



Challenges and Chances for SBB in Small and Mid-sized Communities

Railway Stations and Spatial Development in Small and Mid-sized Communities in Switzerland

Imprint

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Preface

Land, the very foundation of our living space, is not only in short supply; it is non-renewable. This makes it all the more important to manage land economically. Since the time when the walls and moats of the medieval city were steadily demolished, the spatially relevant problems of society have been solved by expanding the size of settlement areas, i.e. the growth of cities and towns. The latest expansion of settled areas, called sprawl, is mainly the result of the use of automobiles, which has produced many negative impacts and consequences.

On 3 March 2013, the voters of Switzerland accepted the revision of the spatial planning law, thus deciding that spatial planning should follow a course of settlement redevelopment (inner development) in order to support sustainability. The associated change in paradigm now poses a major challenge for all the actors involved. In particular, the careful and diligent coordination of future settlement development with the public transport system is one of the core tasks.

The Swiss Federal Railways could be one of the main drivers in fulfilling the intention of the new law because the catchment areas of railway stations allow a higher population density and therefore a higher building density. These catchment areas, the land within a radius of 300 m of a railway station, have thus become crystallisation points for redevelopment.

Small and mid-sized communities will increasingly become the focus of settlement development because potential settlement areas around railway stations in the larger cities in Switzerland will decline in the next ten to twenty years. According to our research, more than two-thirds of the potential settlement areas in Switzerland will be found in small and mid-sized communities.

The goal of our research was therefore the systematic investigation of potential settlement areas in small and mid-sized communities in selected railway corridors. The results should lead to the recognition of the connection between railway lines and local settlement development and thus to recommendations for the SBB on approaches and methods

for handling future coordination efforts. The survey method was based on the experience and knowledge gained from the research project, Raum⁺, which was developed over the past ten years by the Chair for Spatial Development at ETH Zurich in cooperation with over 300 communities in eleven cantons.

The investigation of 63 small and mid-sized communities located within certain important railway corridors, including 66 railway stations, revealed more than 127 ha of potential settlement area in the 300 m catchment area. For the total municipal territory of all communities, the total was over 1`175 ha. If these areas are used exclusively for housing purposes, i.e. with a medium gross floor area ratio of 0.8 and a simplified 50 m² per resident, then ca. 20`000 residents could be accommodated in the 300 m catchment area of those 66 railway stations; using a somewhat lower middle range density of 0.6, then it becomes 130`000 residents for the entire community area. However according to the existing zoning laws, some parts of these reserves are located in the working zones, which possibly could be transformed into residential zones in future zoning plan revisions. These numbers are simple estimates, but they demonstrate that the potential of small and mid-sized communities should not be dismissed.

Tailor-made solutions must be found for the mobilisation and development of the potential for each of these sites. Particularly in small and mid-sized communities, the railway station areas are not the only crystallisation points of public life; these points also include those spaces important to the location's identity.

Based on the potential importance and valuation of the properties, we propose 16 station areas with high potentials for further process. Therefore the SBB should consider initiating development process in such areas, also prioritising the other sites for long-term developments. One advantage of taking the leading role in these developments for the SBB is to be able to direct the process based on its general strategies regarding real estate, parking areas, mobility hubs, etc.

In the run-up to the formal processes, i.e. zoning plans and design procedures, informal processes will also play a role in achieving optimal solutions for settlement development and operational offers. Community-related and corridor-related processes, which often include cross-cantonal processes, would be reasonable efforts in this direction. Research findings in this report underline the necessity for a coordinating role (a so called «Kümmerer») between the SBB and communities specifically for small and mid-sized communities, due to the particular situation and scale.

This approach goes along with the national strategy of promoting further development of the network of cities and places. The arc of its Central Plateau (from Zurich to Lake Geneva) is Switzerland's main living space, containing more than five million inhabitants. In addition to utilising the settlement area potential of the larger cities, it also offers reserves for ca. one million inhabitants in its smaller and mid-sized communities.

With one focus on the railway stations and stops of the public transport system and another on a sense of proportion and quality settlement-based development, it would be possible to pursue the creation of a large, competitive European metropolitan region with differentiated offers and possibilities based the cities and sites of Switzerland's Central Plateau. The structural elements are variously formed cultural landscapes, urban areas with individual urban designs and economic profiles, and, in their respective functional catchment areas, a high number of small and mid-sized communities.

Combining the railway network with a public transport system that offers frequent intervals could create a strategic backbone for the national network of cities and locations. It is obvious that advancing sprawl would counteract this approach because it would increase the use of automobiles and cause an accompanying lower density of transport. For high-performance roads that are already at their operating limit, this additional traffic would be hard to manage. Beyond that, it will depend on guiding future settlement development to utilise the existing railway network of cities and locations,

especially in the areas that are well connected by public transportation, thus mutually complementing one another.

In addition, any project of internal redevelopment must be carefully coordinated with the capacity of the existing infrastructure, also those of the railways. If certain threshold values are exceeded, over-concentration and negative outcomes must be reckoned with. Extensive additional investments in the public transport system could be required. These could lead to a quantum leap in accessibility and capacity, which in turn might bring undesirable outcomes for the location factors of manageability and urban design variety, including the small and mid-sized communities of Switzerland's Central Plateau. The investigation and recommendations of the selected corridors must also consider these aspects.

The research also showed that there are still numerous open questions to be answered. We intend to look into these and other questions within the framework of a plan supported by the Swiss National Fund. In that respect, the SBB research funds not only supported the investigation, it also provided an important foundation for further research on this important topic.

We thank the representatives of the Swiss Federal Railways and the members of the Advisory Group for their constructive review and support. We would be very pleased when the results of our research stimulate an integrative spatial and railway development.

Prof. Dr. Bernd Scholl
Zurich, May 2016

Summary

Existing well-functioning railways and significant quantity of land reserves: Are there any possibilities for the SBB railway stations to impulse further development in small and mid-sized communities?

This research addresses the potential opportunities for integrated long-term development around railway stations in small and medium-sized cities in the Swiss Central Plateau. Here, potential for urban and commercial redevelopment is still highly significant, while knowledge, experience and instruments for inner-development (*Innenentwicklung*) are rather limited so far and the SBB has the possibility to take the leading role for starting redevelopment processes. Using the data from the series of Raum+ projects in different cantons and communities in Switzerland, this research is based on the existing land reserves within community building zones that allow further development by law.

Considering the significant potential of accommodating future population in Switzerland, this research seeks to benefit from the existing infrastructure to decentralize the probable population spill over from the major metropolitan areas such as Zurich, St.Gallen and Basel. Therefore a methodology based on case studies has been designed to examine this hypothesis in a one-year research project. The five settlement corridors branching out of the metropolitan region of Zurich, encompassing railway connections, have been selected. These corridors are Zurich-St.Gallen, Zurich-Basel, Zurich-Biel, Zurich-Schaffhausen and Zurich-Zug.

In collaboration with the SBB (Swiss Federal Railways), the research focuses on the available land reserves in small and medium-sized communities, as well as the existing and possible railway infrastructural development in such communities.



As one of the major transportation modes, railways not only have a substantial role in infrastructural network, but it also has an enormous impact on the settlement structure. The influence of railway infrastructure is so excessive that any small change in the network, whether upgrading the railroads or modifying the timetable of the trains, might influence the settlement structure in just a few years. Considering transportation planning and spatial development as two sides of the same coin, this research focuses on the railway development strategies and the mutual influence on the future settlement development. Subsequently, we concentrate on the railway stations as the main gates of the 21st century towns in Switzerland.

According to former researches in this field, majority of the inner-development potentials are among the small and mid-sized communal boundaries in the Central Swiss Plateau (Grams, 2015). However, when it comes to the future settlement development based on the projected population growth, these types of communities are the most neglected regions.

1. Introduction

National statistics show future settlement development will confront density thresholds and limited resources in large agglomeration center such as Zurich. This might lead the settlement pattern to either extend official building zones (*Bauzone*) in large cities or to denser developments within current building zones. In both cases, multiple pressures on the existing infrastructures and resources are inevitable (Fig. 2).

As one of the major transportation modes, railways not only have a substantial role in the infrastructural network, they also have an enormous impact on the settlement structure. Since railway networks are mostly planned to serve large transport nodes, such as agglomeration centers, it is widely argued that they could also stimulate growth in small and mid-sized communities connected to these networks. Changes such as upgrading the railroads, modifying the train timetable, making more frequent stops or conversely fewer train stops could have various short-term and long-term effects on future settlement development (Scholl & Drewello, 2016).

In this research, we consider transportation planning and spatial

development as two sides of the same coin; therefore we focus on railway development strategies and the impact of future settlement development on Switzerland. While we consider railway stations as the main gateways to all 21st century Swiss communities, our concentration is mainly on the immediate impacts of the railway stations on the spatial pattern of small and mid-sized communities.

This publication strives to reveal the potential hidden in small and mid-sized Swiss communities that are well connected to the transportation network and highly accessible to major urban centers. Moreover, in this study, we investigated a variety of railway station development opportunities in small and mid-sized communities within their larger regional context. This investigation revealed many conflicts as well as opportunities. Consequently, a set of categories was introduced to help the actors and the decision-makers, who have a different perspective of such areas, follow our results.

In the first chapter, a more detailed explanation of the purpose and main questions of this study are presented. Additionally, the chapter contains definitions of the major terms used in this manuscript as well as the general approach and methodology of the research.

In the second chapter, an overview of the current spatial situation in the study area, an overview of the existing railway network, important elements of the historical development, and the prospects of future extensions are presented and discussed.

Chapter 3 introduces the current discussion on planning procedures in small communities and discusses the relevant challenges for collaborative planning and decision-making processes related to railway station development among different actors and stakeholders, while chapter 4 is dedicated to a summary of the previous discussions and reveals that a consistent analysis of the available land reserves and spatial threshold is greatly needed.

Chapter 5 defines small and mid-sized communities in the study area by presenting different typology of the communities based on space users. Moreover after determining the small and mid-sized communities, an analysis on the corridor scale is prepared only considering the small and mid-sized communities. Also general approaches and initiatives for smaller scales are discussed in this chapter but will be implied in detail in chapter 6.

Chapter 6 is dedicated to the focus areas and individual corridor sections and offers a closer look at the local scale for every station located in the small and mid-sized communities alongside each section.

In chapter 7 all the research findings are presented and different scenarios and options are questioned in order to conclude with a classification of different cases and their requirements for further development. Also the report ends the discussions with recommendations from the authors for different kinds of actors. Finally, the future possibilities to follow-up this research with similar approaches is outlined.

Existing, well-functioning railways and a significant quantity of land reserves: What possibilities do SBB railway stations offer to help stimulate further development in small and mid-sized communities?

1.1 Purpose of the Study

This research addresses potential opportunities for a more integrated and long-term railway and spatial development alongside the major railway corridors in Switzerland, which end at the agglomeration center of Zurich.

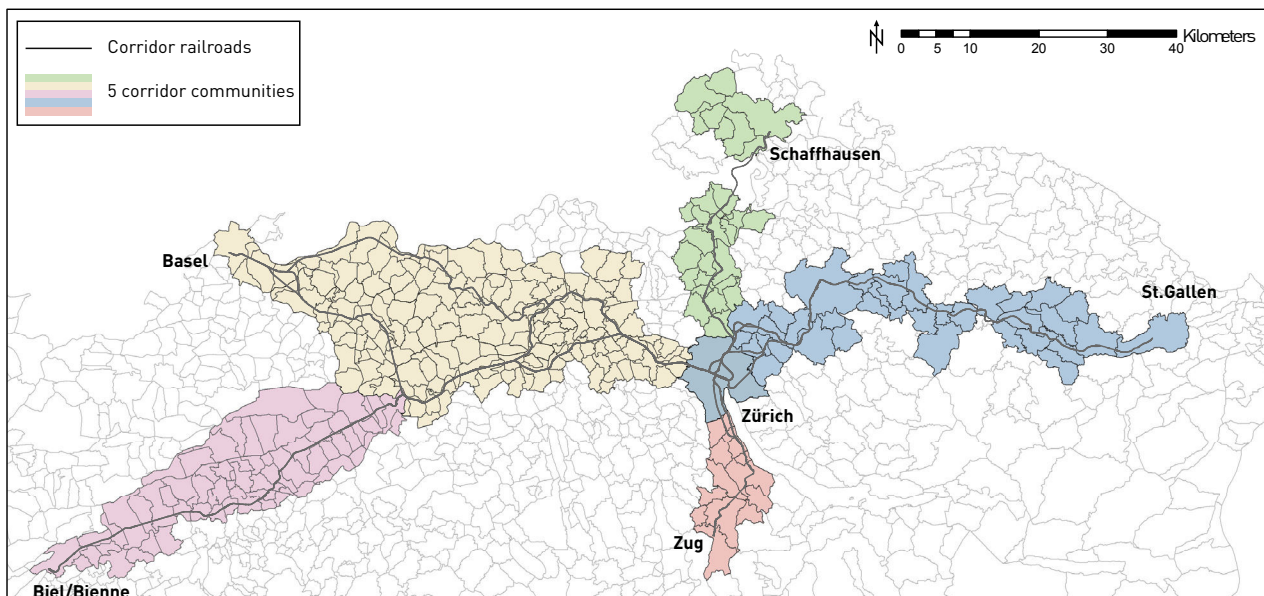


Figure 1. Study area in five major settlement corridors (Source: Authors | Data: Swisstopo, 2015)

It is part of an extensive study undertaken by the Chair of Spatial Development at ETH Zurich investigating the undisclosed aspects of an integrated railway and spatial development, as well as a more active collaboration among different stakeholders in planning procedures in Switzerland. The Chair of Spatial Development examined the idea of railways as one possible tool to activate the significant land reserves in small and mid-sized communities in the Swiss Central Plateau. One important reason for such an effort is that these reserves are already among the official building zones and are well connected to different infrastructural networks. In other words, activation of such land reserves could contribute

to a more decentralized, yet very compact settlement development pattern, which would also encourage a life style oriented towards public transport. Therefore, this might be a chance for both spatial planning actors and railway-related stakeholders to collaborate more intensively and efficiently in order to identify potential locations as well as conflict areas.

During the one-year period of this research, the focus was mostly on small and mid-sized communities, which do not have a cohesive, consistent and problem-oriented planning procedure (Grams, 2015). While the projects of national and cantonal importance have priority for planners and decision-makers, and

attract the proper attention, small and mid-sized communities are struggling with urban/rural identity questions and poorly used land resources. Some of these communities, those located at the edge of agglomeration regions, will become dormitory towns or face population shrinkage.

The study area consists of five settlement corridors in the northern part of the Swiss Central Plateau and has Zurich at the core of this network (Fig.1). It includes seven railway sections (Fig. 16), including the corresponding communities, which are our research laboratory and the center of our examination.

1.2 Definition of Terms

Some of the terms in this report have specific meanings and indicate explicit senses. Since the literature used in this report is mainly translated from first hand data and sources in German, some of the following terms explain the specific meaning of the term as well as the German origin.

The **Swiss Central Plateau** refers to a plateau that stretches from the city of Zurich to the Lake of Geneva with the Jura Mountains to the northwest and the Swiss Alps to the south. The German term is *Schweizer Mittelland*, sometimes also referred to as the *Mittellandbogen*. Although this area covers only about 30% of the Switzerland's land surface, it offers a favourable setting along its rivers and lakes for settlement development.

A central concept that needed to be clarified in the early stages of the research is the scale of the project. In this study, the smallest governmental

unit of investigation is the *Kommune*: the local authority district; municipality. The English translation for the German term *Gemeinde* is community, local authority district. This term has been also translated as municipality, depending on size or legal form (HarperCollins, 2015).

The terms 'small' and 'mid-sized' communities are based on population. In this research, mid-sized communities have a range of inhabitants between 2'000 and 13'000. According to the initial assessment, mid-sized communities with a population above 10'000 are at the edge of transformation into an urban form, meaning that the community is large enough to require a specific level of services and planning considerations, but still needs to fill this gap with economic, industrial and other urban activities. For a more detailed classification of this research, see chapter 5.

Guiding Plan is the translation of the Swiss-German term *Richtplan*, which is a management tool that includes a broad framework of guidelines. It needs to be simultaneously coordinated with different policies and governmental guidelines (*Bundesversammlung der Schweizerischen Eidgenossenschaft*, 2016).

Zoning Plan is the translation of the German term *Zonenplan*, which is used to indicate the legal use of land for certain purposes as decided by the local authorities (*Nutzungsplanung*: land-use planning). This instrument distinguishes the official uses of designated areas, such as building zones, agricultural land, and special zones for protection purposes. The regulations defined in this instrument are binding to all (*Bundesversammlung der Schweizerischen Eidgenossenschaft*, 2016).

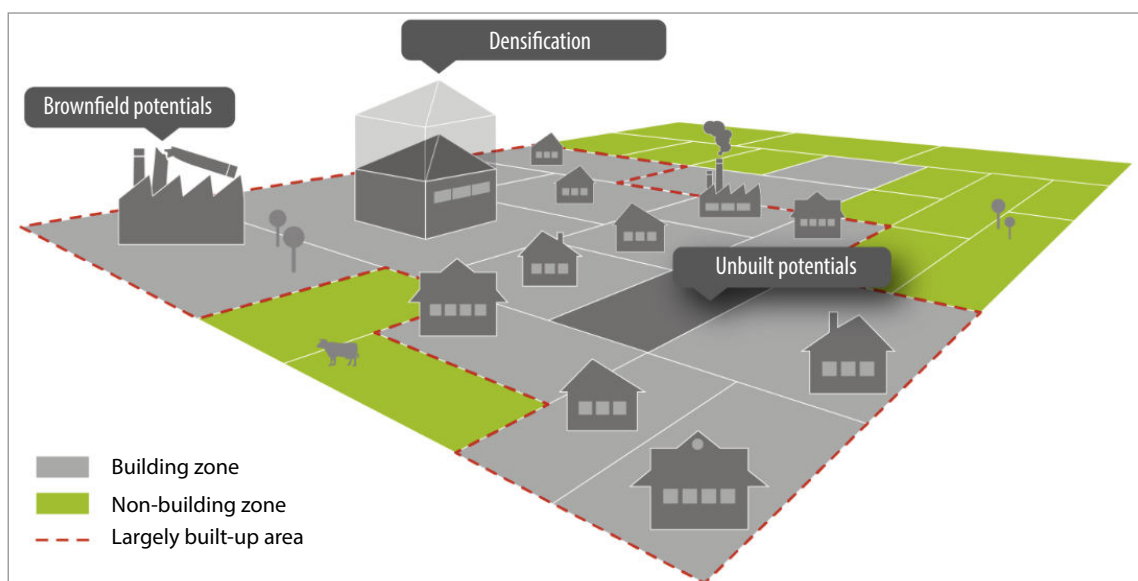


Figure 2. Schematic image of the building zone and inner development potentials in Swiss communities (Source: Nebel, 2014; slightly adapted by the authors)

1.3 Questions and Hypotheses

Considering the long-term, solid impact of railway infrastructures on shaping spatial development patterns, this project not only investigates land reserves and current density patterns, it also aims to reveal the potential for future infrastructural upgrades in relation to the inner development potential and settlement thresholds.

As mentioned in section 1.1 Purpose of the Study, this research focuses only on small and mid-sized communities. Initially, the idea of taking such communities under consideration comes from former research conducted at the Chair of Spatial Development at the Institute for Spatial and Landscape Development at ETH Zurich in 2011. In this research project, Grams (2015) discovered that the small and mid-sized communities in Switzerland's Central Plateau have a large proportion of the 'floor area' reserves, almost two-thirds of the total floor area reserves in Switzerland. These would be capable of accommodating a large portion of future population growth. In her doctoral thesis, *Spielräume für Dichte*, 2011-2014, (Ranges for Density), Grams found that 93% of all Swiss communities have a population below 10'000 inhabitants and most are organised under the militia system.¹ According to this research, in addition to sector governance in small and mid-sized communities, a segmented public transportation system also services these areas, at intervals determined by different official cantonal borders (Grams, 2015).

We assume that the Swiss Federal Railways (SFR) (*Schweizerische Bundesbahnen* - SBB) has a potential role to trigger or terminate the development trends in such small and mid-sized communities with railway stations. This assumption is based on

the accessibility and connectivity that the SBB provides in such communities, as well as the number of developable land parcels that the SBB owns around the railway stations, which currently are not well utilised. Such properties are often located in a strategic, central location within the communities. However, most of these properties are not adequately taken into consideration in local or cantonal planning procedures. For instance, in many cases, SBB properties are not included in the community's zoning plan. One reason for this is that they have been considered as potential infrastructure sites and not as possible sites for future residential or economic development.

Although there is no assured future spatial structure for the Central Plateau, Grams (2015) showed that the estimated population growth could be rationally coordinated within the built environment sites inside the official building zones of the communities, especially in the small and mid-sized communities.

The two major hypotheses of this project are:

- 1) Railway stations are eligible to enhance the settlement areas, and
- 2) SBB can take the leading role in this process and assure it through a strong collaboration with the local and regional governments (community and

cantons) to ensure a good quality of urban life.

This process would also open opportunities to save extra costs when constructing extensive infrastructures in future. Therefore, we started by obtaining an overview of the land reserves and population projections in different small and mid-sized communities that are also connected to the railway network by a railway station.

In a broader context, the project aims to elaborate upon the current situation in the crowded sprawling urban centers in metropolitan areas and to discover the potential for transformation from scattered, low-density settlements to a more compact decentralised pattern that would benefit from a well-functioning railway system.

The major research questions are:

- How would future settlement development affect the railway network's functionality?
- How would an upgrade of the railway stations stimulate inner development in small and mid-sized communities and activate the existing land reserves in such regions?
- What are the relevant criteria for changing the role of railway stations with consideration for the corresponding community as well as the entire railway corridor?

¹ Communities with militia system lack a cohesive and consistent planning procedure, while there is no full-time planning position in the local government allocated for such expertises. This means such communities often get impulsed by the larger scale planning from cantonal and federal strategies (Grams, 2015).

1.4 Methodology

From a spatial planning perspective, one of the main reasons for disregarding small and mid-sized communities is the lack of a cohesive, consistent and problem-oriented planning procedure in the various planning and decision-making processes in Switzerland (Grams, 2015). This makes small and mid-sized communities very vulnerable and dependent on the large-scale plans from the national and cantonal levels. The same situation currently holds for the regional railway timetable, which is mainly based on the connections between the large nodes of the corridor, whereas the smaller nodes are passively influenced every time a small change takes place in the timetable.

Assuming the railway stations are strategic development locations in small and mid-sized communities, there is no single actor responsible for the development of the stations in such communities. In such communities, to construct even a small-scale development in the vicinity of a station requires a high level of coordination, negotiation and compromises among the actors and stakeholders.

The SBB, one of the most important actors in developments around railway stations, also owns some land parcels for building stations, parking areas, free parcels, etc. The role of SBB as owner of these strategic land parcels

is very crucial to this topic. Up to the present, most station developments initiated by the SBB have taken place in large and very large communities. In other words, SBB sets its priorities mainly on stations with a higher number of passenger frequencies and a reasonable development potential. The major factors that make these stations into first priorities vary from one project to another, but the common indicators include a cohesive collaboration among the main actors, the community's interest and willingness to transform such districts, a significant amount of developable land around the stations and neighbouring districts, and the corresponding zoning regulations.

Clearly, the definitions of small, mid-sized, large and very large communities are somewhat relative and vary from one situation to another. In our approach, we define a range of population for each level of community. Communities with a population below 2'000 inhabitants are considered small communities. In the literature, mid-sized communities are defined as having a population below 10'000 inhabitants (BFS, 2014).

Figure 3 illustrates the analysis levels used in this research, consisting of a) corridor level, b) influential region level, and c) station level. The largest scale is the corridor level, which investigates communities and stations

in the form of a corridor alongside a railway section. At this level, we have two methodologies: 1) the focus is on the communal borders alongside the railway section. The advantage of this approach is we can investigate the corridor with the existing data within the communal borders, such as population projection data (see chapter 5); 2) the second method for the corridor level is mainly made up of data produced by this project (see chapter 6). This methodology focuses only on the area within a radius of 300 m of the railway stations. The data are to compare the corridors. Therefore, the results are shown in form of a corridor, but only represent the area in close vicinity of the railway station (300 m-radius).

The influential region level represents the region that can potentially be affected by development around the railway station. It usually covers a larger area than the community borders.

The smallest level is the station area, which is like an 'intersection' for the various actors, thus becoming a kind of scope for development decisions and considerations. In general, our approach is to consider the collaboration and the various visions in all of these three scales for small and mid-sized communities with railway stations.

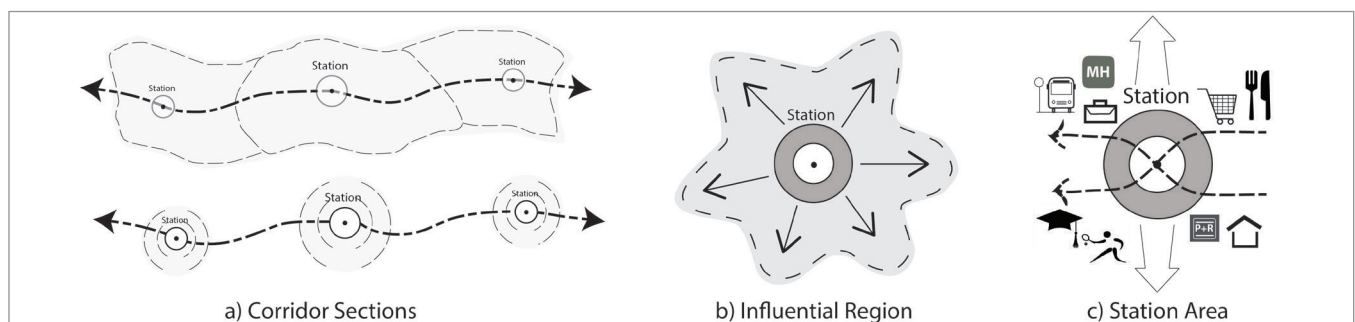


Figure 3. Symbolic illustration for different levels of assessment focusing on stations (Source: Authors)

2. Overview and Assessment of the Current Situation

Determining the current situation is the first step in any research. This chapter gives a quick overview on relevant information the later analysis and recommendations are based on.

