/or the maintenance of existing Benchmarks; and preparing and delivering samples of Benchmark sketches, photos and panoramas to the Principal; and coordination of the production and installation methodology of Benchmarks and their external elements with the Principal	Activity 1–4; Approval 2–5	Necessary approvals for Benchmark installation and maintenance are obtained, and examples of sketches, photographs and panoramas are delivered and approved by the Principal, and production and installation methodology of Benchmarks and their external elements have been approved by the Principal
2	**Phase 1** - Production of New Benchmarks and external elements of Benchmarks	Activity 2–7; Approval 3–8	The Benchmarks and external elements of the Benchmarks produced have been approved by the Principal
3	**Phase 2** - Maintenance of existing Benchmarks, collection of in situ information describing the locations of the Benchmarks and the preliminary measurement of Maintained Benchmarks	Activity 3–12; Approval 4–13	The existing Benchmarks are maintained and preliminary measured; Completed maintenance work have been approved by the Principal
4	**Phase 3** - Installation of New Benchmarks, collection of in situ information describing the locations of the Benchmarks and the preliminary measurement of New Benchmarks	Activity 8–12; Approval 9–13	New Benchmarks are installed and preliminary measured
	Phase 4		
5	Preparation and delivery of the draft version of the Final Report and Review by the Principal and the Owner	Activity 7–13; Review 8–15	Draft version of the Final Report is delivered and reviewed by the Principal and the Owner
6	Completion and delivery of the Final Report	Activity 14–16	Final Report is delivered to the Principal
7	Review and approval of the Final Report by the Principal	Approval 16–17	Final Report is approved by the Principal

Annex 14. Time Schedule, Latvia

Stage	Description of activity	Milestones *Weeks from Commencement Date	Achievable result of the activity
1	**Preparation phase** - obtaining approvals and permits required for the installation of New Benchmarks and/or the maintenance of existing Benchmarks; and preparing and delivering samples of Benchmark sketches, photos and panoramas to the Principal; and coordination of the production and installation methodology of Benchmarks and their external elements with the Principal	Activity; Approval	Necessary approvals for Benchmark installation and maintenance are obtained, and examples of sketches, photographs and panoramas are delivered and approved by the Principal, and production and installation methodology of Benchmarks and their external elements have been approved by the Principal
2	**Phase 1** - Production of New Benchmarks and external elements of Benchmarks	Activity; Approval	The Benchmarks and external elements of the Benchmarks produced have been approved by the Principal
3	**Phase 2** - Maintenance of existing Benchmarks, collection of in situ information describing the locations of the Benchmarks and the preliminary measurement of Maintained Benchmarks	Activity; Approval	The existing Benchmarks are maintained and preliminary measured; Completed maintenance work have been approved by the Principal
4	**Phase 3** - Installation of New Benchmarks, collection of in situ information describing the locations of the Benchmarks and the preliminary measurement of New Benchmarks	Activity; Approval	New Benchmarks are installed and preliminary measured
	Phase 4		
5	Preparation and delivery of the draft version of the Final Report and Review by the Principal and the Owner	Activity; Review	Draft version of the Final Report is delivered and reviewed by the Principal and the Owner
6	Completion and delivery of the Final Report	Activity	Final Report is delivered to the Principal
7	Review and approval of the Final Report by the Principal	Approval	Final Report is approved by the Principal

Annex 15. Time Schedule, Lithuania

Stage	Description of activity	Milestones *Weeks from Commencement date	Achievable result of the activity
1	**Preparation phase** - obtaining approvals and permits required for the installation of New Benchmarks and/or the maintenance of existing Benchmarks; and preparing and delivering samples of Benchmark sketches, photos and panoramas to the Principal; and coordination of the production and installation methodology of Benchmarks and their external elements with the Principal	Activity (1–5), Approval (2–6)	Necessary approvals for Benchmark installation and maintenance are obtained, and examples of sketches, photographs and panoramas are delivered and approved by the Principal, and production and installation methodology of Benchmarks and their external elements have been approved by the Principal
2	**Phase 1** - Production of New Benchmarks and external elements of Benchmarks	Activity (2–10), Approval (3–11)	The Benchmarks and external elements of the Benchmarks produced have been approved by the Principal
3	**Phase 2** - Maintenance of existing Benchmarks, collection of in situ information describing the locations of the Benchmarks and the preliminary measurement of Maintained Benchmarks	Activity (8–13), Approval (9–14)	The existing Benchmarks are maintained and preliminary measured; Completed maintenance work have been approved by the Principal
4	**Phase 3** - Installation of New Benchmarks, collection of in situ information describing the locations of the Benchmarks and the preliminary measurement of New Benchmarks	Activity (4–13), Approval (5–14)	New Benchmarks are installed and preliminary measured
	Phase 4		
5	Preparation and delivery of the draft version of the Final Report and Review by the Principal and the Owner	Activity (7–14), Review (8–15)	Draft version of the Final Report is delivered and reviewed by the Principal and the Owner
6	Completion and delivery of the Final Report	Activity (14–16)	Final Report is delivered to the Principal
7	Review and approval of the Final Report by the Principal	Approval (16–18)	Final Report is approved by the Principal