2.1 Rail Network

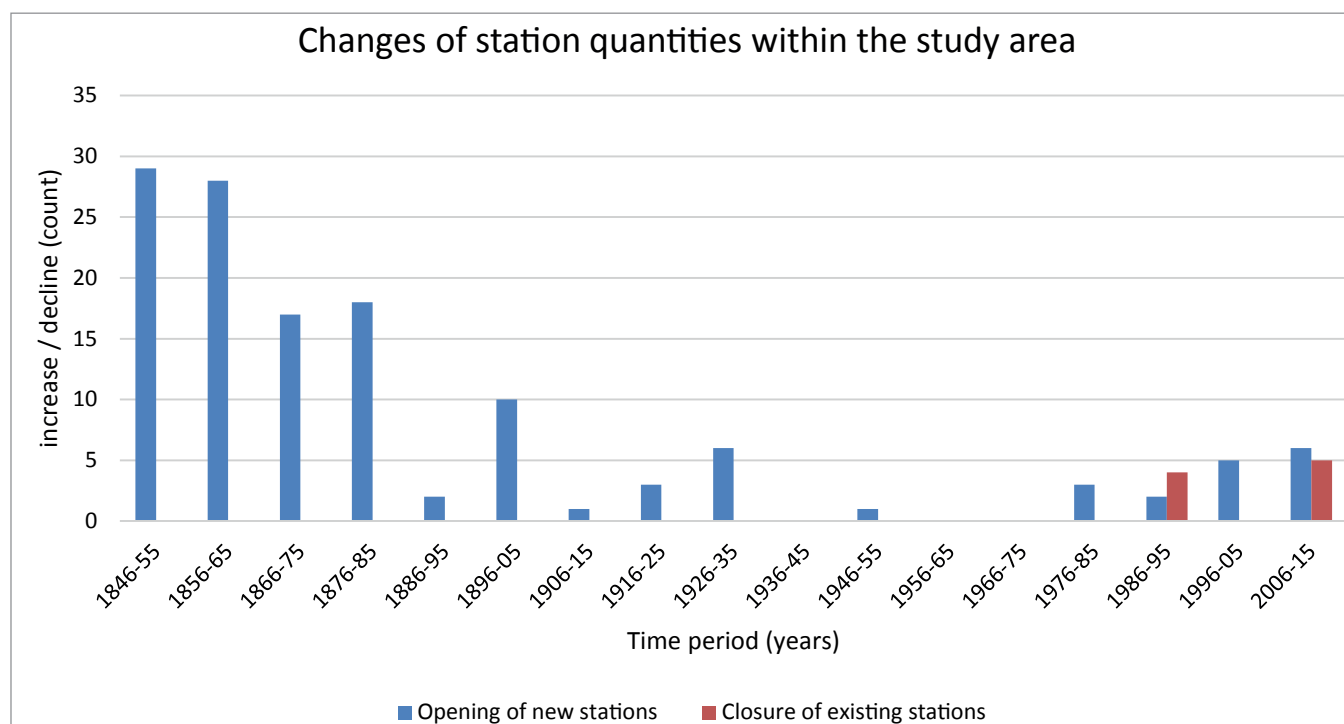


Figure 4. Changes of station quantities within the study area (Source: Authors)

The key questions in this research closely relate to the Swiss railway network and its positive effects on a compact urban development. This chapter addresses in the following three brief subchapters the historical development, future plans and projects as well as the future capacity reserves

available on the network in 2025 and beyond.

2.1.1 Historical development

In 1847, the first Swiss railway line started to operate between Zurich and Baden. By the beginning of the

20th century, a dense railway network had been established throughout the entire country. This first intense phase of railway network development was finished in 1916 with the opening of the Hauenstein Tunnel between Sissach and Olten, which is within the study area. At this time, 107 stations were in operation. By the time of the Second

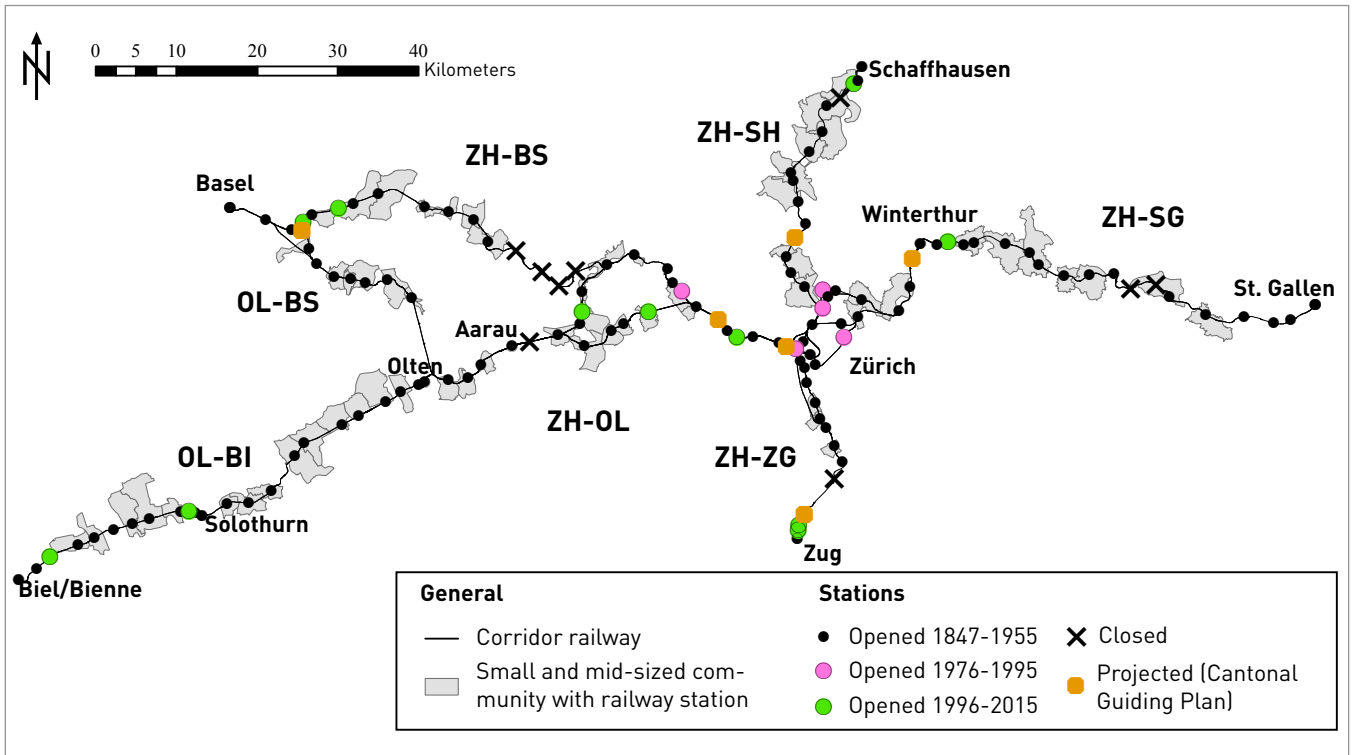


Figure 5. Overview of the train stations within the study area [Source: Authors, based on status of 31.12.2015 | Data: Swisstopo, 2015]

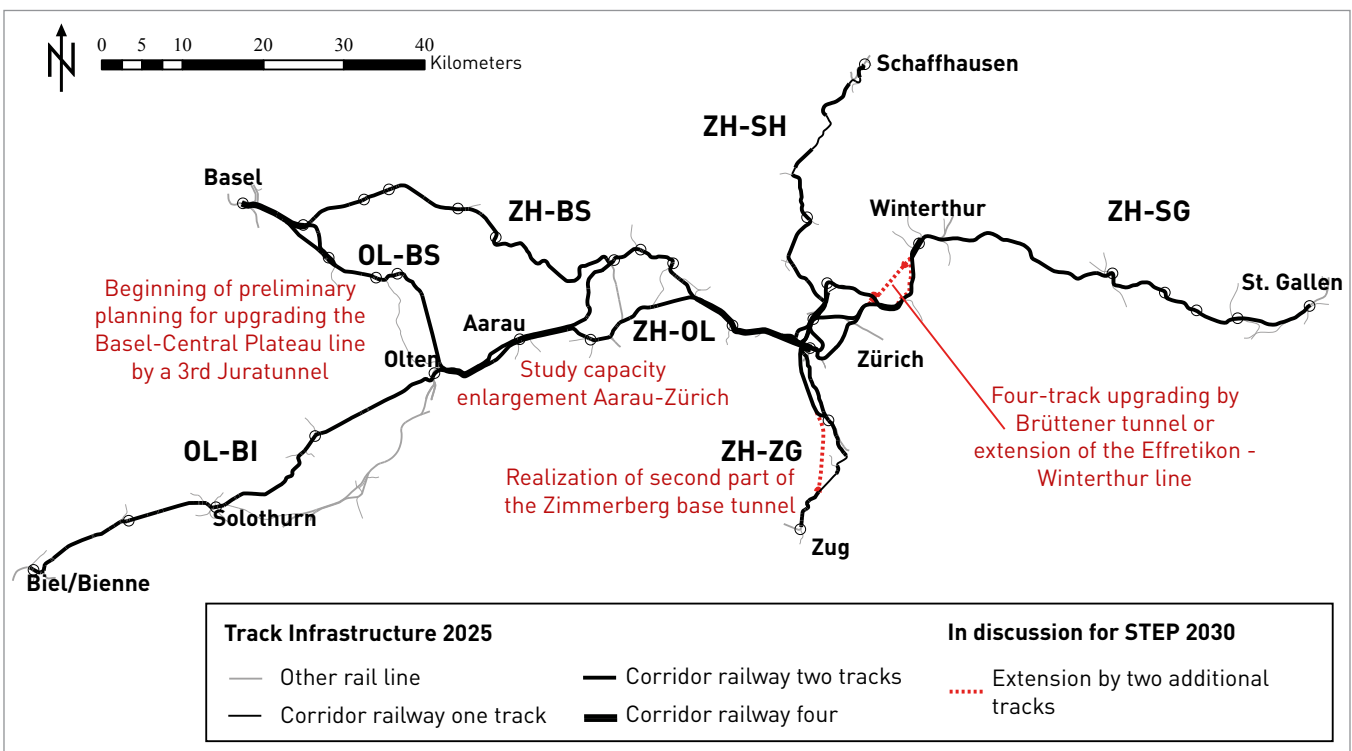


Figure 6. Rail infrastructure in the study area 2030 [Source: Authors | Data: BAV 2014a; BAV 2014b; Swisstopo, 2015]

World War, the part of the network within the study area was almost completely electrified. The increasing system performance and growing demand led to the opening of seven additional stations along the existing network (see Fig. 4).

Between the 1940s and 1970s, the railways experienced a phase of stagnation. At this time, investments in the transportation infrastructure were focused on the road network. Only one additional station, Kloten-Flughafen, today Kloten-Balsberg, was established

within the study area. With the opening of the Käferberg line in 1969 and the Heitersberg line in 1975, an ongoing phase of investment and network expansion was initiated. By the end of 2015, various capacity extensions and upgrades, such as the third and fourth tracks for Dietikon-Killwangen, the underground stations Zurich Museumstrasse and Löwenstrasse and the Adler Tunnel between Muttenz and Liestal were put into operation. Parallel to these new stations, the primary number and distribution of stations was revised. Four stations remotely located

and poorly frequented were closed between 1976 and 1995. In the same period, related to the establishment of the Zurich S-Bahn system, five additional stations went into operation, all in the vicinity of Zurich. An additional eleven stations were opened between 1996 and 2015, this time mainly related to the implementation and expansion of the S-Bahn systems of other agglomerations, such as Basel or Zug. Another five stations were closed between 1996 and 2015 (see Fig. 5).

2.1.2 Future plans and prospects

Further extensions of the Swiss railway network are projected for the future. Single construction projects are usually bundled into packages. Currently under construction or being planned are the packages NEAT (Connections to European High-Performance Network), ZEB and STEP 2025, which are scheduled

for completion by 2025. A follow-up package, STEP 2030, is in preparation and will be discussed by the Federal Parliament in 2018, while completion is planned for 2030 (Bundesamt für Verkehr/Swiss Federal Office of Transport, 2014a). Figure 6 shows the planned rail infrastructure as of 2025 as well as the extensions planned for 2030. Regarding the implementation of additional train stations, information can be found in the cantonal Guiding

Plans (Richtpläne). According to these planning instruments, six stations are projected, which are also shown in Figure 6.

2.1.3 Future capacity reserves

The coordination of settlement and infrastructure development requires an overview of the extent and position of the

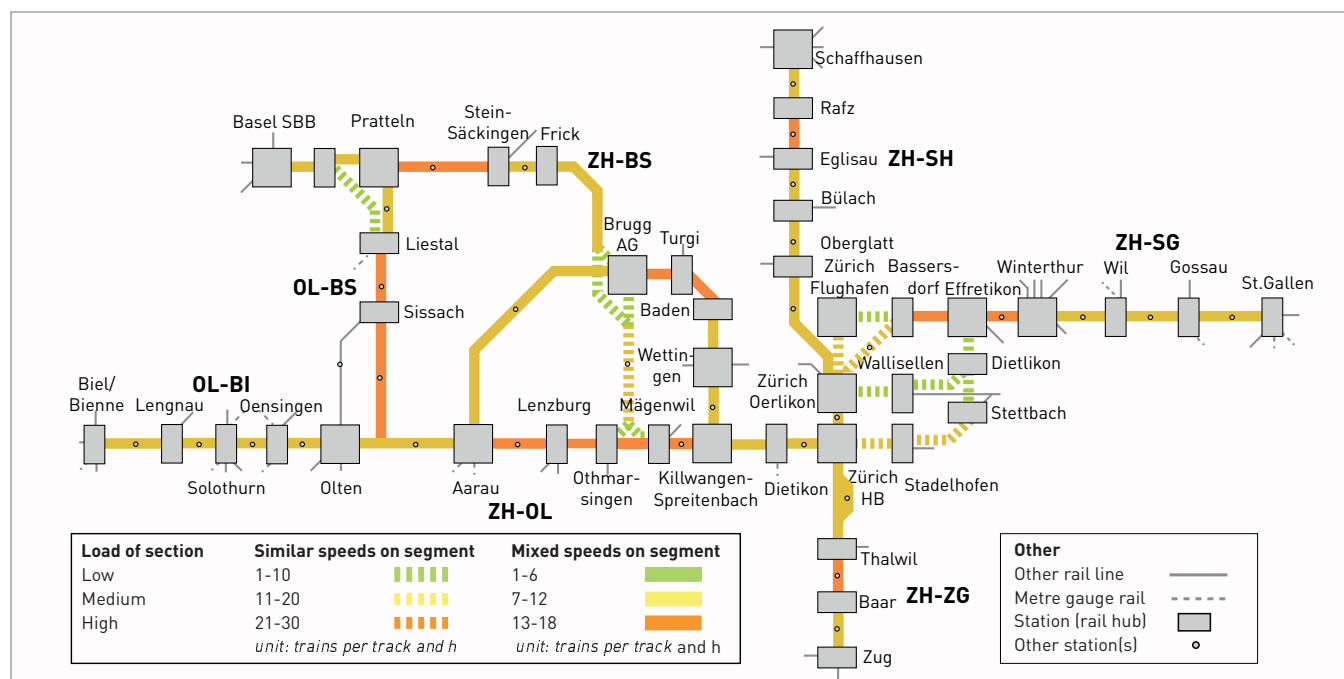


Figure 7. Railway corridor loads until 2025 (regardless of the railway nodes) [Source: Authors | Data: BAV, 2014b]

respective reserves. We assume that settlement development is desirable in regions with sufficient available land reserves and good connections to the railway network as a main public transport system. Furthermore, we assume that it is more efficient to increase the infrastructure capacity in the existing network through minor actions, such as increasing the number of signal blocks where possible, rather than developing expensive extensions, such as additional tracks or new rail lines. Thus, it is important to know where capacities will still be available in future within the study area.

The Federal Department of the Environment, Transport, Energy and Communications (UVEK) published an analysis in 2012 on a long-term perspective for the Swiss rail network. That report contains an analysis of future passenger capacities and shortcuts on the national scale (*Bundesamt für Verkehr, 2012*). Due to the passage of the Federal Decree on the Funding and Expansion of Railway Infrastructure (FABI) in 2013 and its approval by the Swiss voters in 2014, the circumstances have changed. To

achieve a current overview of capacities and reserves in the corridors studied in this research, we needed to do our own analysis. Due to the lack of specific data, a simplified approach was chosen to identify the future rail network load.

The number of tracks available in 2025 is shown in Figure 6. The demand for infrastructure in the form of peak-time train routes in 2025 is defined in the Schedule Reference Concept 2025 (BAV, 2014b).² Based on this information and assumptions about the capacity of rail lines under conditions of both mixed speeds and similar speeds, we conducted a section-wise evaluation of the loads. This section-wise evaluation ignores detailed schedule considerations and capacity constraints in the rail hubs. Figure 7 shows the results for the year 2025 in a schematic overview in which section capacities for additional train routes are still available in future without requiring major track extensions. In 2025, the rail network within almost the entire study area will be used on a medium to high level of performance. None of the corridors offers any considerable free capacity. For example, capacities of the sections

Killwangen–Spreitenbach–Aarau and Olten–Liestal will be heavily used. On the sections Olten–Solothurn–Biel and Winterthur–St.Gallen, capacities will be used on a medium level. In these sections, additional train routes can probably be created, however, only under the consideration of restrictions given by the schedule or an appropriate corridor upgrade. In 2030, the bottlenecks between Zurich–Winterthur as well as Thalwil–Zug may be removed due to the construction of the Zimmerberg Tunnel II and the Brüttener Tunnel, where compared to 2025, only a few additional trains are expected.³

Beyond 2025–2030, requirements imposed on the rail network have not yet been defined on the level of train routes. Requirements imposed on the rail network in 2050 were discussed by the UVEK in 2012. As shown in Figure 8, a 15-minute train frequency is expected to be standard between the major agglomerations for long-distance trains. The same frequency is expected for the core areas of the S-Bahn systems (BAV, 2012).

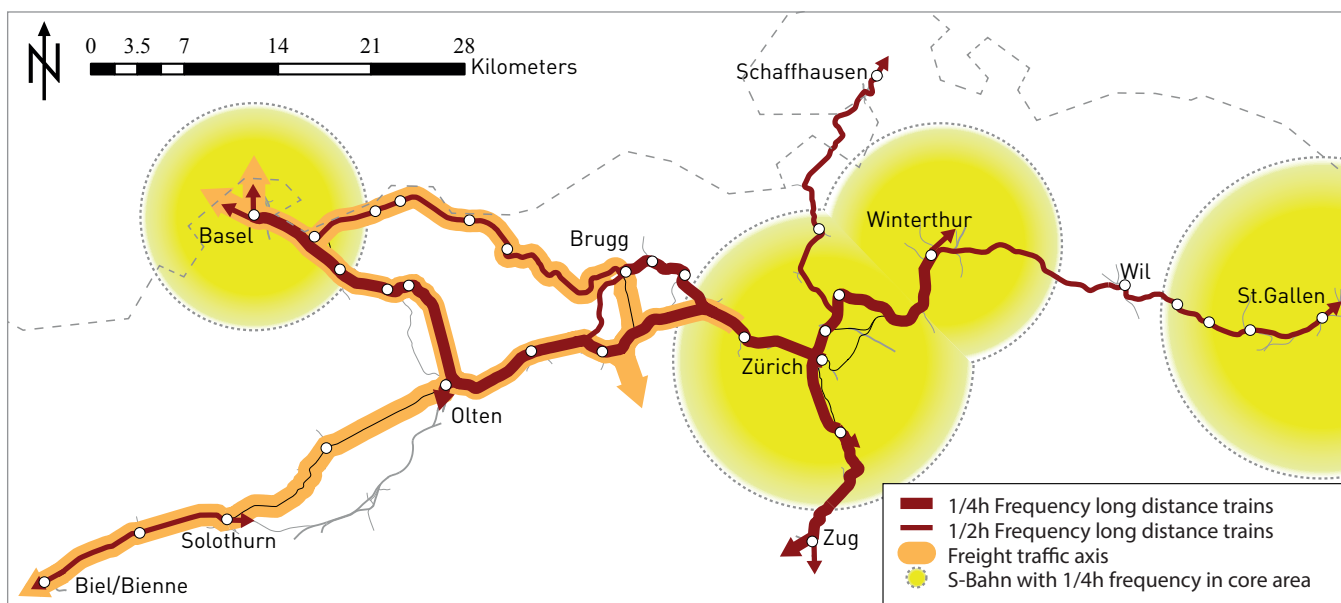


Figure 8. Imposed requirements on railway infrastructure in 2025 [Source: Adapted from BAV, 2012 | Data: Swisstopo, 2015]

² Increased demand for seating is indirectly represented in the demand for additional train paths.

³ Having no schedule reference concept available for 2030, demand for following additional train paths compared to 2025 is assumed: two additional hourly IC train pairs Zurich – Bern, two additional hourly IR train pairs Zurich – Zug, additional hourly freight train pair on the north-south and east-west corridor (Source: *Dokumentation Planungsgrundlagen STEP Ausbauschnitt 2030, Bericht, Bundesamt für Verkehr, 2014, S.35f.*)

2.2 Corridor Communities Characteristics

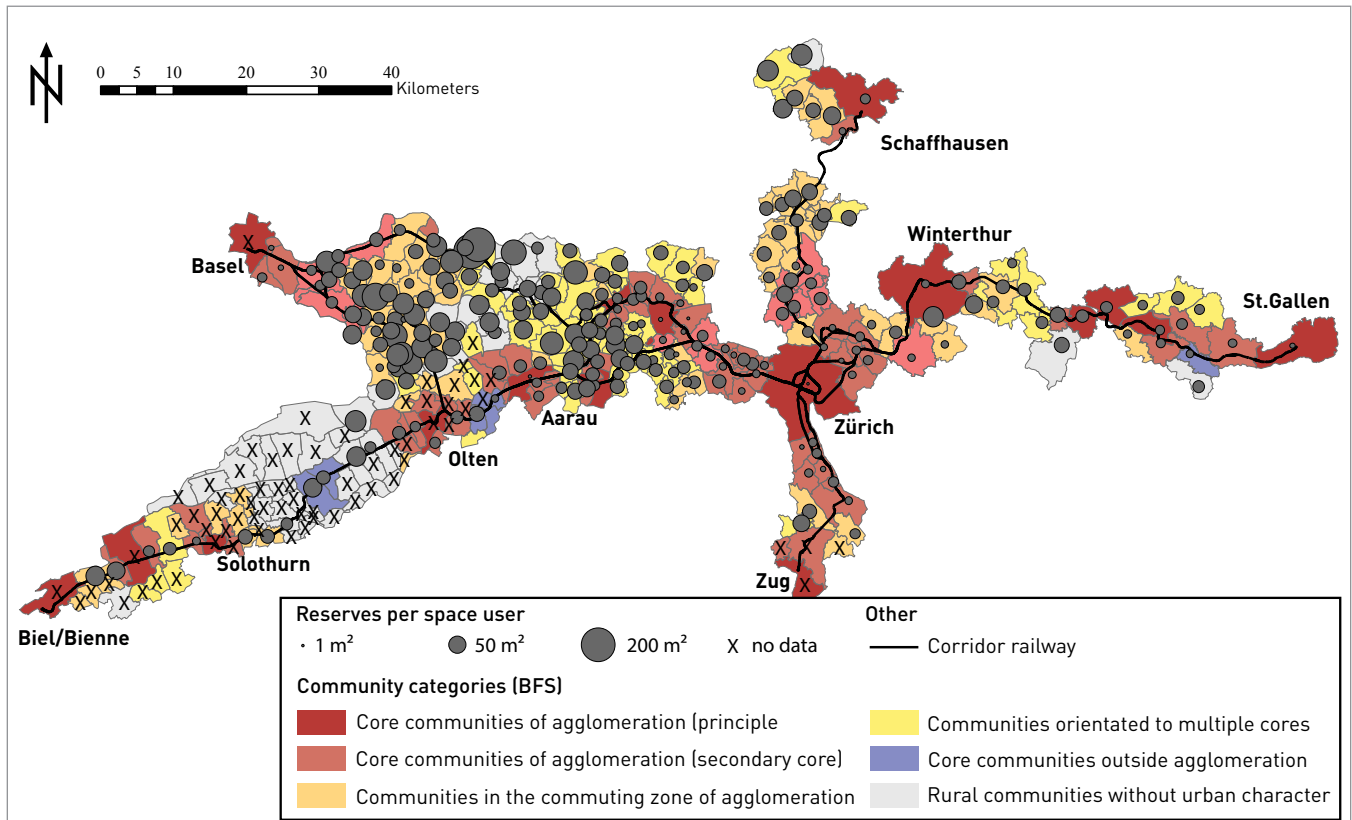


Figure 9. Communities based on urban characteristics and prospected population growth [Source: Authors | Data: BFS, 2014; W+P, 2015]

In 2014, the Federal Office of Statistics (BFS) published a revised typology of Swiss communities, characterising the respective urban character of each community. According to the BFS terminology⁴ the following six terms are used in this study to designate six categories of urban character: **principle and secondary core communities of agglomerations** (communities representing the primary or secondary cores of an agglomeration), **communities in the commuting zone of agglomerations**,

communities oriented to multiple cores, core communities outside agglomerations and rural communities without urban character (BFS, 2014). Along the corridors in this study area, all six types can be found, as Figure 9 shows. While in proximity to Zurich, the stations along the corridors are situated only in communities located in or oriented to the agglomerations, three stations in rural communities without urban character can be found between Olten and Biel, and another between Zurich

and Basel. Up to 2025, according to the real estate consulting agency Wüst+Partner (W+P, 2015), two-thirds of the estimated population growth within the study area is expected to happen in the 91 core communities of the agglomerations. The other one-third of population growth is expected to spread over 234 other communities, however, the 54 rural communities without urban character are not expected to experience any population growth.

⁴ Based on the original translation of this terms from German to English, BFS used 'municipality' for the term 'Gemeinde'. However in this document, we consider 'community' as the proper translation for 'Gemeinde', while municipality might be misrepresented as the area with a more obvious urban identity.

2.3 Settlement Reserves

In general, different types of reserves for development are available in the built-up settlement areas. The two following subchapters give an overview of the settlement reserves assessed by the Raum⁺ approach and reserves on SBB areas.

2.3.1 Raum⁺ data

The objective of the Raum⁺ approach is to gather detailed information on the extent, location and quality of the available settlement reserves. The Raum⁺ approach was developed at the ETH Chair of Spatial Development until 2006 and since then constantly optimised. Within our study area, the

approach was used in the cantons of St.Gallen, Thurgau, Basel Landschaft and Schaffhausen (see Fig. 10). For the cantons of Zurich, Aargau, Solothurn and Bern, Raum⁺ data have not been gathered to date, therefore, we had to refer to the respective cantonal data. The results of the finished Raum⁺ projects show that the reserves in rural communities in relation to the number of space-users (*Raumnutzer*) within the respective area are higher than in urban regions. Raum⁺ also revealed that the present reserves could absorb the increased demand for residential development indicated by the projected population growth.

The cantonal data are based on data assessments other than Raum⁺ data. Thus, a consistent analysis of the current reserves within the study area is needed to get a better understanding of where additional settlement development should be pursued in relation to future rail corridor capacities.

Figure 11 shows the preliminary results of the available settlement reserves within the study area. The available reserves are given in m² per space-user, which includes inhabitants and employees. The reserves per space-user range from 2 m² in Zurich up to 199 m² in Münchwilen (AG). On average,

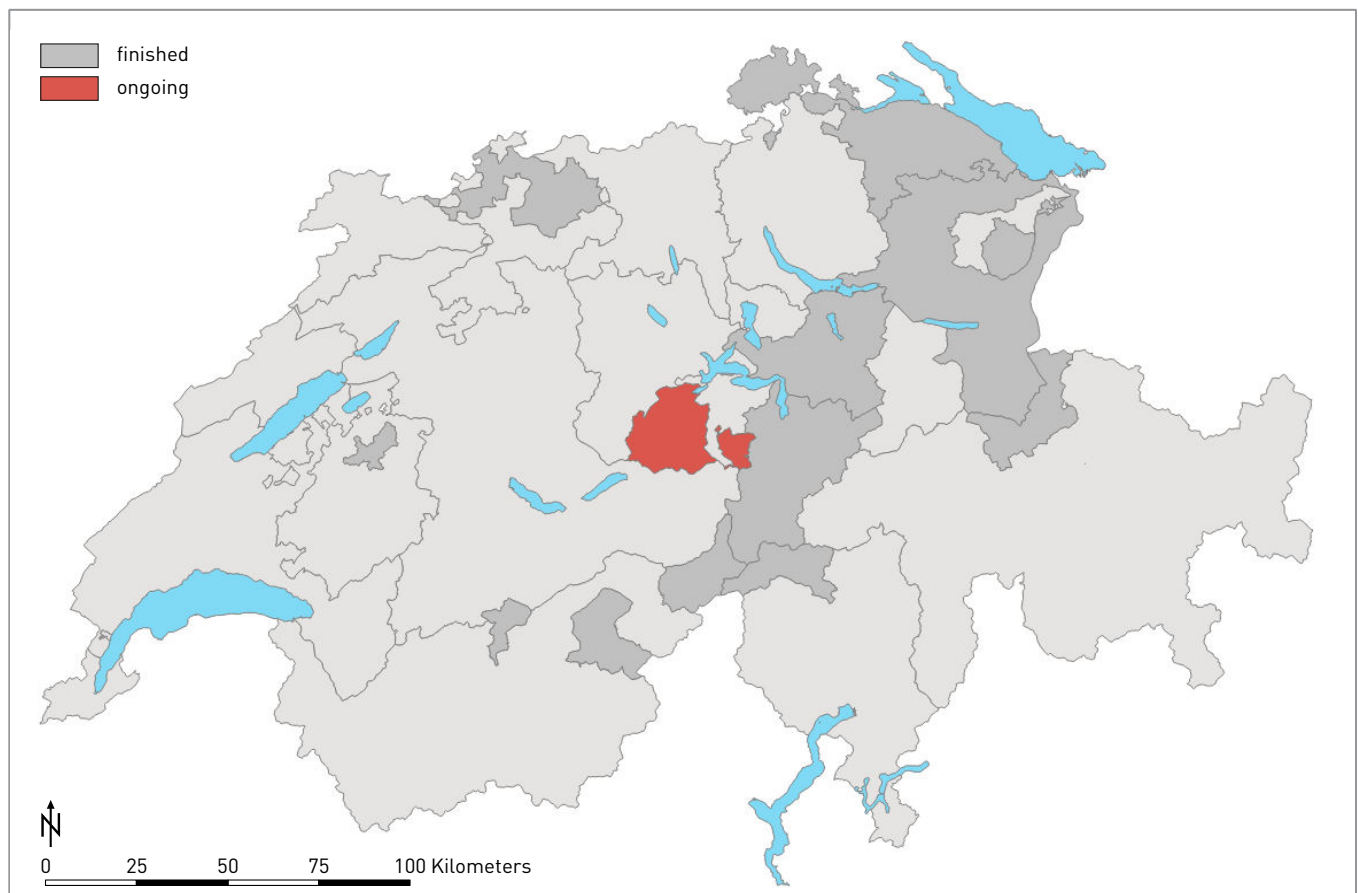


Figure 10. Swiss cantons and regions, where Raum⁺ projects were executed (Source: IRL ETH - Raum⁺ Project)

2. Overview and Assessment of the Current Situation

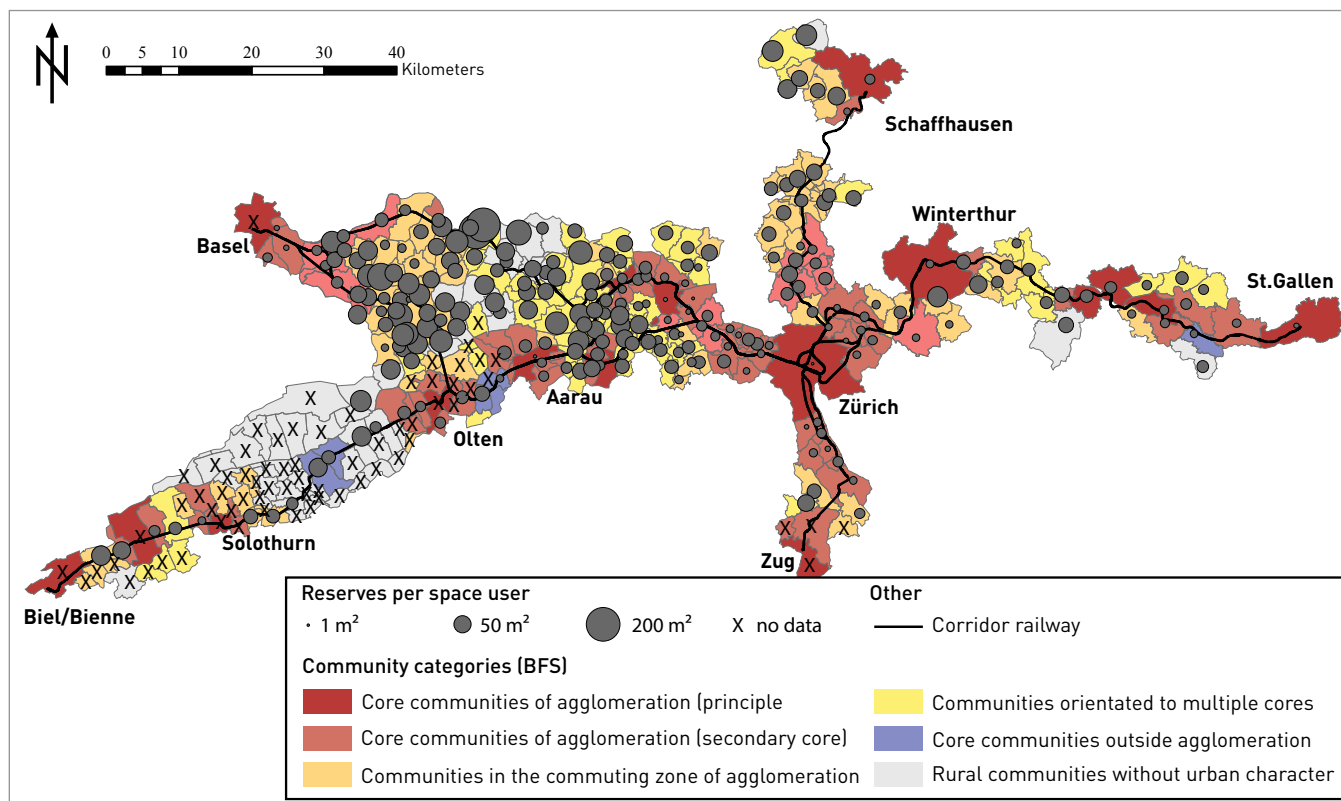


Figure 11. Urban character of the target communes and available reserves per space user on communal level (Source: Authors | Data: see appendix I)

each community within the study area has 36 m² of reserves available.

As Figure 12 indicates, the most extensive reserves, 54 m² per space-user, are available in rural communities without urban character. The lowest amount, on average 21 m² per space-user, is available in the principle core communities of the agglomerations.

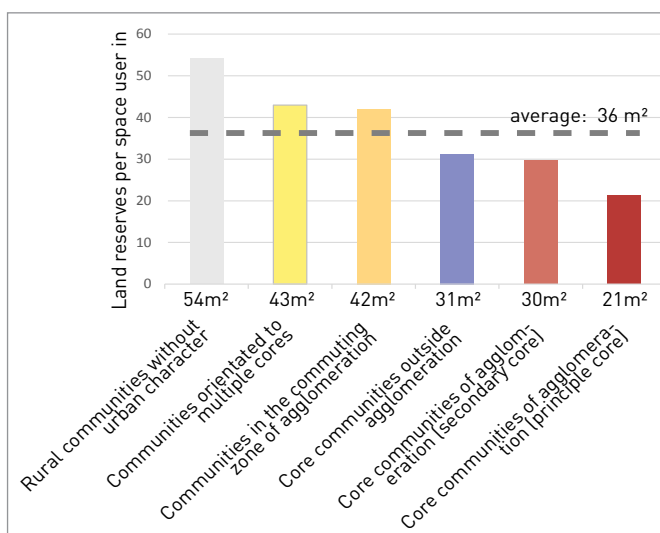


Figure 12. Urban character of the target communes and available reserves per space user on communal level (Source: Authors | Data: see appendix I)

2.3.2 SBB data

Apart from the settlement reserves gathered by Raum+, SBB properties are expected to comprise a significant amount. Nationwide, SBB owns a total of 93 km² of land,⁵ which is equivalent to almost half the size of the Canton of Zug. This makes

SBB one of the main landowners in Switzerland (*Eidgenössische Finanzkontrolle*, 2012). Within the study area, SBB properties comprise 23.7 km², of which 18.3 km² belong to the SBB Infrastructure Division. These properties mainly consist of areas dedicated to rail infrastructure, such as tracks or signal boxes. In addition,

the Infrastructure Division operates 0.1 km² of power supply systems, including transformer stations and landlines. The other 5.4 km² of SBB properties belong to the Real Estate Division, including mainly station buildings, access areas, safety buffer zones and other areas.

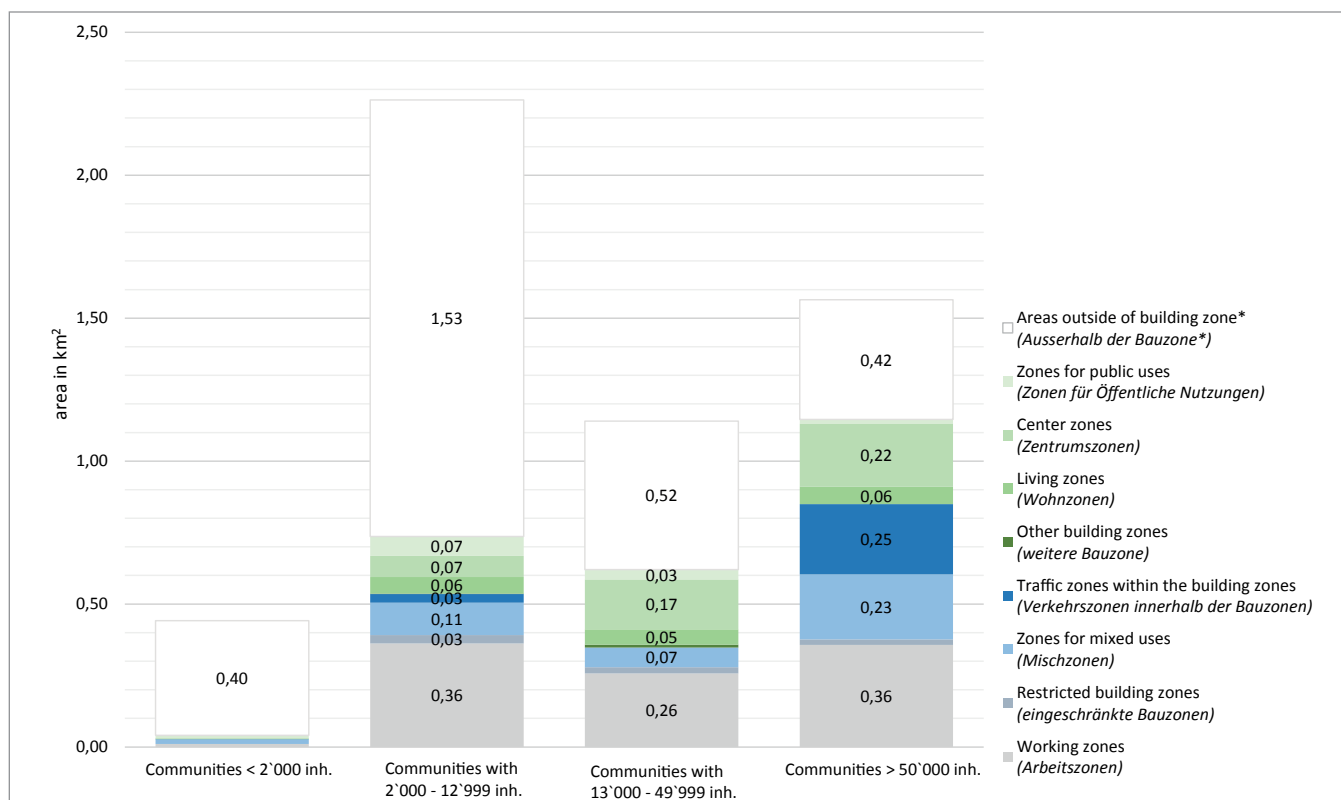


Figure 13. Extent of SBB real estate properties within the study area [Source: Authors | Data: SBB, 2015]

* Remark to the category of "Auserhalb des Bauzone"; especially in smaller communities, station areas are often not formally part of building zones, although the station areas are located in the built-up area of settlement.

Figure 13 gives an overview of the areas owned by the SBB Real Estate Division within the study area. The chart shows the kind of building zone where these 5.4 km² are located. Although the study area covers densely populated areas of the Swiss Central Plateau, including numerous major cities, half of the properties (2.7 km²) are located in communities with less than 13'000

inhabitants. Of these, 0.8 km² are located inside defined building zones, while 1.9 km² are allocated to non-building zones. However, especially in smaller communities, station areas are often not formally part of building zones, although the station areas are located in the built-up area of settlement. This short overview

indicates that SBB owns considerable amounts of land in small communities.

Nevertheless, for a deeper understanding of the challenges and opportunities facing SBB, further analysis is needed on the questions of how these areas are currently used and to what extent they may be available for future development.

⁵ Whereof 77.0 km² belong to SBB Infrastructure, 14.7 km² to SBB Real Estate and 1.4 km² belong to SBB Energy

3. Actors and Decision-Making Processes for Railway Station Development

Diverse actors and stakeholders are involved in the development of the railway system and its stations. This chapter gives an overview of the different actors' strategies and decision-making processes relevant to the further analysis of station development.

3.1 Confederation

The Swiss Confederation is sole holder of the Swiss Federal Railways (SBB), which is organised as a public corporation. Within the current strategy aims for the SBB, the Federal Council sees the Federal Government's role as the leading position for planning the further development of public transport. One important aim of the Federal Government is a demand-based extension of the public transport infrastructure that also considers the consequent costs. A second important aim is to increase the share of rail transport in transalpine freight traffic

(UVEK, 2015a). Detailed policies and measures are defined in the Federal Sectoral Plan for Rail Infrastructure (UVEK, 2015b). The implementation is delegated to the SBB, explicitly including its affiliates.

Regarding future settlement development, the Federal Council recently confirmed the importance of redevelopment as its policy. The Federal Council's Sustainable Development Strategy 2016–2019 sets out priorities for sustainable development for the mid-term to the long-term. In Action

Area 2: Urban Development, Mobility and Infrastructure, the Federal Council identifies the need for redevelopment as a key medium-term challenge up to 2030: "Greater efforts must be made to use land economically and to guide urban development even more strictly inwards. Inward development should be conceived in a way that preserves or increases the appeal of urban areas, while offering a suitable framework of open spaces and infrastructures to meet residents' needs" (Swiss Federal Council, 2016, P 52).

3.2 Cantons

In the regional transport service, the cantons have priority for concept development. The order of regional train and bus services is also a

cantonal assignment. An attractive public transport is very important for the cantons, as it can positively affect the attractiveness of the cantons as

economic and residential locations. Cantonal strategies and projects concerning public transport are projected by the responsible cantonal

departments and coordinated with the guiding plans (*Richtpläne*). A commonly mentioned aim is to guarantee attractive connections from the regions to the cantonal centers, with good connections to national and international destinations. Half-hour frequencies are the target for regional train services, with more frequent

connections in agglomerated areas or in peak hours. In the guiding plans of the cantons of Thurgau, Zurich and Basel-Landschaft, the federal goal of dealing economically with land resources is also stated. In the cantons of Aargau, Bern, Schaffhausen, Solothurn and St.Gallen, the guiding plans are currently being adjusted to

give priority to redevelopment before new development, among other updates. The cantons of Aargau, Basel-Landschaft, Solothurn, St.Gallen, Thurgau and Zurich have additionally published a guiding plan chapter focusing on the development potential of railway station areas of cantonal importance.⁶

3.3 Regions

In some cantons, a regional planning scale also exists between the cantons and the communities. In the Canton of Zurich, for example, 11 planning regions adjust the goals and standards given by the cantonal guiding plans

to meet regional requirements. Elsewhere, planning regions are also organised across cantonal borders, e.g. Regio Wil, which covers areas of the cantons of St.Gallen and Thurgau. The aim is to act on small agglomerations

and their hinterlands through these planning regions. Neither the planning regions nor the other actors focus on railway corridors as considered in this study.

3.4 Communities

The communities are the lowest administration level in Switzerland. By law, the communities are the general authority for public issues that do not explicitly fall into the area of responsibility of upper administration levels or special communities. However, the communities are not 'equal' in many aspects. While the most populated community, Zurich, had 390`474 inhabitants at the end of 2014, the least populated community in Switzerland, Corrippo, had only 13 inhabitants. Within the study area, the smallest community with a railway station is Tecknau, canton of Basel-Landschaft, with 860 inhabitants.

Like the number of inhabitants, the political organisation of the communities is also distinctly different. Community assemblies or parliaments can take on the role of legislative authority. In the majority of Swiss communities,

especially in the German-speaking area, community assemblies are still widespread (Schuler et al. 1997). In this region, communities with less than 10`000 inhabitants are typically organised under a 'militia system', and hold regular assemblies where political decisions are made by the voting citizens. In communities with less than 2`000 inhabitants, spatial planning tasks are often mandated to private planning offices. Communities with up to 10`000 inhabitants often engage part-time administrators for spatial planning, while work-intensive tasks, such as zoning plan revisions, are outsourced to external offices. Communities with more than 10`000 inhabitants are typically organised as a parliamentary system. Political decisions are taken in the community parliament, which represents the electorate. Here spatial planning is often carried out by community planning departments.

Nevertheless, independent of their size and organisation, communities are of great importance as political and statistical units.

Through good accessibility by public transport in Switzerland, railway stations are often central locations for the communities and focal points for inner development. Useful amenities and services are commonly offered in the direct vicinity. From a spatial and economic perspective, the already good accessibility, which will increase in future, will enable station areas to become ideal spots for future urban development. However, according to a survey in 2009–2010, land-use planning had reached or exceeded its capacity in 11.5% of Swiss communities, and for the approval of building permits in 11.6% of the communities. These two statistics were in the top ten categories where communities reach

⁶ This paragraph is based on the cantonal guiding plans listed in the References.

their limit of performance (Ladner et al. 2013). Evidence has also shown that small communities often have difficulties with putting provisions given by the cantonal guiding planning into action. The personnel resources are restricted, especially in the smaller communities, and experience is limited regarding redevelopment (ETH Zurich, 2013). However, ongoing and projected revisions of building

zones in direct vicinity to railway stations show that local authorities are increasingly concerned with urban development around railway stations. For example, between 2011 and 2015, in the Zurich–St.Gallen corridor, seven zoning changes within 300 m around the railway stations were carried out by small and mid-sized communities. Most of these changes led to extension of the building zones or better use of legally

settlement areas, which are already within the building zone. For the period 2016–2020, 10 zoning plan revisions are projected in the vicinity of the stations. In the Zurich–Basel corridor, a similar trend can be observed (see Fig. 14). Only one community has delimited the building zone by rezoning a land parcel into a non-building zone in the period 2011 to 2015.

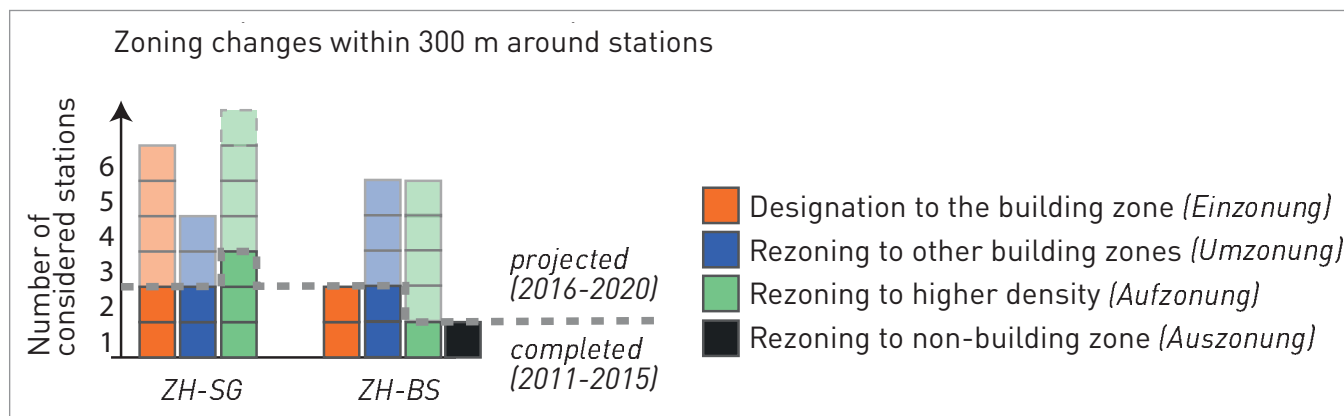


Figure 14. Zoning revisions in 2011–2020, considering zoning changes within 300 m around 22 stations [Source: Authors | Data: see appendix I]

In addition to being potential focal points for urban development, stations also act as hubs between rail and bus services. Accordingly, community authorities expect that attractive connections between local buses and the rail network will be provided. The responsibility for funding and organising community bus lines differs

between cantons. In the Canton of Bern, for example, bus services are planned and ordered by the canton, while in other cantons, the agglomerations or communities carry out this task (AöV, 2014). However, regional train schedules are usually oriented to major rail hubs in order to offer good connections to the rail network. At

intermediate stations, this can result in asynchronous train departures for the opposite directions of travel and, in some cases, impede the hub function of stations in small communities. Such cases are typical, especially for small communities dealing with the contradictions between higher levels of planning and local particularities.

3.5 SBB

The Swiss Federal Railways (SBB) operates 60% of the Swiss Rail network. The corporation is subdivided into four divisions: Passenger, Freight/SBB Cargo, Infrastructure and Real Estate. The Passenger Division is responsible for the operation of passenger trains, including commuter trains and long-distance trains. SBB Cargo handles the organisation of freight transport,

while Infrastructure provides the railway installations used by the Passenger and Freight Divisions. The Infrastructure Division is in charge of railway installations, such as tracks and signal boxes, as well as platforms and passenger access routes. The division's tasks include planning, construction, operation and maintenance of these railway installations. The Real Estate

Division manages all properties owned by SBB. Thus, the SBB Real Estate portfolio covers a wide range: from maintenance depots through office complexes to station buildings and diverse structures. The portfolio also includes properties used for P+R (Park and Rail), areas used by SBB Cargo and empty sites. Special strategic goals were formulated by the Federal

Government and delegated to SBB Real Estate. The main task requires the affiliate to design its stations in an attractive way, develop them into customer-friendly service centers and facilitate rail access. Another aspect of the task is to coordinate the development with the cantonal and communal authorities. In addition, the Federal Government expects an active portfolio management and a profit-oriented development of SBB's estates and properties (UVEK, 2015a). The Real Estate Division has to transfer 150 million Swiss francs annually to the Infrastructure Division. In addition, Real Estate has to pay contributions to the recapitalisation of the pension fund.

The Federal Government also assigns special strategic goals to the SBB Infrastructure Division. These goals include an adequately maintained infrastructure as well as customer-friendly access for goods and passengers to the rail network. The scope for the investments of SBB Infrastructure is strongly driven by an implementation of extension projects and regulations. For instance, to fulfil the Federal Act on the Elimination of Discrimination

against People with Disabilities (*Behindertengleichstellungsgesetz*) of 2002 (BehiG, 2013), SBB Infrastructure is still investing personnel and financial resources in the enhancement of platforms and disabled-friendly platform accesses. Moreover, currently inadequate stations, such as Bern or Winterthur, will be expanded to adapt to the increasing number of station users. Except for major stations and important rail hubs, the majority of stations already have appropriate station access for the future. Thus, from an Infrastructure Division point of view, extension projects, such as the improvement of platform accessibility to surrounding development potentials, are neither mandatory nor priority. Therefore, the funding of such projects has to be ensured by community contributions or by sponsorship from specific funding schemes, such as agglomeration programmes.

SBB Infrastructure and SBB Real Estate are compulsory partners in the planning of station development projects in communities. Today, three instruments are used for the coordination of different actors and interests. The long-term development of railway system hubs, including its

proximities, is coordinated in an overall perspective (*Gesamtperspektive*) (Stöckli, 2015). The fields of this instrument are considered to be the future rail infrastructure development, the future transport offer and urban area developments. The long-term development of railway system hubs through the omission of area developments is coordinated in master plans (*Rahmenplan*), for instance, in Winterthur. On behalf of SBB, communication with 49 communities is currently managed systematically using the partner management system (*ibid.*). The purpose of partner management is to coordinate the communication using a designated contact person and a common communication platform (*ibid.*). However, these instruments concentrate solely on major communities. The coordination with small communities is grounded on project-based collaborations. Unfortunately, a systematic coordination of station development in small and mid-sized communities is missing (see Fig. 15).

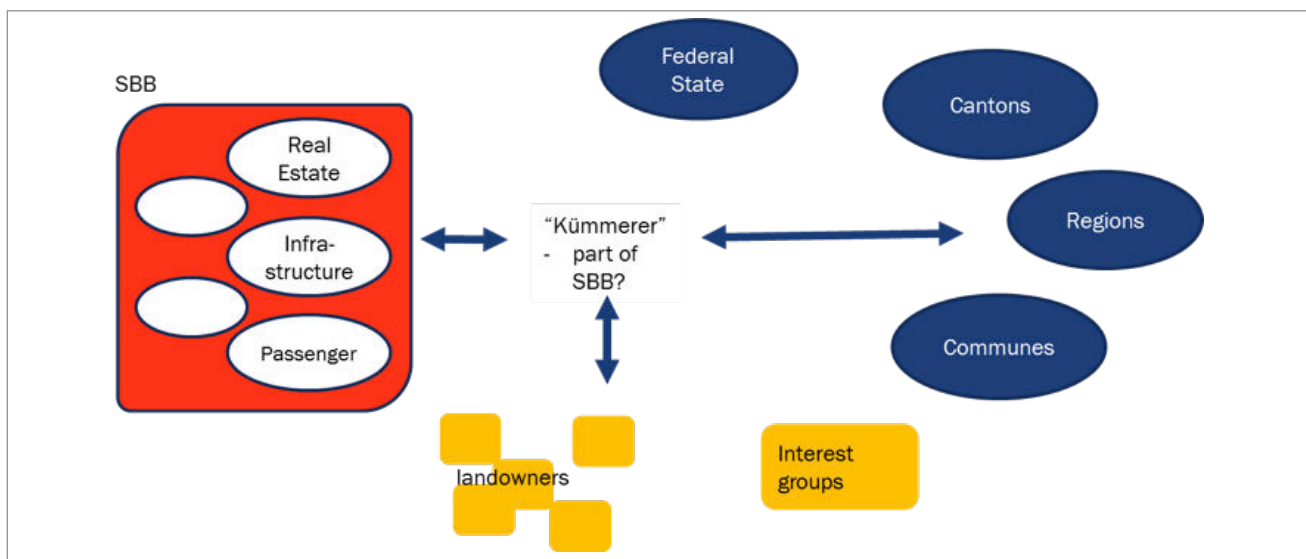


Figure 15. Actors-network on station development (Source: Authors)

4. Summary of Preliminary Findings

The overview shows that the SBB rail network is in a continuing period of investment and network expansion. However, bottlenecks are already occurring in the network. Several network sections are operating at maximum capacity. An analysis for 2025 that considers the funded extension projects and the future schedule reveals that bottlenecks will continue in the study area of the intake areas to Zurich and Basel. Only major infrastructure extensions could create additional train routes for these critical sections. Without these improvements, additional passenger services could only be introduced on medium-use sections, such as Olten–Biel or Winterthur–St.Gallen, and only under consideration of schedule restrictions.

Population prognoses published by the real estate consulting agency Wüst+Partner (2015) show that two-thirds of the estimated population growth up to 2025 is expected to affect the 91 core communities of the agglomerations. The other one-third of population growth is expected to spread over 234 other communities, of which the 54 rural communities without urban character are not expected to have any population growth. The real estate sector expects the section Olten–Biel, for instance, to have only a slight population growth (see Fig. 24).

The overview of the available building zone reserves clearly shows, however, that substantial reserves are available

outside the agglomerated areas, while reserves within the agglomerated areas will remain limited (see Fig. 21). In 2014, on average, 36 m² per space user were available for development in each community, while an average of 54 m² was available in rural communities without urban character and just 21 m² in core communities of agglomerations (Fig. 12). Further reserves are also owned by the SBB, which is one of the main landowners in Switzerland. Within the study area, the properties comprise a total of 1`830 ha, of which 540 ha are owned by SBB Real Estate. With 250 ha, almost half of SBB Real Estates properties are located in small and mid-sized communities. To assess if a population spillover into regions with extensive building zones will occur in future, a better understanding is needed of the position and extent of reserves around the railway stations in small and mid-sized communities.

The Federal Council identified the need for redevelopment and an economic use of land as a key medium-term challenge up to the year 2030. The correlating strategy 'redevelopment before new development' is increasingly embedded in the cantonal guiding plans. However, communities still have difficulties with putting the provisions given by the cantonal guiding plans into operation. At the same time, evidence shows that community authorities are concerned with urban development around railway stations and facilitate

redevelopment by implementing building zone revisions in direct vicinity to their stations.

It is clear that the SBB, as a stakeholder, requires the Infrastructure and Real Estate Divisions to be profit-oriented. Both can take a leading role to stimulate development, but only if this meets their business goals. In recent years, their business activities were focused on the development of real estate properties in the agglomerations. On the basis of the proposed analysis of reserves around the stations of small and mid-sized communities, the SBB Real Estate Division needs new parameters in order to determine the location of possible business opportunities in future. Furthermore, a strategy should be submitted for the future handling of stations in small and mid-sized communities. Since collaboration and negotiation between the communities and the SBB is needed for railway station projects, this can help identify the most promising stations for future development, as well as improve collaborations with communities by concentrating the available resources on auspicious projects.



5. Analysis

Based on the findings from the general assessment and overviews in previous chapters, this chapter presents the main problems related to an integrated spatial and railway development, especially in small and mid-sized communities.

5.1 Study Area

Previous studies have shown that there is significant development potential in small and mid-sized communities; however, a coherent planning vision is still missing (Grams, 2015). To prepare for current and future conflicts in the study area requires classifying the communities that indicates the size, typology and professional planning status in each target community.

It is also important to consider such areas within their larger context. In

our study, the larger context consists of regions along the railway networks where the inhabitants and employees of such regions are potential railway passengers. Therefore, five groups of communities that are connected by the same railroads have been chosen for study (Figure 16). This approach has some benefits, such as the comparability of communities with different characteristics, which will later help assess potential settlement corridors based on pilot

case studies. Studying settlement and railway corridors together will lead to a simultaneous railway and spatial analysis and better coordination, making it easier to diagnose potential development spots as well as problem areas. This approach provides more flexibility and wider maneuverability in trying to resolve problems.

The communities located in the Zurich–Basel corridor have a wide range of characteristics, however, the

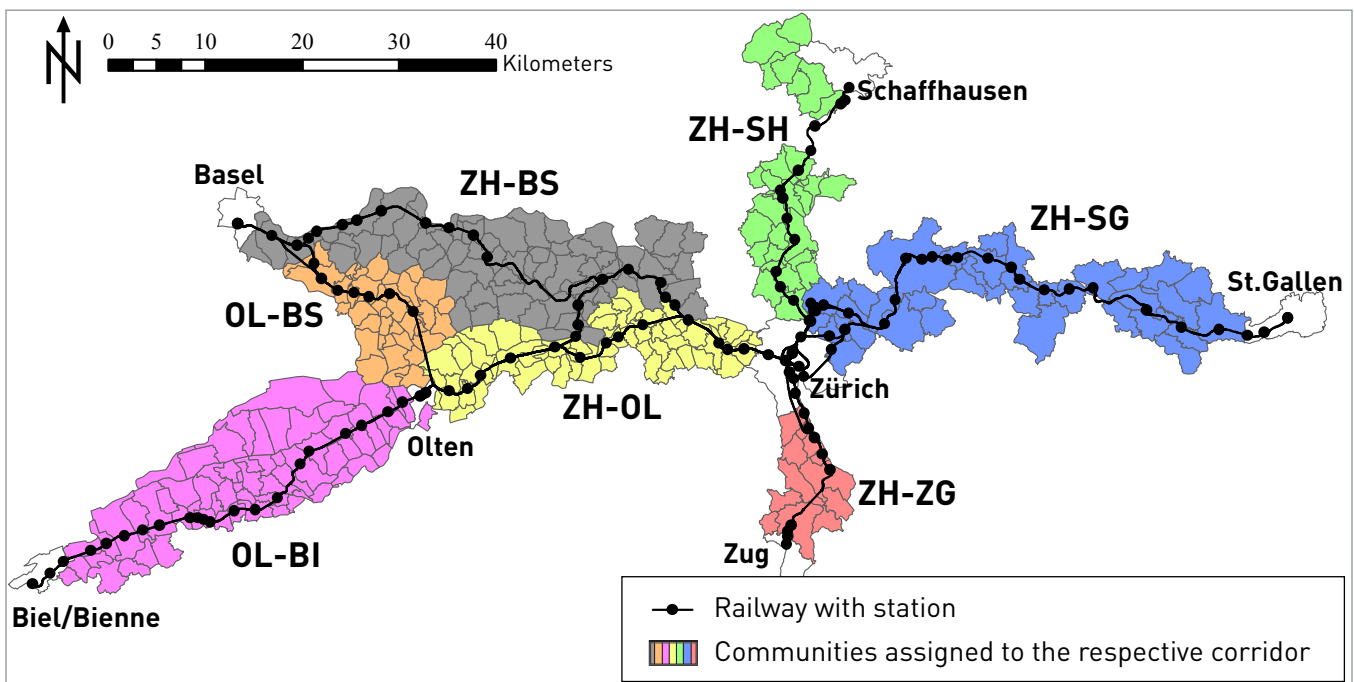


Figure 16. Five group of communes connecting to Zurich by railroads (Source: Authors | Data: Swisstopo, 2015a)

corridor itself can easily be divided into three sections. Furthermore, smaller sections provide a more detailed analysis and more specific suggestions (Figure 17). But it must be noted that the sections do not represent homogenous areas with similar community characteristics. Therefore, we focus on the sections instead of the entire corridor to avoid complexity, especially in the corridor

Zürich–Basel, which topography and spatial patterns of the settlements vary considerably.

The variety of communities along each of the railway sections range from agglomeration core communities to rural communities without urban characteristics. Using the classification of Swiss communities by urban characteristics conducted

by the ARE (Swiss Federal Office of Spatial Development), the diversity of communities is visible in each section (see Fig. 9) (BFS, 2014).

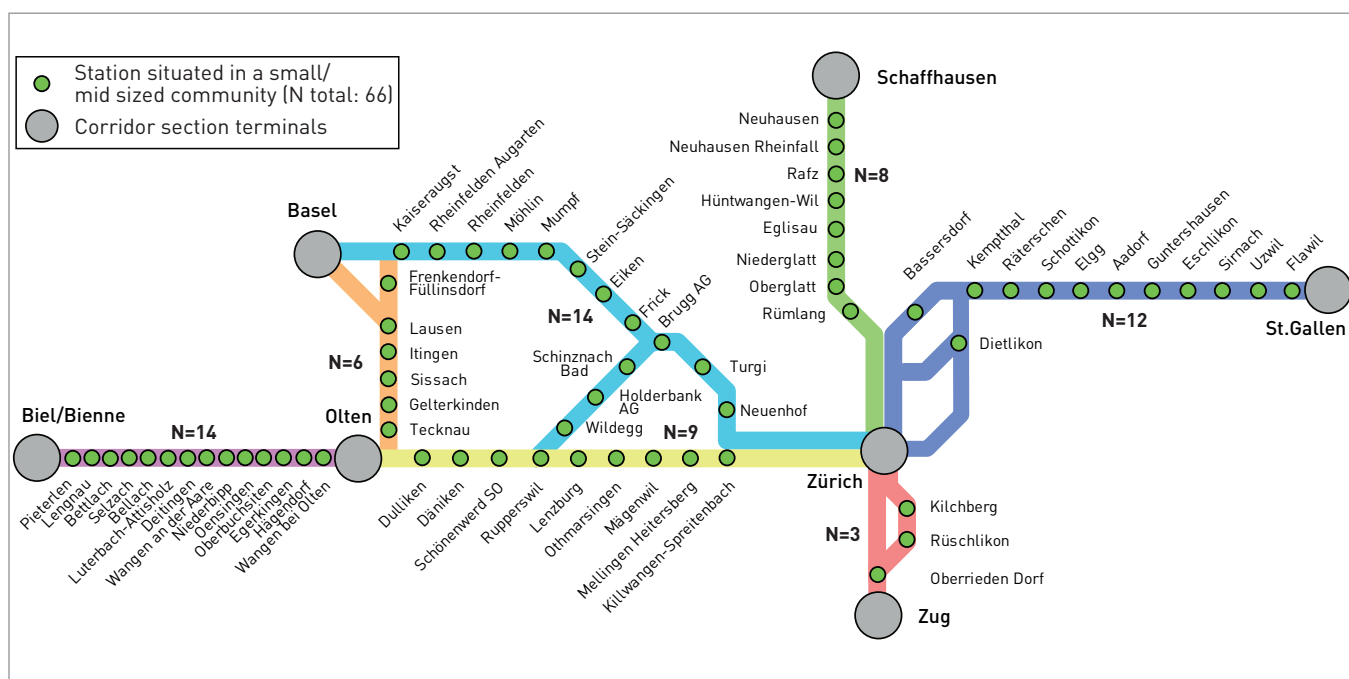


Figure 17. Seven railway sections and the corresponding stations in small and mid-sized communities (Source: Authors)

Seven railway sections are chosen to investigate the ways that different railway connections can influence the small and mid-sized communities. However there are stations with various functionalities in each section. The questions is what criteria should be considered to change or retain the railway station functionality in the network.

	Sections	Number of Communities	Number of Small & Mid-sized Communities	Number of Small and Mid-sized Communities with Station
1	Zurich-St.Gallen	36	25 (69%)	10 (40%)
2	Zurich-Schaffhausen	31	28 (90%)	7 (25%)
3	Zurich-Zug	15	9 (60%)	3 (33%)
4	Zurich-Olten	59	54 (92%)	9 (17%)
5	Zurich-Basel	79	74 (94%)	14 (19%)
6	Olten-Basel	39	38 (97%)	6 (16%)
7	Olten-Biel	66	65 (98%)	14 (22%)
8	Total	325	293 (90%)	63 (23%)

Table 1. Overview of the communities based on the population classification (Source: Authors | Data: BFS)

5.2 Definition of Small and Mid-sized Communities

Although population density is the classic criteria for the statistical definition of a city, adding the number of employees would link this definition to other aspects of cities that are

relevant to urban economic and industrial activities. In this study, we have developed our classification based on the definitions of the Swiss Federal Office of Statistics (BFS) for the

urban characteristics of different Swiss communities (BFS, 2014). What the BFS has produced includes not only the number of inhabitants and employees, but also the equivalent number of

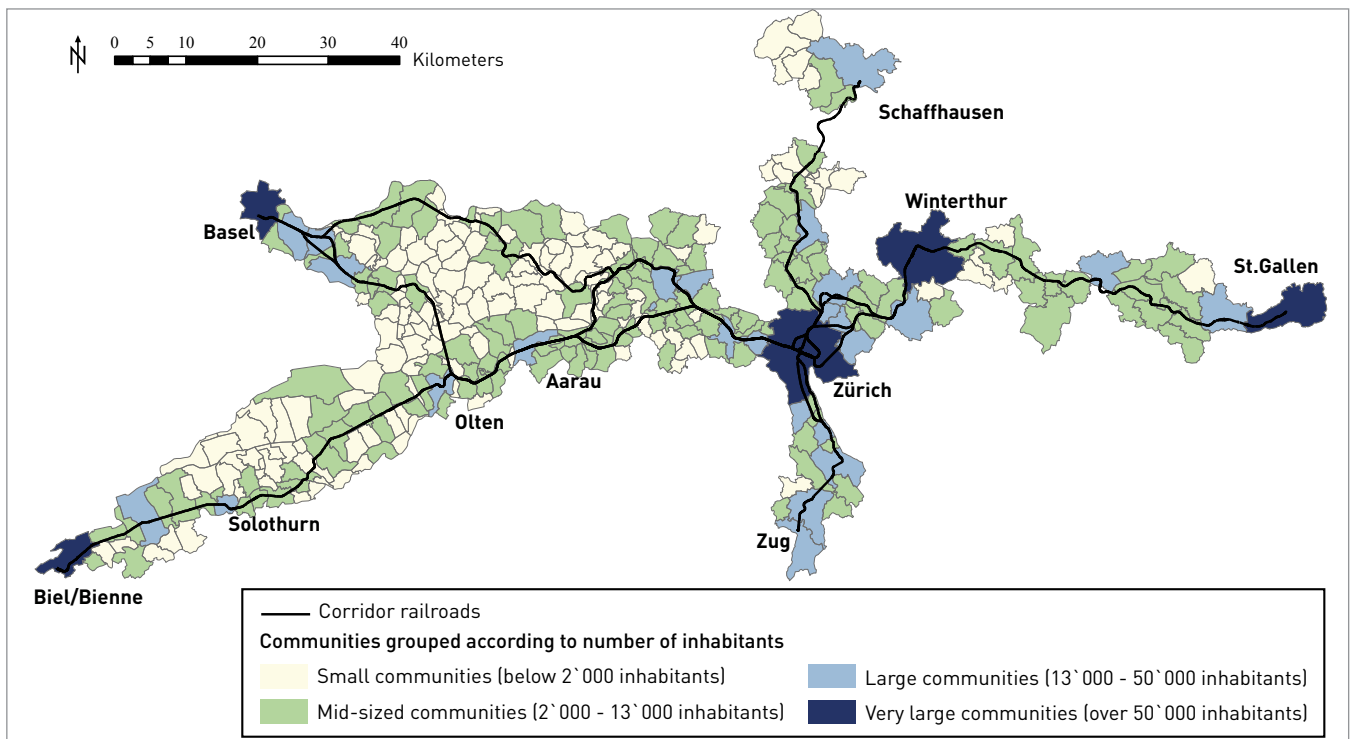


Figure 18. Classification of the communities alongside the corridor railroads based on the size (Source: Authors | Data: BFS, 2014)

overnight stays at hotels and resorts by tourists. This variable is called EBL, which stands for residents (*Einwohner*), employees (*Beschäftigte*) and overnight stays (*Logiernächte*).

$$EBL = \text{Residents} + \text{Employees} + (\text{overnight stays} * 2) / 365$$

The factor 2 is used because of double counting of the day or night population. According to this formula,

we have considered communities with an EBL above 20`000 as large or very large communities (BFS, 2014). Therefore, the target communities in this study consist of the EBLs below 20`000 (Figure 18). In this study area, the communities with an EBL below 20`000 are coincidentally the same as the communities with below 13`000 inhabitants. Therefore, for simplification, the number of

inhabitants is addressed in this research instead of the EBL.

An integrated spatial and infrastructure development is a multi-faceted issue and requires different data. In this section, possible opportunities and conflicts of this multi-faceted topic are presented for these aspects: planning processes, land reserves and number of SBB properties.

5.3 Research Aspects

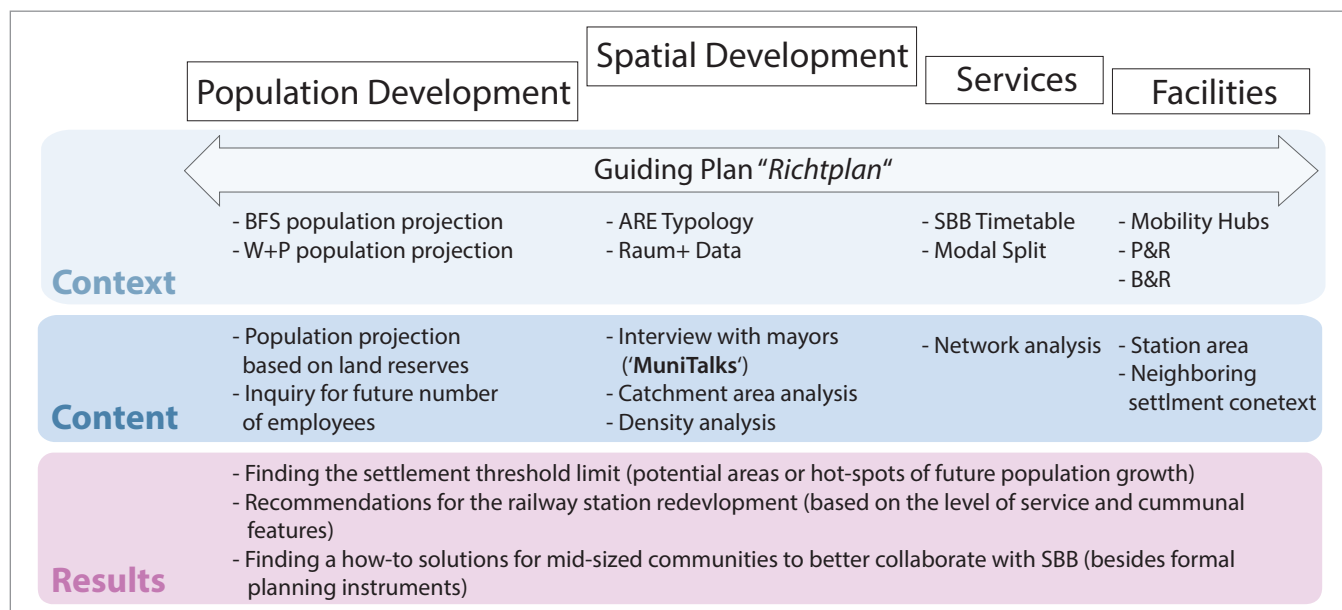


Figure 19. Different aspects of the research topic and major approaches (Source: Authors)

5.3.1 Planning Procedure

Most of the information related to the 325 communities in the study was collected from the SBB data, federal offices or special initiatives, such as the Raum+ projects. This data

provided the basis for the formulation of our methodology, which forms the 'context' of this research. In order to develop further analyses, new data and methodology were also initiated during the project to enlarge the 'content' of this research.

As different actors and stakeholders are involved in the process of

decision-making for railway station development, the development of railway station data is more complex. This complexity is increased again when the data is required for research. In the following chapters, we try to relate different types of data and synchronize them, in order to provide homogeneous and comparable case studies.

5.3.2 Land Reserves

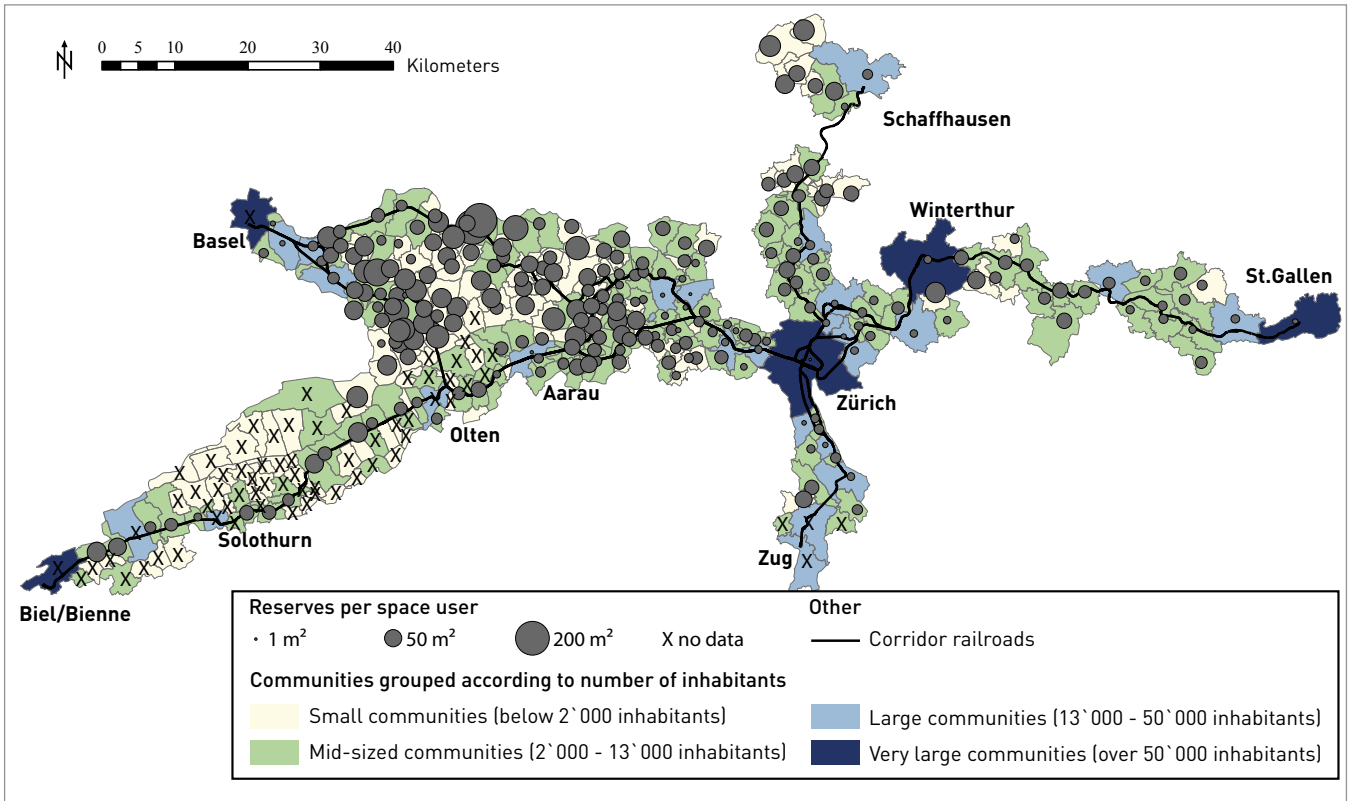


Figure 20. Overview of the available land reserves per space user within the study area [Source: Authors | Data: see Appendix I]

Data on the amount of available land reserves is not transparent in all target communities. Although data about reserves is provided in some cantons, the definition of land reserves varies from one canton to another. We have chosen Raum+ data as the basis for the land reserve analysis and chosen similar categories from the other cantonal data. Figure 20 illustrates the distribution and the amount of land reserves per space-user, e.g. inhabitants, employees and travellers who stay over night in the study area. The Canton of Solothurn has not provided any data on its land reserves. Nevertheless, we compared the significant amount of reserves located in the small and mid-sized communities, especially in the western corridors.

The bar chart in Figure 21 indicates the available land reserves in different classes per space-user, which provides a setting for a fair comparison. It also shows the limitations of accommodating additional population in large and very large communities without considering the potential in smaller communities.

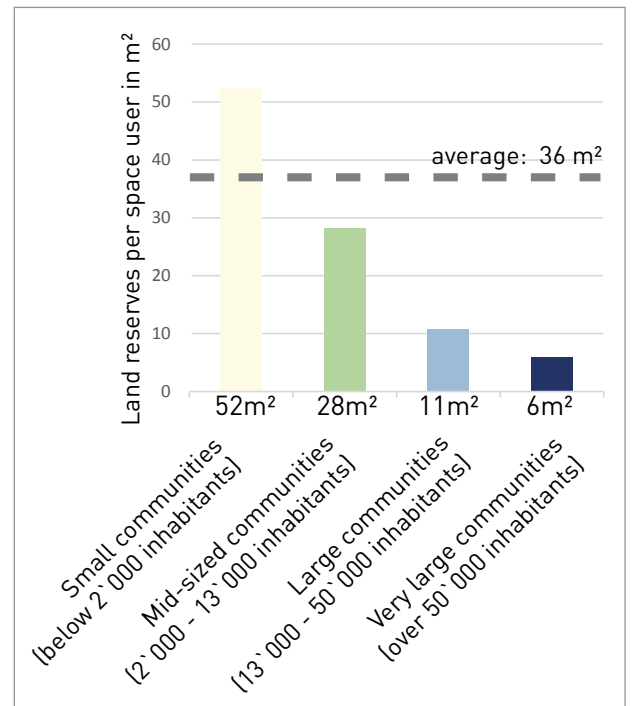


Figure 21. The amount of available land reserves in m² per space user in different types of communes [Source: Authors | Data: see Appendix I; BFS, 2014]

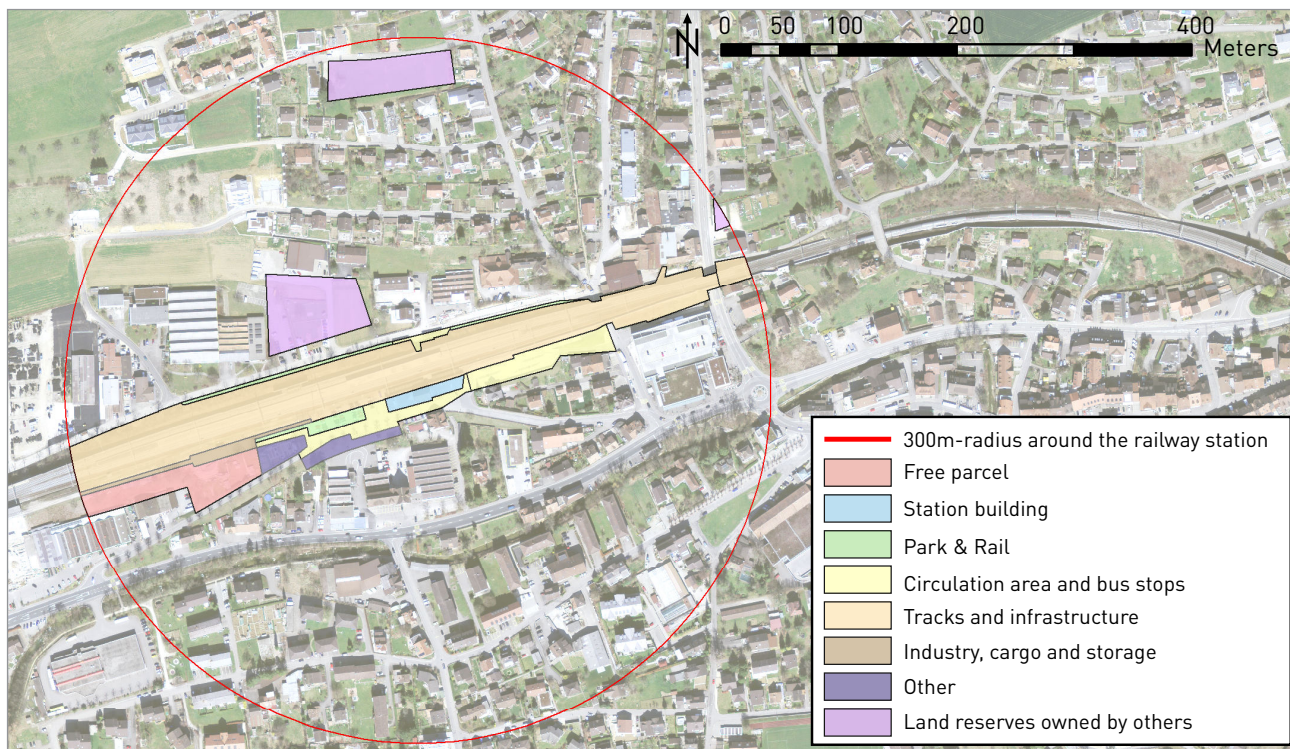


Figure 22. An example of the current use of SBB Real Estate properties in six main categories (Source: Authors | Data: Swisstopo, 2015a; SBB Real Estate)

5.3.3 SBB Properties

In addition to the general land reserves, there are also some land reserves belonging to the SBB Real Estate Division. Although these land reserves are often strategically located, many of them are not considered in the zoning plan of small and mid-sized communities. To provide informative data for the current use of the land owned by SBB Real Estate, aerial images (Swisstopo, 2014a) along with data on the boundaries of the properties (SBB Real Estate) was used to identify the land parcels. Figure 22 shows the six categories developed to distinguish developable and available land parcels from the already functioning and not-developable properties.

Free parcels indicate the land parcels available for further development. Naturally, the railway station buildings, bus stops and circulation areas are essential elements and parts of the currently functioning stations. Technical, industrial and infrastructural lands are among the not-developable parts of the land.

In the following chapters, the main focus is on the free parcels belonging to SBB Real Estate that are immediately available for further development. These parcels have double-faced importance for both SBB and the community authorities, while there are potentials for a collaborative town center redevelopment or denser housing areas in such well located land parcels.

5.4 Corridor Analysis

From a spatial planning perspective, the railway sections available for development in the study area have different characteristics. This is important mainly for their attractiveness and how they can fulfil the housing demand of the small and mid-sized communities in each defined railway section.

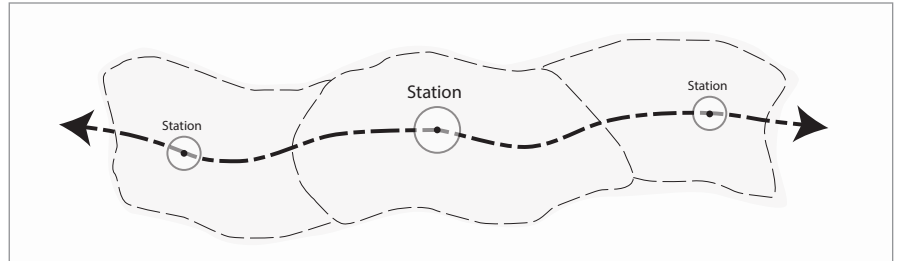


Figure 23. Schematic sketch of the corridor analysis scale [Source: Authors]

According to the Wüst+Partner data, the population growth of small and mid-sized communities along railway corridors will vary from one section to another due to differences in housing demand, the number of small and mid-sized communities in each section, and distance from the agglomeration centers, particularly Zurich and Basel. Figure 24 shows the population projections from Wüst+Partner data and the available land reserves within the official building zones of the small and mid-sized communities that have the potential to accommodate new residents and be available by 2025.

Focusing on the land reserves in this analysis the following areas are recognized: *(Innenentwicklungspotenziale)*, which are unbuilt areas within the building zone with an extent of at least 2'000 m²; empty sites (*Baulücken*), which are unbuilt plots within the building zone, encompassing an extent of less than 2'000 m²; new development reserves (*Aussenreserven*) for an extent of at least 200 m², which are located within the legalized building zones. The reason is mostly because of the attractiveness

and housing demand of the small and mid-sized communes in each defined railway sections. For instance, based on the current regulations there are available land reserves for additional 9'000 inhabitants in section Zurich - Olten until 2025. Also based on the population projection, 6'000 more inhabitants will be accommodated in communities alongside this section. Therefore the section has enough land reserves until 2025.

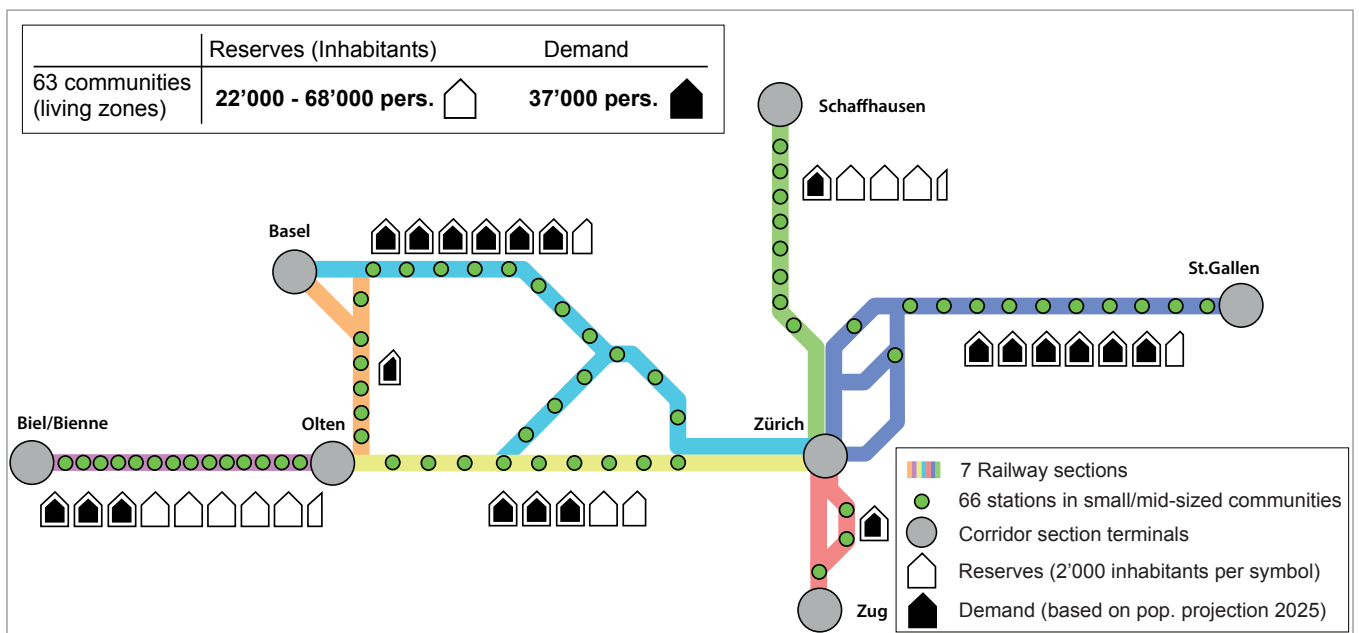


Figure 24. Population growth and inhabitant capacity based on available reserves until 2025 [Source: Authors | Data: W+P, 2015; see Appendix I]



6. Research Results

There are 63 small and mid-sized Swiss communities as the objects of investigation located alongside 7 important railway sections in this research. This chapter addresses current concerns as well as future development possibilities in the close vicinity of the railway stations in these communities (300 m radius distance from the railway station) from spatial development perspective.

6.1 Pilot Corridor Findings

Pilot case study is a preliminary study conducted on the small group of cases in order to evaluate feasibility and time. In this research corridor Zurich-St.Gallen is defined as the pilot corridor. The information gained from its study was used as the basis for other corridors.

6.1.1 Strategy

We chose to concentrate on developing research criteria for a smaller set

of case studies before starting on the study of 63 small and mid-sized communities. After completing an overview of the different community types in our case study, the final methodology was applied to all the case studies. The railway corridor from Zurich to St.Gallen was chosen for the pilot case study.

The Zurich–St.Gallen corridor connects 19 communities directly along its railway line, where each community

has a station. Treating the stations as nodes, it also serves a larger catchment area. This catchment area provides potential passengers and railway users for the stations along the corridor. If we include this catchment area, the pilot corridor then services 35 communities. Based on our definition, 25 of these communities are small and mid-sized communities (see Table 1, chapter 5).

One of the most crucial tasks in integrated spatial and infrastructure

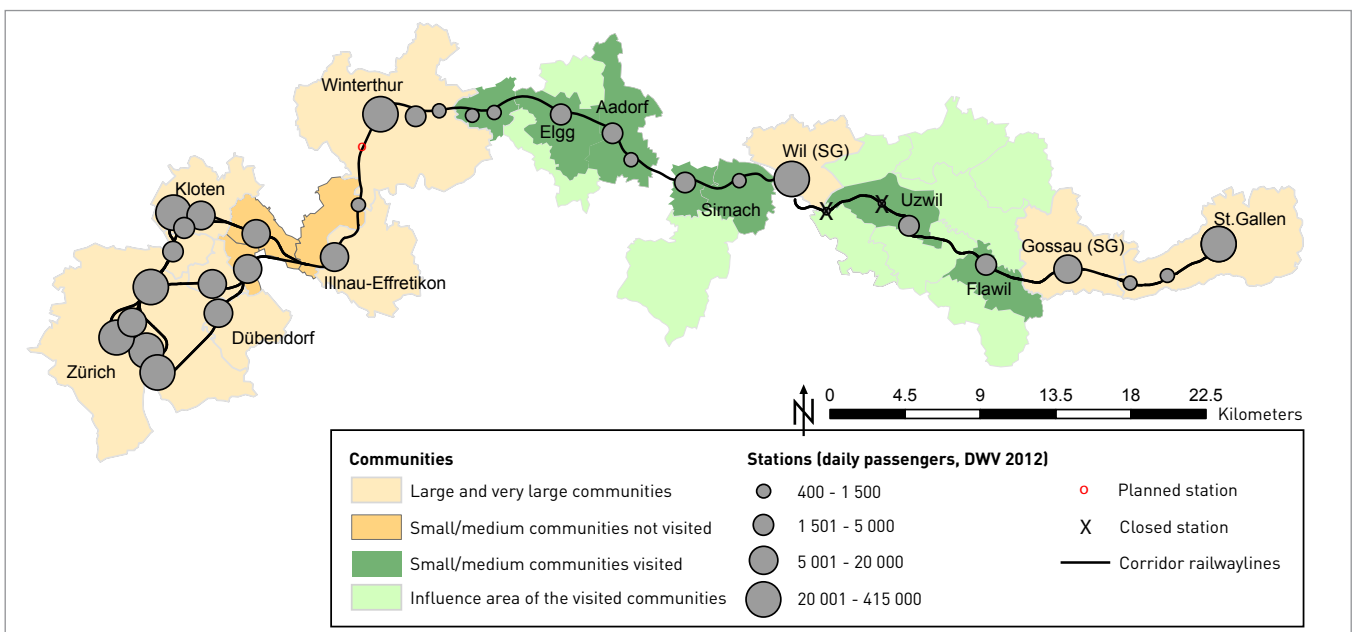


Figure 25. Visited communities for MuniTalks in addition to the passenger frequency - Pilot corridor [Source: Authors | Data: SBB, 2015; BFS, 2014]

development is to find the proper perimeters for investigation and planning. Here, the main question is if the regular governmental boundaries are the best perimeter for spatial and transportation planning. For our purposes, we examined government boundaries, such as communal or cantonal boundaries, to see if they would still function in an integrated analysis. If the results of this examination were negative, then we would need to define a new perimeter based on the catchment area or influential region of the railway stations.

The terms catchment area and influential region might seem similar in definition, but these are two different concepts. The catchment area represents the settlement area around the railway stations, where railway users live and work. Therefore, it is necessary to have an estimate of the number of railway users for future planning purposes. An influential region is the area that could be influenced by the impact of a transport infrastructural node (in this case, a railway station). Settlements are highly responsive to any change in railway network connections. For instance, any change in the timetable or stop frequencies might not only change the influential region physically, it might also affect transportation mode choice. In general, both catchment areas and influential regions could conform to the governmental boundaries. However, this actually happens rarely, especially when the station is located at the edge of a governmental boundary. In this case, both catchment areas and influential regions could cover the neighbouring settlement area by crossing the respective governmental boundaries.

In this investigation, we first examined the information to define the catchment area. Although this

method is more suitable for an integrated infrastructural and spatial development study, there are practical difficulties shifting from community boundaries to catchment areas. For example, from one community to another, the data is not homogenous or sometimes not even available. However, although we initially analysed the pilot corridor (Zurich–St.Gallen) based on catchment areas, for the other six corridor sections, we followed the community and cantonal boundaries. This is mainly because gathering data for the other areas is tough and time-consuming. Finally, to obtain a consistent analysis, all seven corridors were examined using the community boundaries.

6.1.2 Interviews with Local Authorities (Municipality Talks: Munitalks)

To discover the potential and the conflicts of railway stations in small and mid-sized communities, we conducted interviews with community authorities and experts. Interviews with the mayors (*Gemeindepräsidenten*) helped clarify the expectations regarding future settlement growth of the communities as well as their expectations regarding railway station development. For this part of the research, we met with 7 community authorities from the pilot corridor (see Fig. 25) and from three communities in other corridors. The initial results were incorporated into

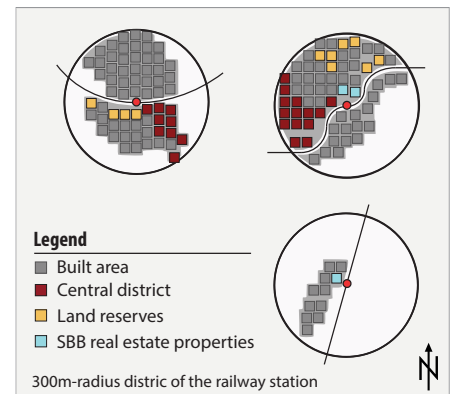


Figure 26. Station⁺ general scheme (Source: Authors | Data: Appendix I)

the corresponding focus areas in the following sections of this chapter.

6.1.3 Station⁺ Method:

We delimited the study perimeter to the vicinity of the railway station for the investigation of the different features of the railway stations in the chosen communities. While this research focuses on the opportunities and challenges for SBB, the main concentration is on SBB stations and the properties belonging to SBB. Analysis showed that most of the properties of SBB's Real Estate Division are located within a 300 m radius of the railway stations. Therefore, a radius of 300 m around the railway station has been empirically considered for the further investigation of all 63 small and mid-sized communities. This approach allowed all the cases to be spatially analysed in the same scale, regardless of the size of the community. It also provides a baseline for further

Catchment area or communal boundaries? What is the proper perimeter to study mutual effects of railway station development and spatial growth in small and mid-sized communities?

comparison among the investigated properties.

This approach also helps mainly in exploring the location of railway stations in the surrounding neighbourhoods. In addition, it reveals information on SBB properties and estimates the amount of land reserves in the immediate vicinity of the railway stations. Using this method, spatial discussion analysis was developed based on: a) the location of stations in relation to town centers and official building zones, b) the amount of land reserves, and c) potentially developable SBB properties in a 300 m radius of the railway stations (Fig. 26).

This method simplifies the conceptual grasp of the space around railway stations in small and mid-sized communities. By illustrating these figures alongside the railway corridor, a quick overview of the station typology can be presented in each direction. For instance, Figure 33 shows an overview of railway stations in the pilot railway corridor Zurich–St.Gallen. This schematic figure shows a variety of railway station types in a corridor. Station+ typology is the basis of our analysis in this chapter. In total, there are 66 railway stations, each represented by a schematic sketch, shown in seven different corridor sections.

One of the most significant attempts in analyzing the pilot corridor is a detailed investigation in the influential region, as well as on the local scale. Figure 27 shows different scales of analysis implemented only in the pilot corridor. It was hardly possible to implement this detailed investigation for all 66 stations in a one-year project. However, some of the general issues and concerns are still valid for similar communities with the same typology for other railway sections. Through this initial typology, it was possible to simplify the results for such a large study area (seven sections).

6.2 Three Focus Areas

We focused on the three areas of Uzwil, Aadorf and Elgg in order to have clearer image of opportunities and conflicts in the small and mid-sized communities. The cases are chosen from the pilot corridor.

6.2.1 Focus Area - Uzwil

The community of Uzwil is one of the important nodes in the Zurich–St.Gallen corridor. Among the BFS categories (2014), Uzwil is classified

as a 'core agglomeration center' (Fig. 9, chapter 2). Because of Uzwil's great potential, this is the first community where the catchment area analysis and the Station+ initiative was applied. Good documentation of the data and information is the strength of planning in this community. Since Uzwil is in the Canton of St.Gallen, we have Raum+ data (Fig. 10, chapter 2). However, the community does not have a full-time planning professional in the local government. This can result in

the community being somewhat passive in processes of decision-making, especially in local politics. It is crucial to be aware of this situation when redevelopment of the railway station or other changes in the railway corridor capacity or functionality is the issue. Considering the catchment area of Station Uzwil, six communities are assumed to provide passengers for this station. Table 2 shows these communities and their population in 2013. As shown in Table 2, the catchment

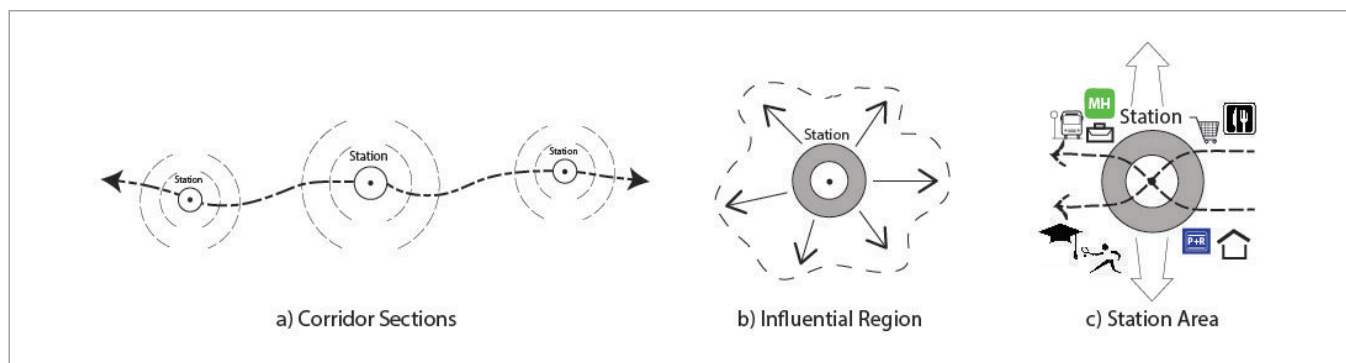


Figure 27. Schematic sketch of all analysis scales for pilot corridor (Source: Authors)

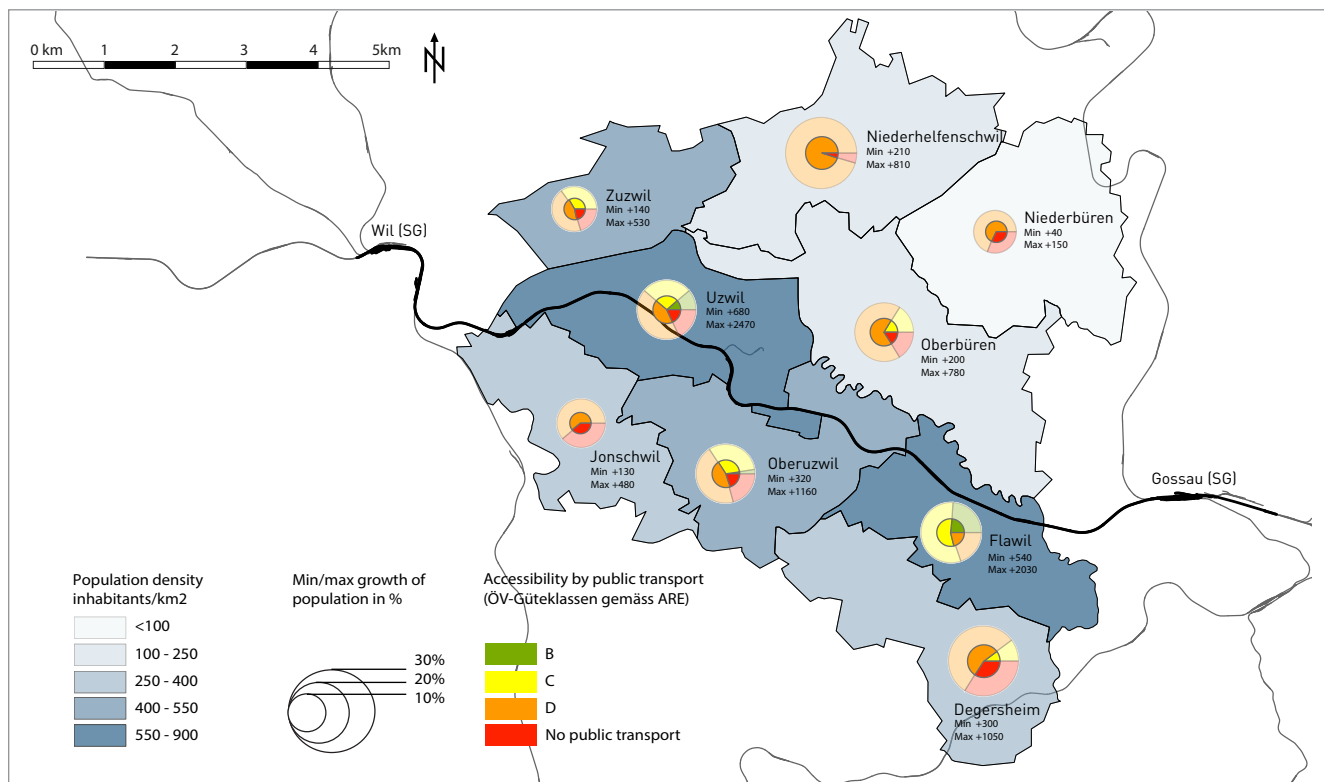


Figure 28. Catchment area of Station Uzwil & Flawil and potential additional inhabitants based on the available land reserves (Source: Authors | Data: Appendix I)

area consists of around 28`000 inhabitants, while Uzwil alone has around 13`000 inhabitants (BFS, 2014). Since some of these communities are also in other stations` catchment areas, e.g. Zuzwil, Jonschwil, Oberbüren, we used one-half of the population total in our calculation for the catchment area inhabitants of Station Uzwil.

The settlement structure is concentrated in a linear area connecting four town centers in three villages, including Oberbüren, Uzwil and Oberuzwil (see Fig. 29). Historically, there were three town centers in this district, each belonging to one town. By introducing the railway station at the edge of Uzwil community, the fourth center emerged north of the railway station. Over time, the settlement structure developed in a way that improved accessibility to the railway station. Gradually, main

businesses and retail stores moved from the historic town center of Uzwil to the railway station neighborhood. Nowadays, the historic town center still preserves its cultural and educational legacy, while commercial and service providers are located mainly in the fourth town center around Station Uzwil (Interviews, Uzwil).

Although the railway station stimulated settlement development in both Uzwil and Oberuzwil, the railway tracks also worked as a strong physical barrier, disconnecting the two sides of the settlement area. There is only one underpass for pedestrians and one for motorised traffic to link the two settlements. Meanwhile, there are many residential and industrial areas

Communes	2013	2025
Uzwil	12'811	13'624
Oberuzwil	6'060	6'632
Niederhelfenschwil	2'951	3'234
Zuzwil (1/2)	4'782*1/2	5'490 *1/2
Jonschwil (1/2)	3'775*1/2	4'384 *1/2
Oberbüren (1/2)	4'184*1/2	4'238 *1/2
Sum	28'193	30'546

Table 2. Population growth in catchment area of Station Uzwil; 2013 status and 2025 projection (Source: Authors | Data: W+P, 2015; BFS, 2014; ARE, 2015)

in the vicinity of the railway station, which makes the location of station very strategic for development.

A 2013 population projection for the catchment area of Uzwil Station showed that approximately 2`000 additional inhabitants are expected by 2025. Around 1`000 of the new population will be accommodated in Uzwil itself (Table 2). Thus, demand for redevelopment will be higher than expected in Uzwil and will need more activation of land reserves.

Needs and requirements

When we consider the potential in relation to population growth and the amount of available land reserves in Uzwil and its catchment area, it is clear that new demands and requirements will arise. Having a large industrial district, and two important educational centers (national and regional levels), in addition to the forthcoming residential and business development, Uzwil will require office buildings and service districts, which are currently missing in Uzwil and its surroundings (*Gemeinde Uzwil*). Although there is a commercial town center parallel the Bahnhofstrasse next to the railway station, there are some settlement areas that are distant from the central district on the far side of the railway tracks. This relates to both land use planning and accessibility level. If the railway tracks function as a physical barrier on the local scale, then a solution will be needed, perhaps a second underpass more in the direction of the northern part of the railway station. This new accessibility could also affect the land use pattern and attract more commercial businesses and services to the remote side of the railway tracks.

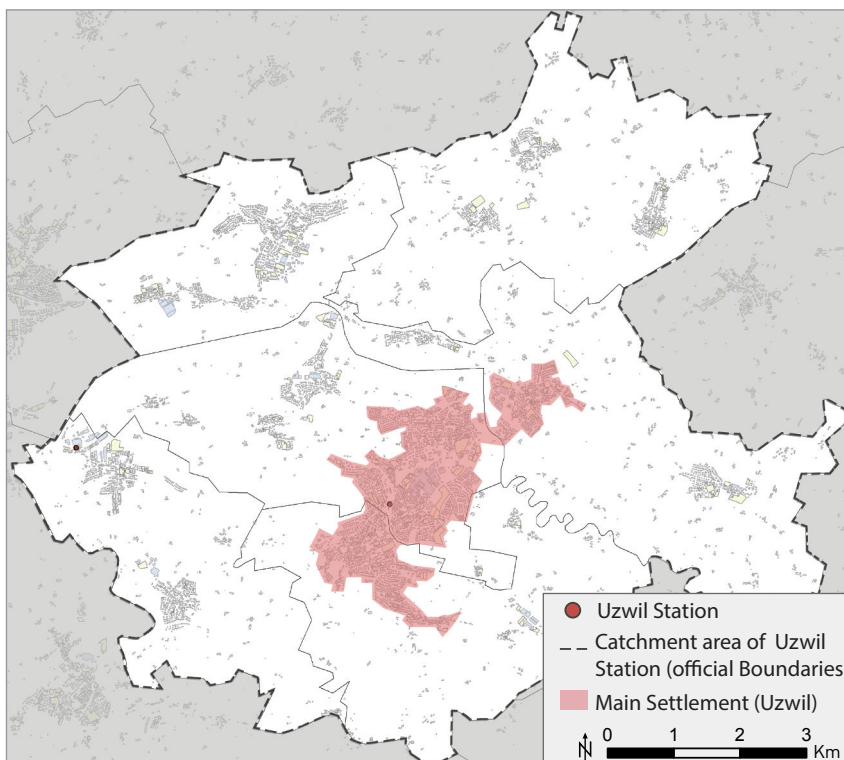


Figure 29. Main settlement region in catchment area of Station Uzwil (Source: Authors)

Opportunities and conflicts

Due to the strategic location of the railway station, properties around and close to the railway station have significant importance. A significant amount of land parcels around the railway station mostly in the eastern side belong to SBB Real Estate. To overcome the problem of railway tracks as a physical and land use barrier, there are two means open to SBB Real Estate:

1. by negotiating the use of these properties in the Uzwil Structure Plan,
- or
2. by cooperating in the redevelopment of the neighbourhood with the Community of Uzwil (*Gemeinde Uzwil*).

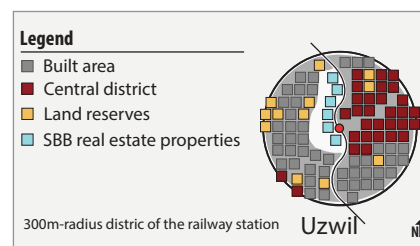


Figure 30. a) Station+ categories in Uzwil Station; b) Station+ scheme in Uzwil Station (Source: Authors | Data: Appendix I)

There are mutual benefits in both options for SBB and the Community of Uzwil. A second underpass was already discussed with the community authorities (*Gemeinde Uzwil, 2015*), however, in 1992 the voters refused the implementation.

6.2.2 Focus Area - Aadorf

Located in the Canton of Thurgau, Aadorf is another example of a mid-sized community from the pilot corridor. The community has two railway stations: Aadorf Station and Guntershausen Station. Currently, both stations have the same number of train stops, however, the characteristics of the neighbourhoods around these two stations are different. In Aadorf, the commercial district of the town borders on the railway station and connects the station to the northern parts of the settlement. But, in Guntershausen, there are no specific commercial or service businesses around the railway station, and the station currently functions as a stop only for the neighbouring housing areas.

The problem of the physical barrier is still valid in both stations. The railway tracks keep the town center's activities and main commercial uses in the northern part of Aadorf Station. In contrast, on the other side, there are only peaceful residential neighbourhoods.

Needs and requirements

The community is expected to face growth of around 1700 additional inhabitants in the next 10 years. This will require planning from the early stages.

Opportunities and conflicts

The upcoming developments are taking place in the northern parts of the town, putting pressure on the communal official building zone.

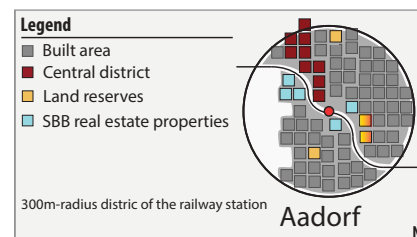


Figure 31. a) Station+ categories in Aadorf Station; b) Station+ scheme in Aadorf Station (Source: Authors | Data: Appendix I)

The future settlement growth of Aadorf will not be oriented towards Guntershausen. The tendency is not to overcome the physical barrier of the railway tracks and connect the northern part of the town to the southern part.

6.2.3 Focus Area - Elgg

The community of Elgg is another example of a mid-sized community. Since Elgg is located in the Canton of Zurich, the planning gap between the cantonal and community levels is more profound. Elgg is located at the cantonal border, thus providing good railway accessibility (and fair offers for tickets into the Canton of Zurich) for other towns in neighbouring cantons. However, it has a low priority on the cantonal level of planning, which puts Elgg in a passive role regarding its future. Moreover, the location of the station is remote from the historic town center of Elgg and the local bus connection only links the railway station to one side of the settlement areas and functions as a physical barrier.

Needs and requirements

An improvement in the railway connections and other means of public transport in Elgg resulted in an increasing number of commuters

to the large urban centers, such as Winterthur and Zurich. This caused a decline in the historic town center, which previously provided basic needs like grocery stores and other amenities. Now there is an opportunity to revitalise the town center around the railway station, so that commuters and citizens could shop or obtain services before or after work. However, the official building zone is very restricted and does not allow filling this gap around the railway station with development. In addition, Elgg needs the power to preserve the unique identity of its cultural characteristics in order to avoid becoming a commuter town.

Opportunities and conflicts

Much of the agricultural land is in a very close proximity to the railway station. The cultural land initiative (*Kulturlandinitiative*) is very strict in the Canton of Zurich, and does not allow development of agricultural lands

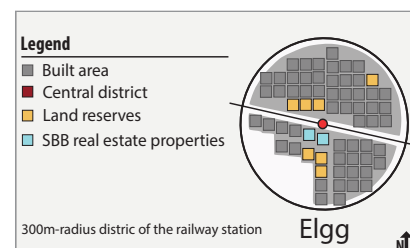


Figure 32. a) Station+ categories in Elgg Station; b) Station+ scheme in Elgg Station (Source: Authors | Data: Appendix I)

without compensation for the land selected. Within the community, the land reserves for the next 5–10 years are located in the most southern part of town. At this location, new settlement development would not have access to the railway station. The conflict is that the strict agricultural land initiative and the boundaries of the official building zone prevents compact development around the railway station, which could serve as a transport hub and a potential alternative for the town center.

6.2.4 Pilot Corridor Results: Zurich - St.Gallen

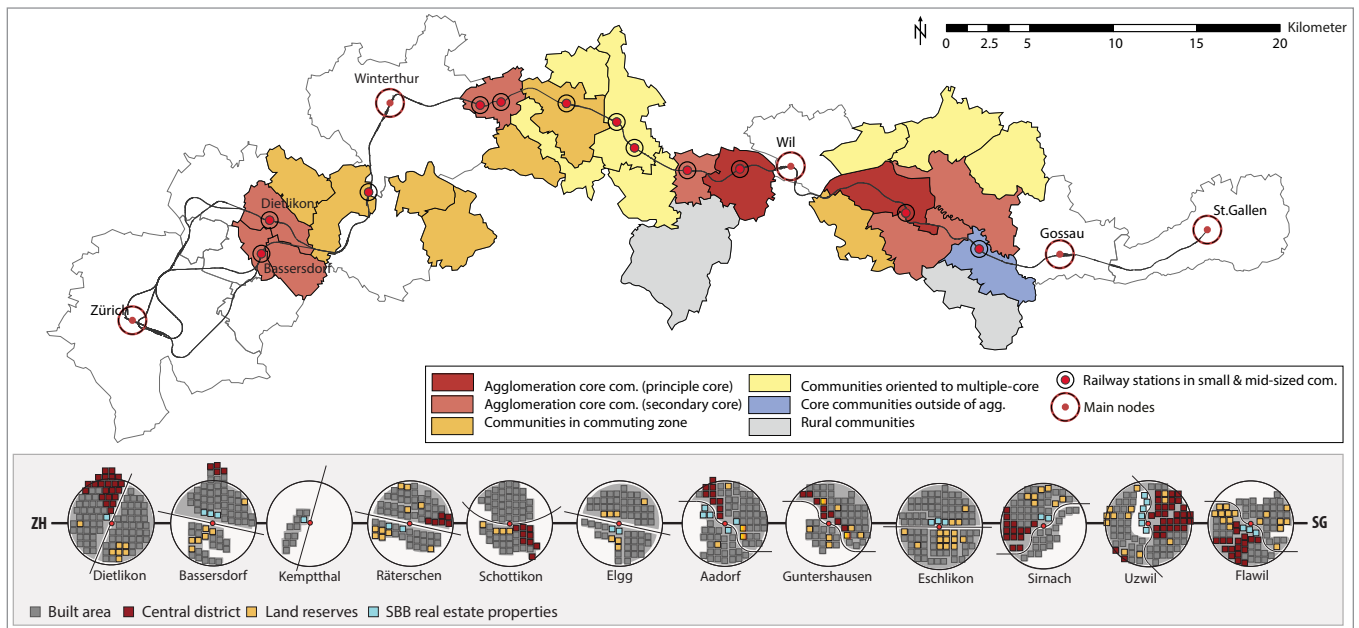


Figure 33. Corridor review: Zurich - St.Gallen [Source: Authors | Data: Appendix II]

- a) BFS typology in small and mid-sized communities;
- b) Schematic Station+ sketches in small and mid-sized communities - Pilot corridor

Excluding the large and very large communities, Figure 33.a illustrates the small and mid-sized communities in the pilot corridor (ZH-SG), based on the BFS typology. The variety of community types, from rural to the core community of the agglomeration, is distinct in this frame. Here, this typology is considered as a very general background, since there is a need for a more detailed analysis. For example, the communities of Uzwil and Sirmach have been both designated as core

communities of the agglomerations, while there are profound differences in terms of population, settlement structure and infrastructure. Other factors, such as available land reserves, population projections, passenger prognoses, location of the stations and the SBB properties were investigated using the Station+ method (Fig. 33.b). Figures 33.a and 33.b together better illustrate the main differences between the railway stations in different communities.

Also, the chart in Figure 34.a indicates there are land reserves available for 450-1'400 more inhabitants in close proximity to the 12 railway stations (300 m radius) in this corridor. Considering the role of the SBB in the potential development of these areas, the pie chart in Figure 34.b shows the current use of SBB properties around the case studies in the ZH-SG corridor.

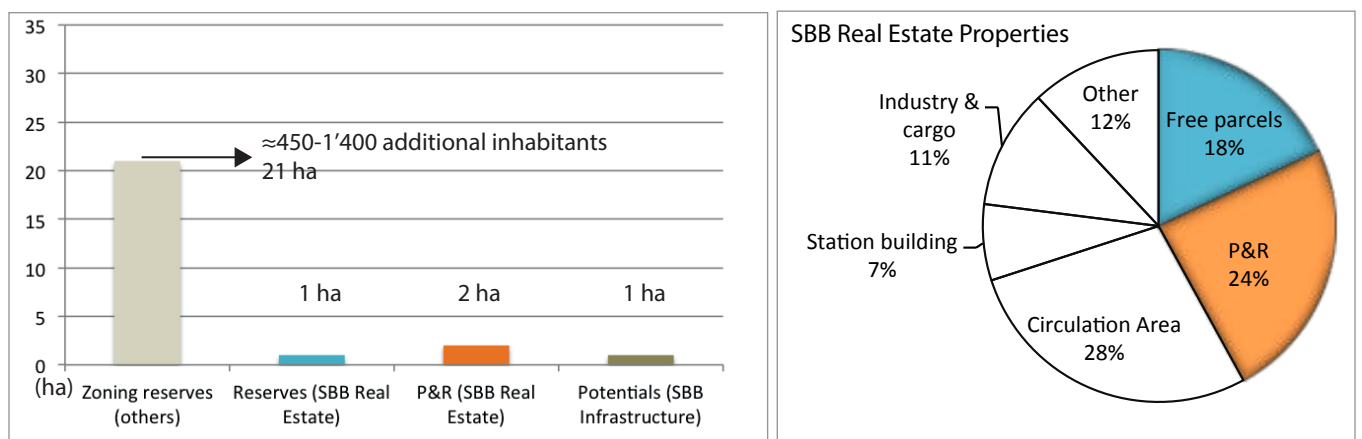


Figure 34. Corridor results: Zurich - St.Gallen [Source: Authors | Data: SBB, Raum+ and cantonal data]

- a) Development potentials within 300m-radius of the stations in all small and mid-sized communities;
- b) Current use of SBB Real Estate properties within 300m-radius of the stations in all small and mid-sized communities

6.3 Corridor Results

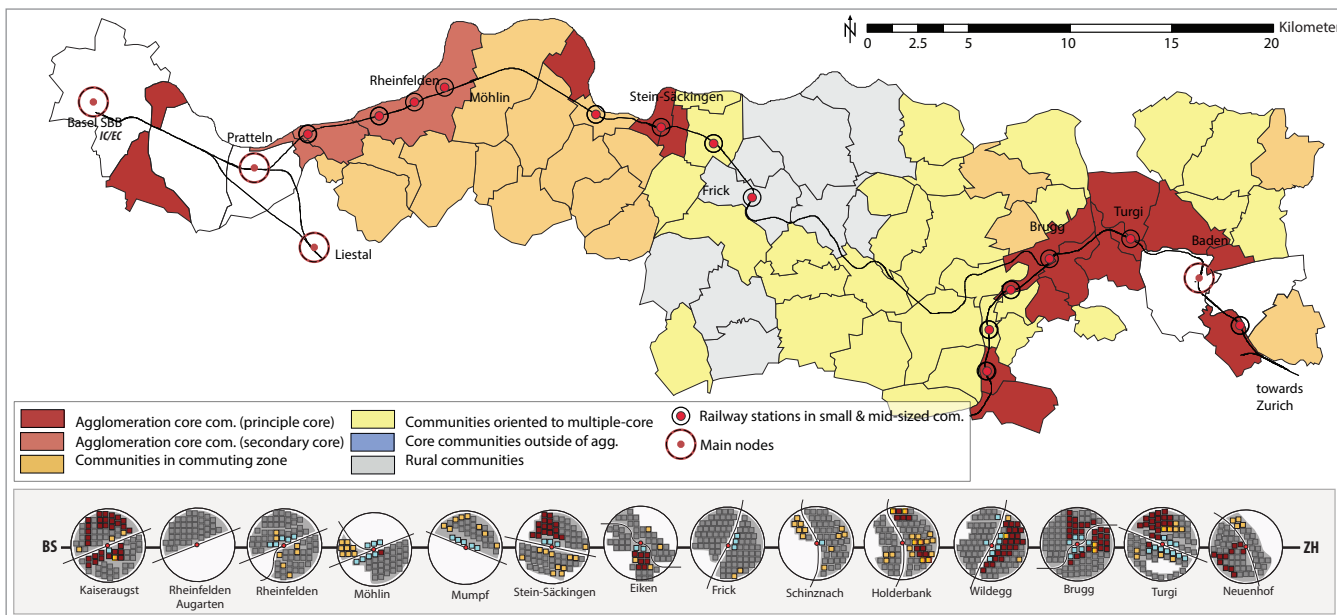


Figure 35. Corridor review: Zurich - Basel (Source: Authors | Data: Appendix II)

- a) BFS typology in small and mid-sized communities;
- b) Schematic Station+ in small and mid-sized communities

Chapter 6.3 shows the result for the other six railway sections, which were studied besides the pilot corridor Zurich - St.Gallen.

6.3.1 Zurich - Basel

The corridor Zurich-Basel (ZH-BS) is one of the most important links connecting the two agglomerations of Zurich and Basel. The specific topography resulted in a two-pole settlement structure. Many small communities are located

between two dense agglomeration cores (Fig. 18). In this area, the role of local public transport and local governance is important. In addition, Station+ shows that, regardless of the weak spatial structure, some of these small communities, such as Frick, have noteworthy potential to stimulate a more compact and organised development, while preserving the agricultural characteristics of the region. The bar chart in Figure 36.a shows that there are around 3 ha of

land reserves belonging to the SBB Real Estate Division in a 300 m radius around the 14 railway stations in small and mid-sized communities in this corridor. The chart also shows that there are land reserves available for 640-2'050 more inhabitants in the 300 m radius of the 14 stations (29 ha). The reserve potential in such a small distance highlights the importance of development in this area and might add spatial and economic value to the SBB properties more quickly.

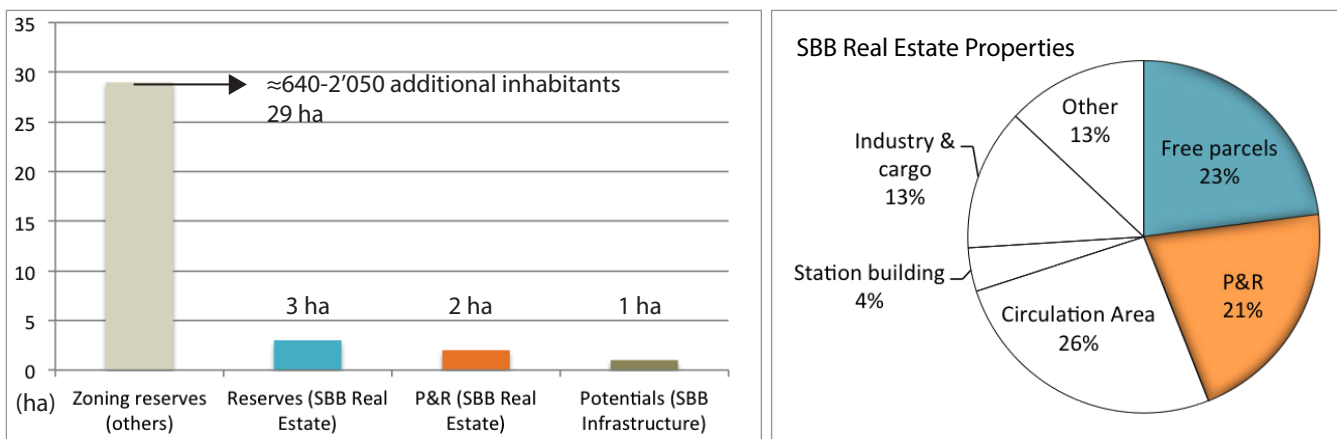


Figure 36. Corridor results: Zurich - Basel (Source: Authors | Data: SBB, Raum+ and cantonal data)

- a) Development potentials within 300m-radius of the stations in all small and mid-sized communities;
- b) Current use of SBB Real Estate properties within 300m-radius of the stations in all small and mid-sized communities

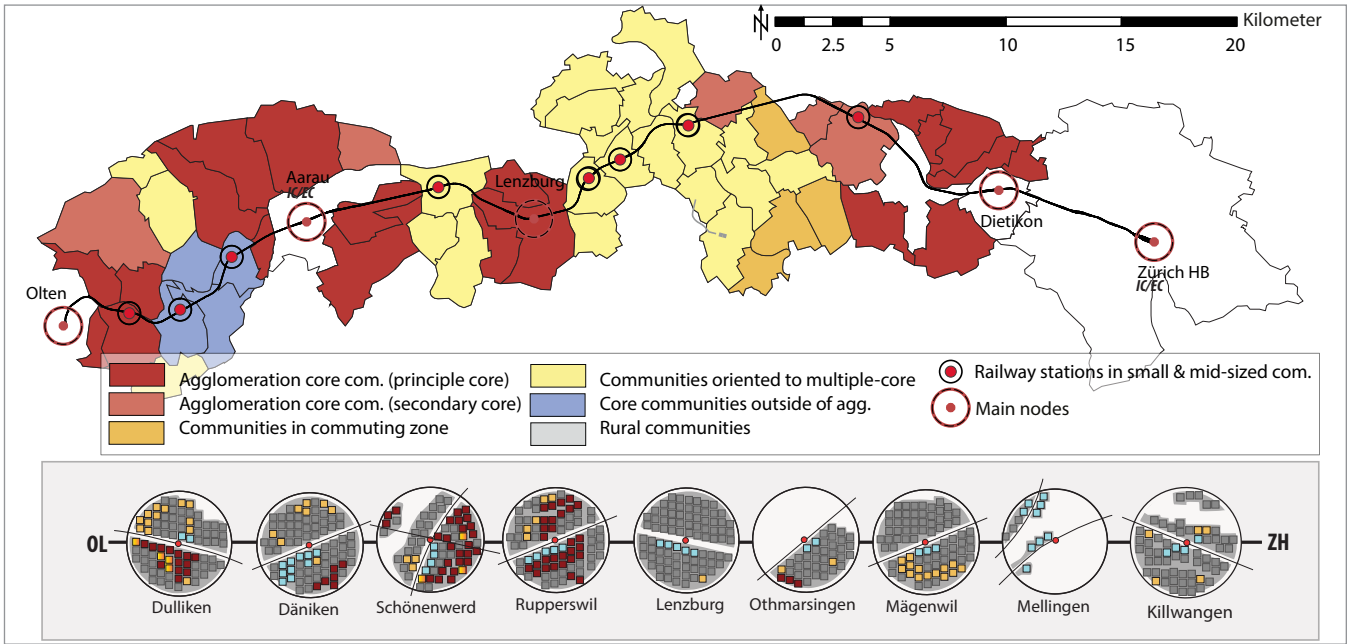


Figure 37. Corridor review: Zurich - Olten [Source: Authors | Data: Appendix II]

- a) BFS typology in small and mid-sized communities;
- b) Schematic Station⁺ in small and mid-sized communities

6.3.2 Zurich - Olten

The section Zurich–Olten (ZH–OL) is part of the settlement corridor west of Zurich (Fig. 1). Although the section connects directly to the agglomeration core of Zurich, an increase in demographics change is not expected before 2025 in small and mid-sized communities in this region. However, there are still land reserves available for 370–1`200 more inhabitants within 300 m of the nine stations (Fig. 38.a). Population projections from

Wüst+Partner show that most of the future residents of the small and mid-sized communities will concentrate around Aarau and Lenzburg, i.e. Schoenenwerd, Rapperswil and Lenzburg. Therefore, having land available in such communities would give the SBB manoeuvrability for further development.

Station⁺ results represent the appropriate location of the stations regarding town commercial centers in Schoenenwerd and Rapperswil.

However, in Lenzburg, the railway station has a remote location compared to the town center, which will make it more challenging for Lenzburg and the SBB to re-think the functionality of the station as a stop or as a town center.

Figure 38.b shows that industry and cargo sector has an important role in the highly-used railway section of Zurich - Olten even around the small stations. However still, there are free parcels available for further development.

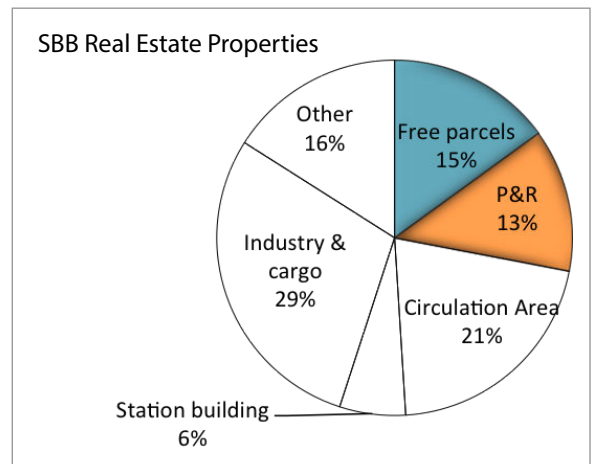
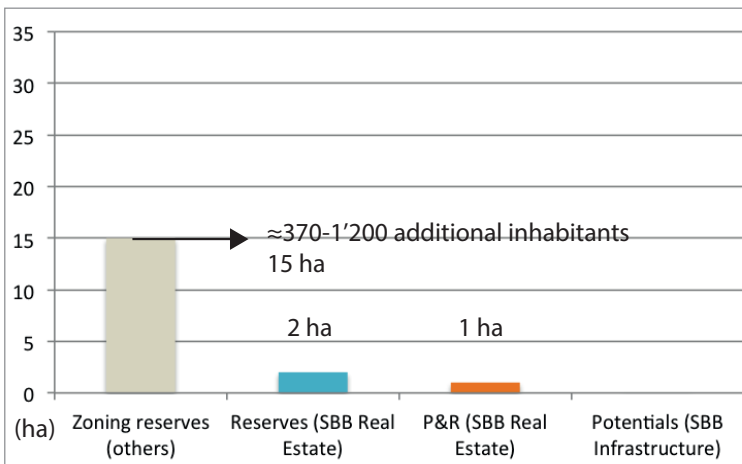


Figure 38. Corridor results: Zurich - Olten [Source: Authors | Data: SBB, Raum⁺ and cantonal data]

- a) Development potentials within 300m-radius of the stations in all small and mid-sized communities;
- b) Current use of SBB Real Estate properties within 300m-radius of the stations in all small and mid-sized communities

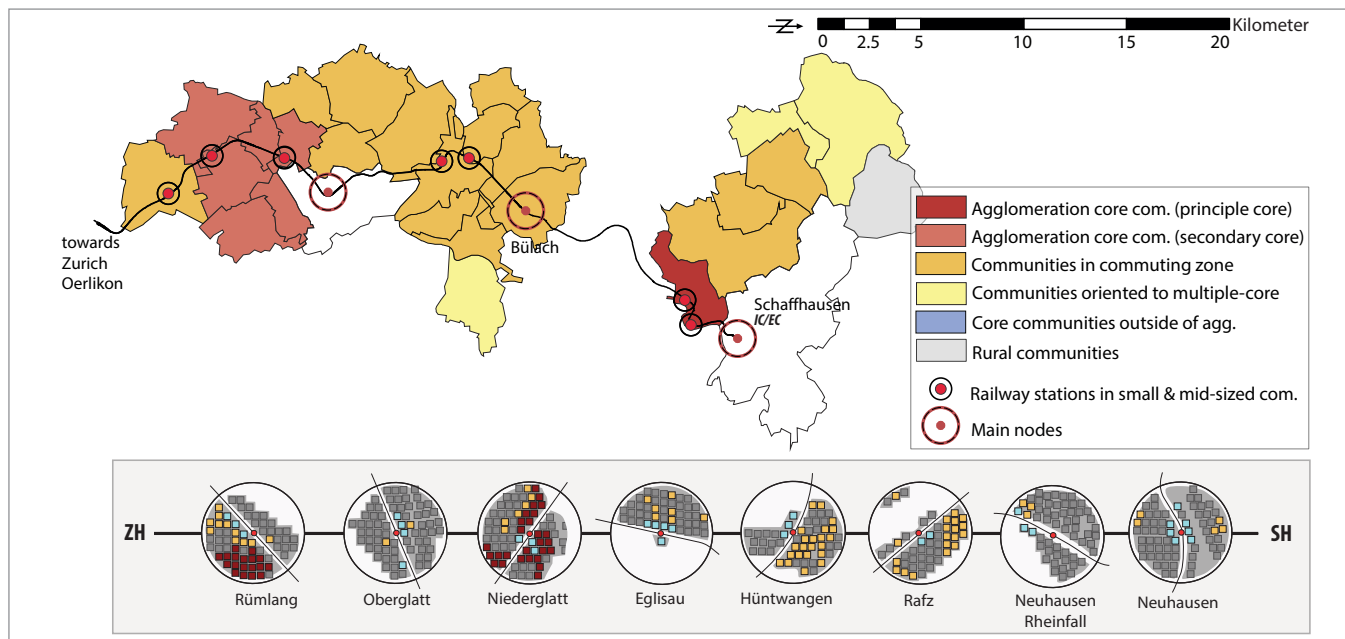


Figure 39. Corridor review: Zurich - Schaffhausen [Source: Authors | Data: Appendix II]

- a) BFS typology in small and mid-sized communities;
- b) Schematic Station* in small and mid-sized communities

6.3.3 Zurich - Schaffhausen

Regardless of the predominant urban characteristics of this section, increasing population growth is expected in the small and mid-sized communities in this region (ZH-SH), especially from Zurich to Bülach, including Rümlang, Oberglatt and Niederglatt.

number of free parcels belonging to the SBB are available for further development. Nevertheless, there is a good chance for a productive collaboration with the local government because the corresponding communities are at the edge of a large agglomeration core, either neighbouring communities of the agglomeration or the agglomeration belt communities, and these communities are aiming to activate the maximum spatial potential of their communities.

Station* revealed that there are a significant number of land reserves in a 300 m distance (21 ha) from eight Swiss stations in these sections. However, a great part of these reserves are located in non-residential zones, such as business zones. Therefore, there is the potential to accommodate between 280 and 910 inhabitants more within the direct vicinity of the railway stations with high accessibility to public transportation.

The challenge in this corridor mainly concerns the SBB, since only a small

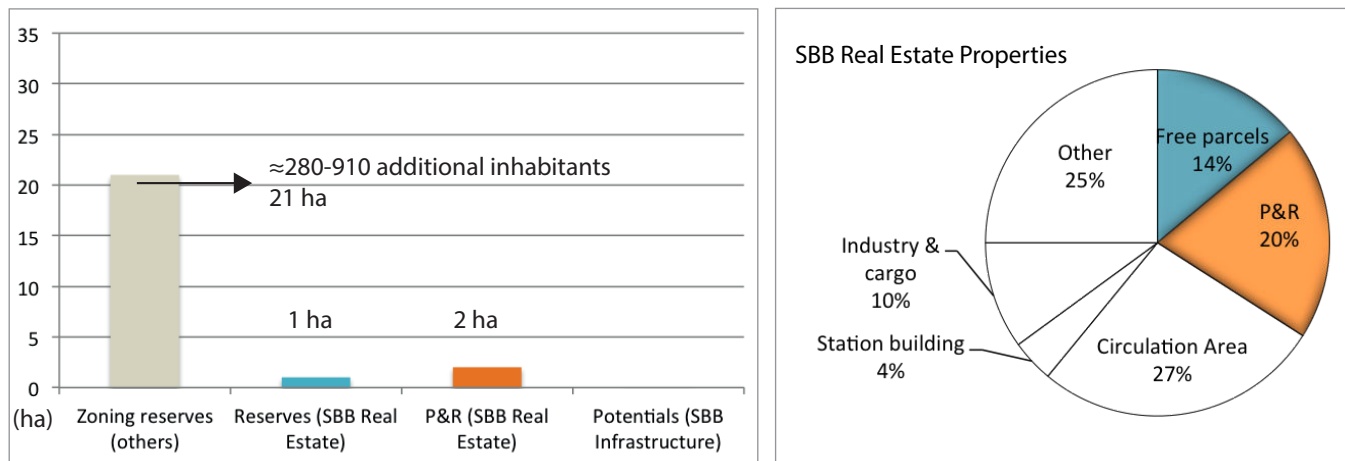


Figure 40. Corridor results: Zurich - Schaffhausen [Source: Authors | Data: SBB, Raum+ and cantonal data]

- a) Development potentials within 300m-radius of the stations in all small and mid-sized communities;
- b) Current use of SBB Real Estate properties within 300m-radius of the stations in all small and mid-sized communities

6.3.4 Zurich - Zug

Compared to the other railway sections, the corridor Zurich–Zug (ZH–ZG) is rather short, consisting of only three railway stations in small and mid-sized communities. According to the Wüst+Partner population projection, the expected population growth will mostly happen in larger communities in this section. Therefore, the small and mid-sized communities will have either a constant population growth or a small increase within the next ten years.

Station+ also revealed that the SBB has no land reserves for further development in the small and mid-sized communities in this section. Additionally, there are limited reserves in the immediate vicinity of the three stations (Fig. 42.a). As a primary observation, evidence and numbers for the population and community typology prove how good accessibility precedes compact development and supports the maximum settlement potential.

Moreover, Figure 42.b shows the amount of land allocated to Park&Ride is relatively small. This may be because the investigation shows a high level of local public transport, which requires fewer parking spaces.

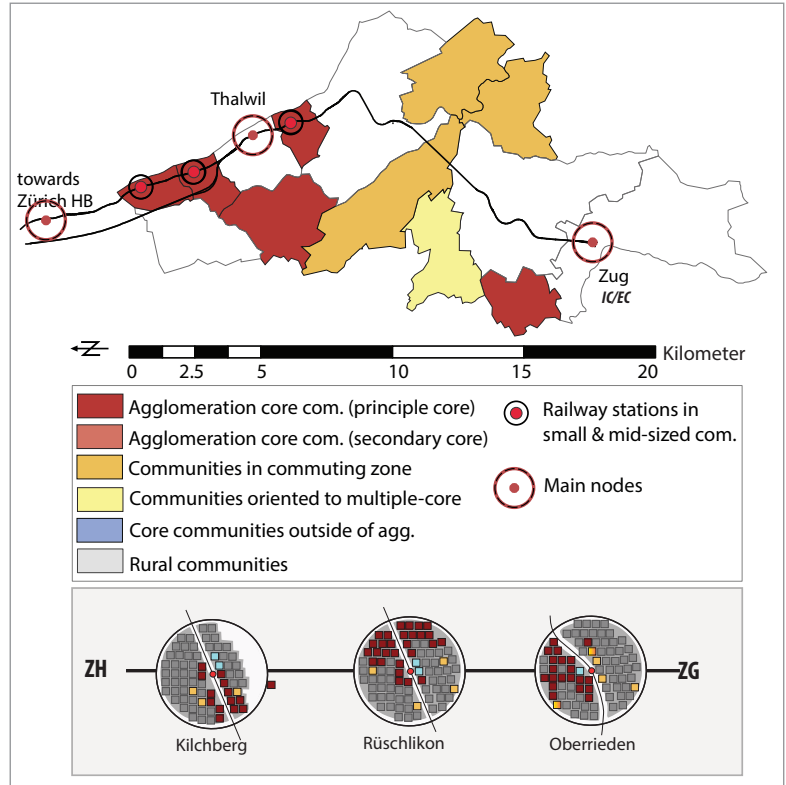


Figure 41. Corridor review: Zurich - Zug [Source: Authors | Data: Appendix II]
 a) BFS typology in small and mid-sized communities;
 b) Schematic Station+ in small and mid-sized communities

In conclusion, a tendency towards further development of the stations in small and mid-sized communities in the Zurich–Zug corridor has already reached its full capacity for the next ten years. In other words, there is no priority for station development in small and mid-sized communities in this corridor, but the spatial structure

in this section could be an example of best-practice in an integrated spatial and infrastructural framework.

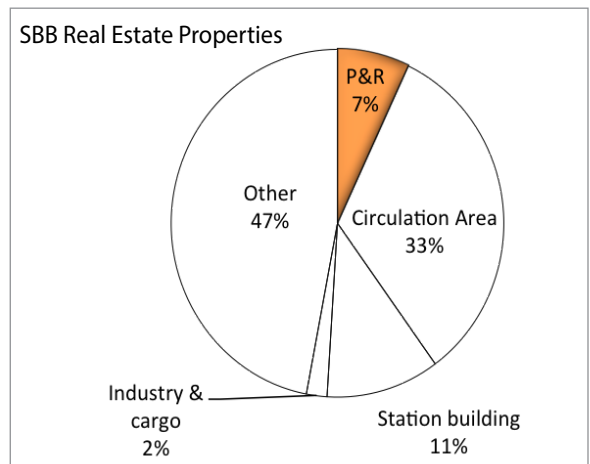
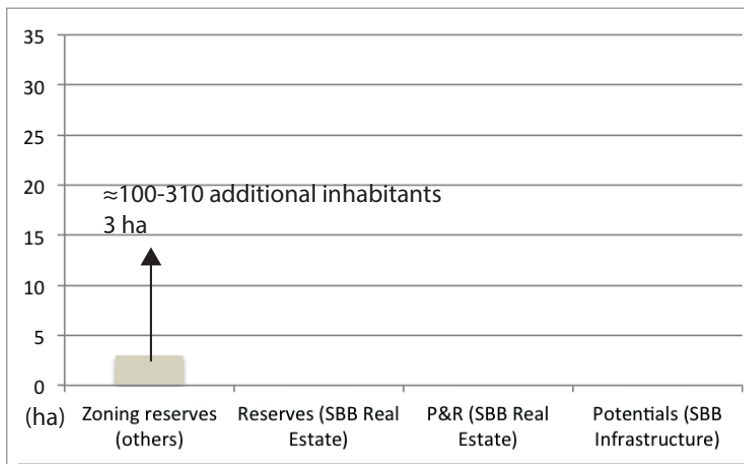


Figure 42. Corridor results: Zurich - Zug [Source: Authors | Data: SBB, Raum+ and cantonal data]
 a) Development potentials within 300m-radius of the stations in all small and mid-sized communities;
 b) Current use of SBB Real Estate properties within 300m-radius of the stations in all small and mid-sized communities

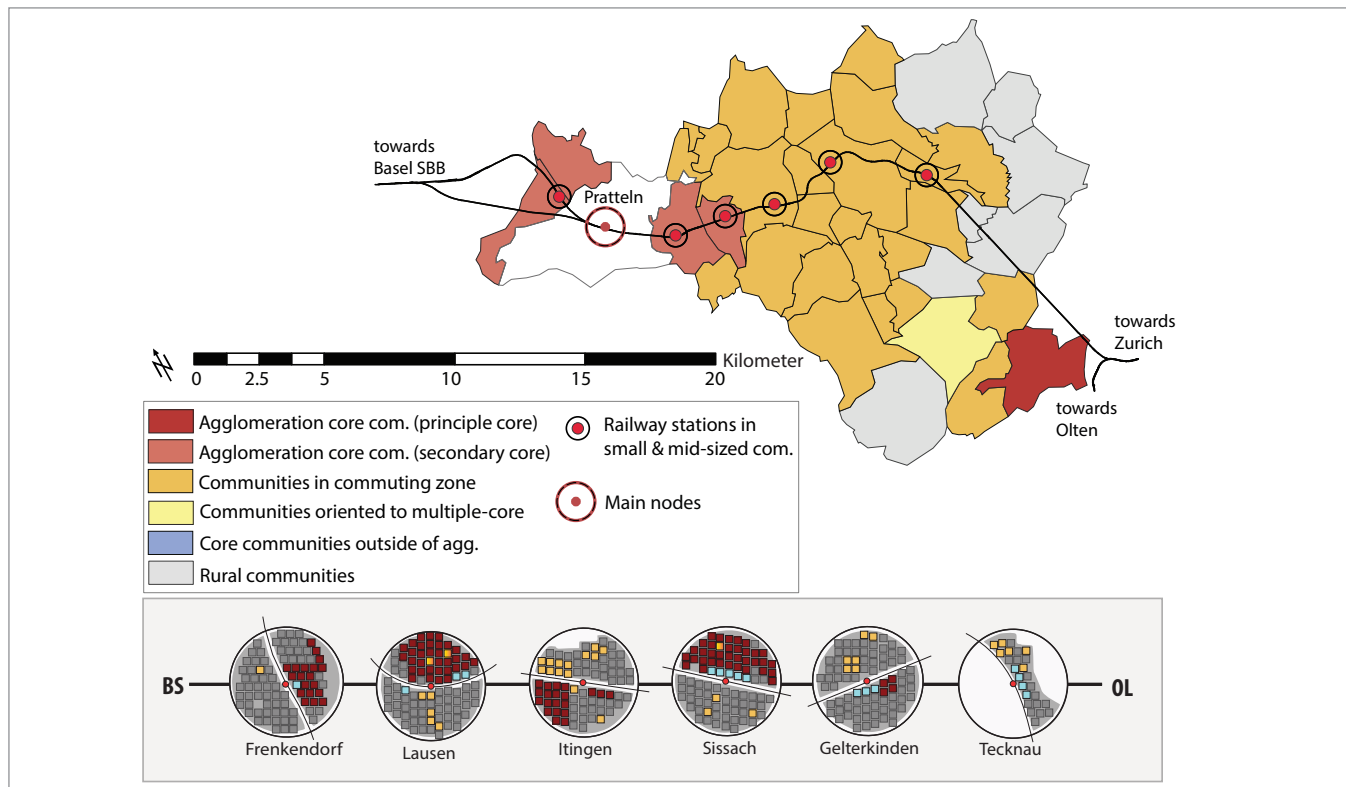


Figure 43. Corridor review: Basel - Olten [Source: Authors | Data: Appendix II]

- a) BFS typology in small and mid-sized communities;
- b) Schematic Station+ in small and mid-sized communities

6.3.5 Basel - Olten

In the Basel-Olten (BS-OL) section, Station+ revealed insignificant amounts of land reserves within a 300 m radius of the six railway stations in small and mid-sized communities. In addition, the SBB only has a small amount of property available for further

development in these areas. Based on the available land reserves in residential zone and the population projection by Wüst+Partner, it is very likely that future housing demand will exceed the available land reserves, including land reserves in floor area, in small and mid-sized communities in this section. For example, Sissach

expects an increase in population as well as number of passengers in the next ten years. However, here the challenge is the inadequate amount of land reserves ready for activation in this period of time.

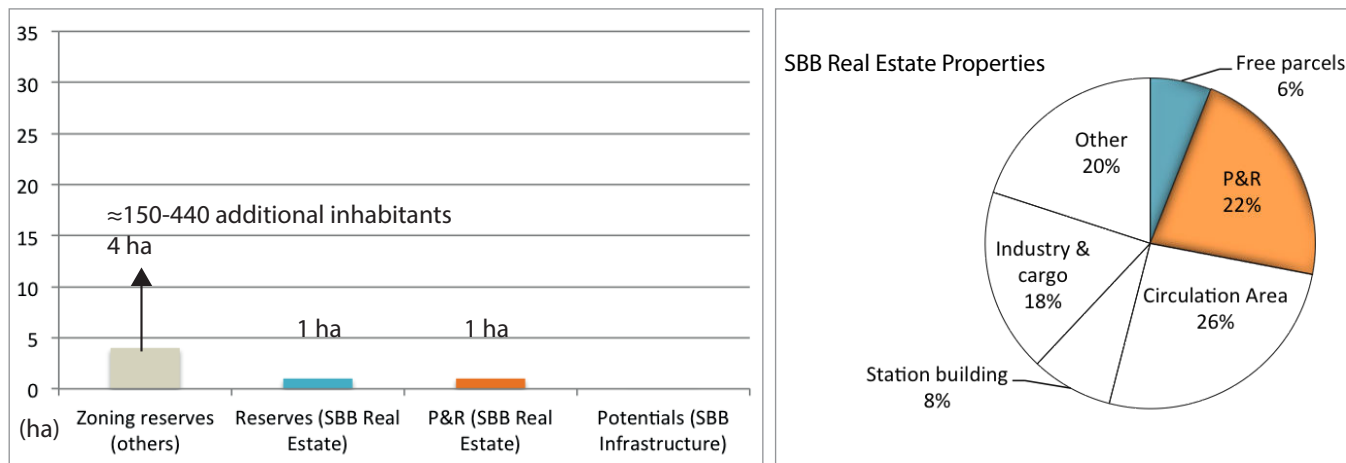


Figure 44. Corridor results: Basel - Olten [Source: Authors | Data: SBB, Raum+ and cantonal data]

- a) Development potentials within 300m-radius of the stations in all small and mid-sized communities;
- b) Current use of SBB Real Estate properties within 300m-radius of the stations in all small and mid-sized communities

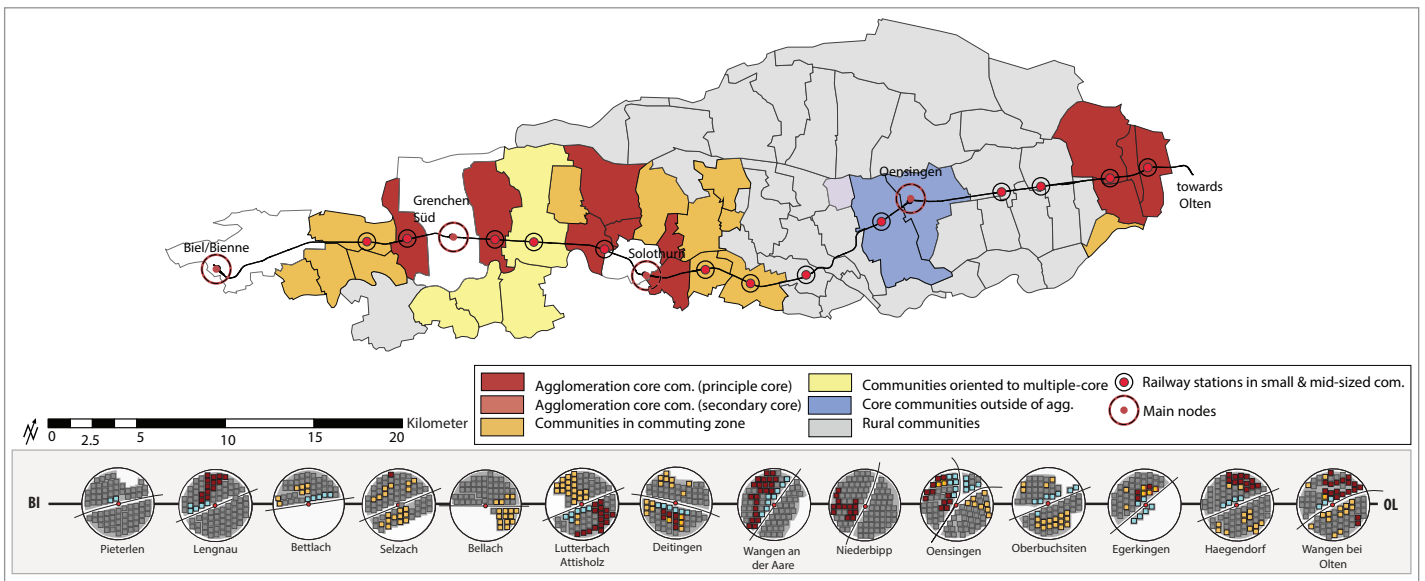


Figure 45. Corridor review: Olten - Biel (Source: Authors | Data: Appendix II)

- a) BFS typology in small and mid-sized communities;
- b) Schematic Station⁺ in small and mid-sized communities

6.3.6 Olten - Biel

The section between Olten and Biel has a unique distinction, while there are not only many small communities located in this region, but also most of the communities have rural and / or agricultural characteristics. Most of the communities in this section will confront shrinkage within the next ten years, based on the Wüst+Partner population projections. At the same time, Station⁺ revealed a significant amount of available land reserves

in this section (35 ha, Fig. 46.a). This initial result highlights the potential for the corresponding communities to reconsider their general strategies either towards attracting population or delimiting the official building zones, i.e. more compact development.

Moreover, shrinkage in this region is not totally inevitable. With regard to the significant amount of land reserves in small and mid-sized communities, it is reasonable to activate such potential through stimulation from public transport improvement. However, this

initially requires a holistic regional programme to clarify the main strategies regarding a sustainable regional development by local and regional authorities.

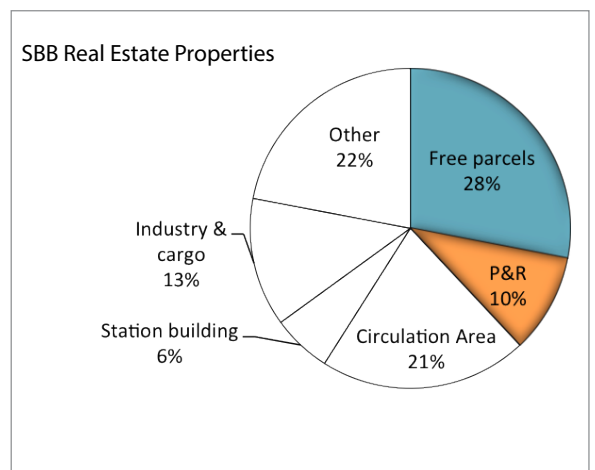
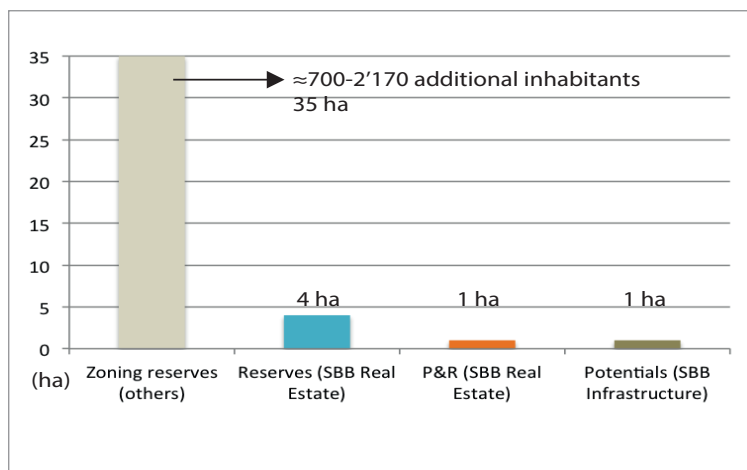


Figure 46. Corridor results: Olten - Biel (Source: Authors | Data: SBB, Raum⁺ and cantonal data)

- a) Development potentials within 300m-radius of the stations in all small and mid-sized communities;
- b) Current use of SBB Real Estate properties within 300m-radius of the stations in all small and mid-sized communities

6.4 General Outcomes

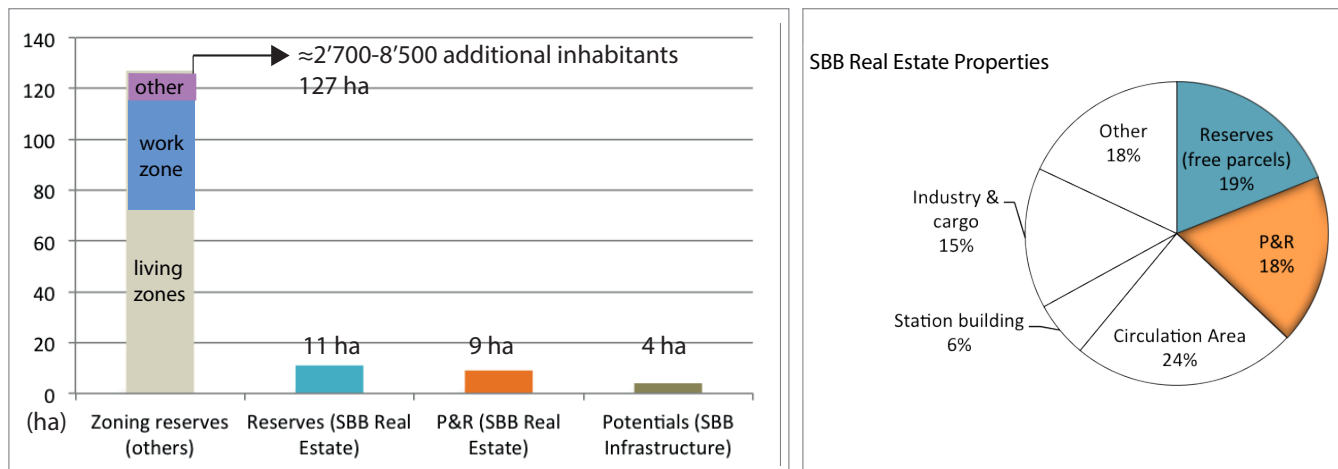


Figure 47. Corridor results: All communities in 7 corridor sections (Source: Authors | Data: SBB, Raum+ and cantonal data)
 a) Development potentials within 300m-radius of the stations in all small and mid-sized communities;
 b) Current use of SBB Real Estate properties within 300m-radius of the stations in all small and mid-sized communities

In conclusion, the investigation in a radius of 300 m of the railway stations in small and mid-sized communities proves a latent potential in those areas with high accessibility to public transportation, either railways or local buses. Figure 47.a indicates the land reserves and the SBB properties available in different

sections for all 66 stations in small and mid-sized communities within this radius. Considering the zoning of the land reserves, there is a range of between 2`700-8`500 additional inhabitant capacities in the immediate neighbourhoods of the railway stations in the studied areas.

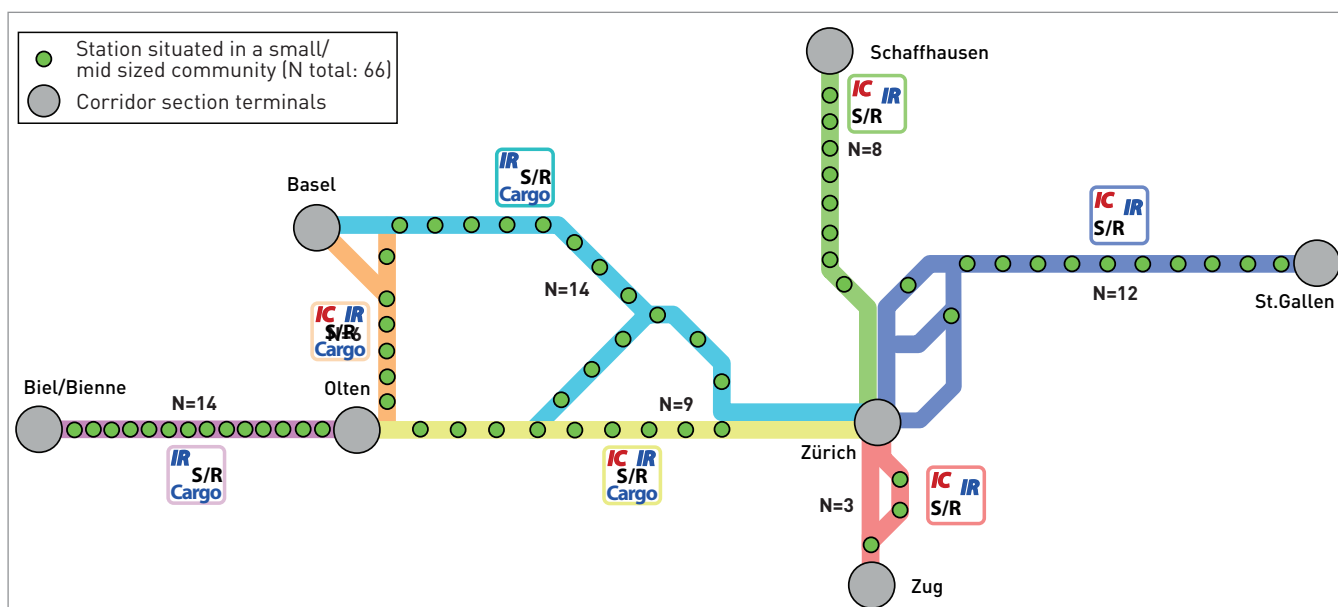


Figure 48. Overview of the train types in each railway section (Source: Authors | Data: SBB data)

6.4.1 Where to take action?

Several indicators are required to answer the questions: Where to take action, and Which stations and communities have priority for further development? Among all the railway stations in the study area, stations located in large and very large communities attract more attention for further development because they benefit from an organised and consistent planning system for short and long-term development.

However, following the long-term development perspectives for stations in large and very large communities, stations in smaller communities also require a clear development vision. Altogether, compared to the large and very large communities, the number of small and mid-sized communities is quite significant in the Swiss Central Plateau. Therefore, based on the analysis in 6.2, some of the most important indicators have been taken

into consideration in form of “Rate of Transformability” (RoT).

6.4.2 Rate of Transformability Model

As one of the aims of this study is to focus on better collaboration among different stakeholders concerning railway station development, particularly community authorities and the SBB, we have applied the same approach in Station+. This means that regardless of the settlement spatial structure, only the data in the immediate vicinity of the railway station are taken into analysis, but especially the reserves belonging to the SBB Real Estate Division.

To find the priorities of development, we have developed a rating model to distinguish among the different types of stations by weighting the indicators with the most effect (Table 3: Rate of Transformability). In the Rate of Transformability model, four spatial and railway-related indicators are weighted for each station in small and mid-sized communities. These indicators consist of:

1. the location of the station
2. the size of free parcels belonging to the SBB Real Estate

3. the prognosis for future station users
4. the population projection in the corresponding community

Figure 49 summarize the results of the RoT derived from 66 stations in the small and mid-sized communities. The first category consists of 16 stations, which have the highest Rate of Transformability and potentials for further development. These communities often have to deal with both rural and urban characteristics, since there is no clear aspects of urban/rural regions in such areas. Therefore there are opportunities for the SBB not only to help such communities to configure a compact and sustainable spatial development by collaborating in a railway station and town center development, but also to follow its general strategies regarding re-thinking of P&R areas and mobility hubs in such regions. This research suggest that communities with stations in the first category to start a close collaboration with the SBB. The second

category with 39 stations and third category with 11 stations, which have respectively second and third priorities are not in an urgent need for further development actions.

Priority I								
Indicators	Weight	Range						
Position of station	0.3	0.6 - 1						
Population projection	0.2	600 - 2800						
Station user prognosis	0.2	600 - 3600						
SBB ownership	0.3	0.1 - 1.3 ha						
RoT	-	0.7 - 1						
Priority II								
Indicators	Weight	Range						
Position of station	0.3	0.3 - 0.6						
Population projection	0.2	300 - 2000						
Station user prognosis	0.2	300 - 2000						
SBB ownership	0.3	0 - 0.4 ha						
RoT	-	0.3 - 0.6						
Priority III								
Indicators	Weight	Range						
Position of station	0.3	0 - 0.4						
Population projection	0.2	-300 - 400						
Station user prognosis	0.2	0 - 300						
SBB ownership	0.3	0 - 0.3 ha						
RoT	-	0 - 0.2						

Table 3. List of stations based on Rate of Transformability categories (Source: Authors | Data: Appendix I)

7. Concluding Remarks

7.1 Discussion

This research project was conducted as part of the collaborated effort toward a more integrated spatial and railway development. More particularly, the project focused on an analysis of land alongside SBB railway corridors in the vicinity of railway stations to explore potential settlement areas. In chapter 2.3, an analysis of the rail network's future capacities was introduced that allowed limited and simplified conclusions. However according to the SBB Infrastructure Division, only a simulation of infrastructure and train capacities as well as a consideration of current trainload factors would allow a more detailed conclusion on the future distribution of bottlenecks and overcapacities in the rail network (Appendix II).

The results of land reserves' analyses are presented in chapter 5.4. These were based on the approach proven by the Raum+ projects, as well as cantonal data for those cantons that do not have Raum+ database. The analysis of the land reserves and the visualizations of reserves per space user as comparable figures could be validly carried over from the Raum+ projects to the study area. However, this approach still leads to the minimum amount of available land reserves, since the potential for densification is disregarded. To reach

higher accuracy, future investigations could take the reserves in gross floor areas into account. The activation of gross floor area reserves would allow further development within the built-up settlement areas (Nebel et al., 2012).

In order to categorize the chances for redevelopment potential around the railway stations in small and mid-sized communities, the Rate of Transformability (RoT) was introduced in chapter 6.8. The rating is based on four single indicators and a weighting factor for each indicator. The main objective of the RoT is to offer a simple data-based categorization of the development potential around railway stations up to 2025. The four indicators are the prognosis of the number of future station users, the population projection of the respective communities, the location of the railway stations and the potential development areas owned by SBB Real Estate. Considering the population projection within the community boundaries facilitated the use of available data, however led to some limitations. Further specific information could be reached, if population projection data were considered not related to the respective community, but related to the stations' influence area. The fourth indicator describing the extent of free

parcels owned by SBB, underlines that chances for development are notably high for SBB in cases of availability of its own assets. It was initially discussed to introduce an additional indicator describing the level of profession present on the community planning level. However, an evident indicator for the planning profession could neither be found in literature nor be defined in the study. Especially in small communities, the planning level depends eminently on the expert knowledge and dedication of the [avocational] employees, which impedes the description of the planning profession by a quantifiable factor. It needs to be concluded that a change of the indicators as well as other weighting would result into other categorization results.

The initial assumption that certain corridors and sections can be characterized by similar development potentials of their stations could only partly be verified. Especially the corridor sections closely located to the agglomerated area of Zurich, comprise station types of all categories. It became apparent that the stations and their particular potential differ highly from one to another. On the corridor sections Olten–Basel and Olten–Biel, however, similar challenges for the covered stations

could be identified. Generally, it needs to be added that the conclusions of this study are based on supposing the strategy “redevelopment before new development” is strictly embarked on in future. Albeit a strong interest by land

owners and actors of the real estate market contradicts a strict observance of the redevelopment strategy, since for these new developments can be much more profitable. A change of opinion in publicity may threaten a

strict observance of redevelopment strategies and result in an undesirable loosening in the long term. Under such circumstances, the results of this study were widely questioned.

7.2 Final Recommendations

Based on the findings listed in chapter 6, the following recommendations are given to the SBB and the community authorities.

7.2.1 Recommendations addressed to SBB

a) The results of this research indicate that the highest chances for urban development can be found around the 16 <first priority> stations. This category includes stations in small and mid-sized communities along the section Zurich–Olten, Zurich–Basel, Zurich–St.Gallen, Zurich–Schaffhausen and Olten–Biel. In detail, the category encompasses the stations of Bassersdorf, Aadorf, Uzwil, Flawil, Kaiseraugst, Stein-Säckingen, Frick, Wildegg, Turgi, Schoenenwerd, Rapperswil, Oensingen, Rümlang, Oberglatt, Niederglatt and Sissach. At these stations, spatial development confronts a considerable shift in terms of population and urban characteristics. By supporting station development in these communities, there are considerable chances to increase the value of SBB Real Estate properties. It is estimated that generalizing this

approach to the entire SBB railway network, almost 100 railway stations fall into this category.⁷

b) Only after the first category railway stations were handled, potential development projects at the 39 second-priority stations should be reviewed. Distinctively, 11 of these stations are located on the section Olten–Biel. The demand for development at the second priority stations is currently restrained, but may increase suddenly, as soon as reserves in the agglomerated regions are depleted and demand spills over to the places that still offer sufficient reserves. This process may start after 2025, depending on the future circumstances. Thus, the dynamics of development around these stations should be kept in view in future. If required, for the meantime, the lead for developing project outlines at these stations is predominantly seen at the community authorities. If, however, no development on SBB properties is conceivable in the long term, it is recommended to dispose of these areas. This avoids the blockage of development intended by others.

c) No development action is needed at the 11 stations that fall under the lowest priority. Here, either substantial free properties, which could enable future development, are not available, or the foreseeable demand is too small to induce investments needs. It is recommended, that – if at all reserves are owned by SBB – the corresponding areas are sold or rented out to others, including the rights for development.

d) An adequate strategic coordination platform needs to be introduced to enhance collaboration between SBB and small and mid-sized communities. A minimum solution could be the implementation of a <permanent point of contact> at the SBB. This contact point should allow the small and mid-sized communities to exchange more targeted with the SBB on project outlines and spatial planning. The task of the ‘permanent point of contact’ was, furthermore, to contribute to the development of internal strategies affecting small and mid-sized communities as well as to bunch their opinions for SBB internal discussions.

e) Automotive modes of transport may be available for the private trip to and

⁷ 16 of the in total 122 stations in the study area fall in the first priority category. This equals a share of 13%. The SBB network contained in 2014 a total of 794 stations, which at an equivalent share results in up to 100 first priority category stations on the whole SBB network.

from the station in the future. A loss of importance of P&R facilities may concomitantly succeed. Thus, the 9 ha of P&R areas owned by SBB Real Estate within the study area should be seen as future strategic reserve for spatial development. However, a date from which on automotive transport will change the current mobility behaviour can't be estimated at the moment.

7.2.2 Recommendations

addressed to

Communities

The organizational parameters force the SBB and its divisions to implement either public funded projects or, following own projects, to invest in

profit-oriented developments. Although the collaboration with community authorities is a special strategic aim set by the Federal Government, the current situation does not allow the SBB to take the leading role for developments around all stations in small and mid-sized communities. The general responsibility for a consistent planning of the station areas, including the neighbourhoods, rather falls to the communities. Thus, community station planning should be based on a clear strategy and follow a comprehensive approach, but also regard the demand. SBB can be convinced for adequate participation in the local station development, if project outlines are planned based on a clear strategic focus.

7.3 Future Research

In order to further reveal the potential in small and mid-sized communities in general planning procedures, it is vital to consider spatial thresholds and capacities also in large and very large communities. However, due to the time limitation in this project, it was not feasible to have an overall inclusive analysis for all types of station development in detail. Therefore, an extended research will be conducted on a following project at the IRL of ETH Zurich, funded by the Swiss National Funding Organization (SNF). Aim is to investigate the possible ways of activating the settlement reserves in different regions, especially alongside heavily used public transport corridors. The focus of this research will be still on the small and mid-sized communities,

but in accordance with the larger communities' development.

The future research, under the title of Railway Capacity and Density Thresholds for the Future Spatial Development in Swiss Central Plateau (SNF-100013_162880), also assesses if the existing formal and informal planning instruments could support more collaborative approaches in the subject of railway and spatial development in small and mid-sized communities. This research takes further steps towards detecting the future general settlement structure in Switzerland in dealing with the increasing housing demands and spill over of the large urban agglomerations.

Uzwil Bahnhof

Linie	Richtung	Kante	Abfahrt
1
2
3
4
5
6
7
8
9
10

PostAuto regibus

B

C



BAHNHOTEL

FELIX

Felix



Literature

Cantonal Guiding Plans (*Richtpläne*)

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Richtplan Kanton Basel-Stadt, Mobilität, Öffentlicher Verkehr, 2015

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Appendix I

Data sources:

Supplier	Year	Description	Version	Source
Canton Aargau (AG)	2015	Bauzonen (Grundnutzung)	2000-2015	Aargauisches Geografisches Informationssystem (AGIS), Abteilung Raumentwicklung, Kanton Aargau
Canton Basel Land (BL)	2015	Raum*	2008	Professur für Raumentwicklung, ETH Zürich
Canton Bern (BE)	2016	Parzellennummern (Flächen)	05.01.2016	GeoKatalog, Amt für Geoinformation des Kantons Bern
Canton Sankt Gallen (SG)	2015	Raum*	2014	Professur für Raumentwicklung, ETH Zürich
Canton Schaffhausen (SH)	2015	Raum*	2013	Professur für Raumentwicklung, ETH Zürich
Canton Solothurn (SO)	2015	AV – Bodenbedeckung, AV – Liegenschaften	28.04.2006- 20.11.2015	Amt für Geoinformation, Kanton Solothurn
Canton Thurgau (TG)	2015	Raum*	2014	Professur für Raumentwicklung, ETH Zürich
Canton Zürich (ZH)	2015	Zonenpläne, Überbauungs- und Erschliessungsstände der Gemeinden	31.12.2013	Geographisches Informationssystem GIS-ZH, Amt für Raumentwicklung Kanton Zürich
Transcantonal	2015	SWISSIMAGE	2012 - 2014	SWISSTOPO, Bundesamt für Landestopographie
Transcantonal	2015	Bauzonen Schweiz (harmonisiert)	30.11.2009- 01.01.2012	UVEK, Bundesamt für Raumentwicklung ARE
Transcantonal	2015	VECTOR200 Level 4 - Administrative Boundaries	01.01.2014	SWISSTOPO, Bundesamt für Landestopographie

Data sources for Station+:

Source	Year	Description	Version
Schweizerische Bundesbahnen SBB	2015	Eigentumsverhältnisse SBB	13.08.2015
SWISSTOPO, Bundesamt für Landestopographie	2015a	VECTOR200 Level 4 - Administrative Boundaries	01.01.2014
SWISSTOPO, Bundesamt für Landestopographie	2015b	SWISSIMAGE	2012 - 2014
UVEK, Bundesamt für Raumentwicklung ARE	2015	Bauzonen Schweiz (harmonisiert)	30.11.2009- 01.01.2012

Appendix II

Interviews:

Supplier	Description	Date
Community of Uzwil	<i>Community talk</i>	<i>05.08.2015</i>
Community of Elgg ZH	<i>Community talk</i>	<i>13.08.2015</i>
Community of Aadorf	<i>Community talk</i>	<i>13.08.2015</i>
Community of Flawil	<i>Community talk</i>	<i>19.08.2015</i>
Community of Sirnach	<i>Community talk</i>	<i>28.08.2015</i>
Community of Elsau	<i>Community talk</i>	<i>21.09.2015</i>
Community of Eschlikon	<i>Community talk</i>	<i>29.10.2015</i>
Community of Rapperswil	<i>Community talk</i>	<i>05.11.2015</i>
Community of Frick	<i>Community talk</i>	<i>05.11.2015</i>
Community of Turgi	<i>Community talk</i>	<i>06.11.2015</i>
SBB Infrastructure	<i>Discussion on railway capacity</i>	<i>07.10.2015</i>

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Acronyms

AöV	Public transport office (<i>Amt für öffentlichen Verkehr</i>)
BAV	Federal Office of Transport (<i>Bundesamt für Verkehr</i>)
BFS	Federal Statistical Office (<i>Bundesamt für Statistik</i>)
B+R	Bike and ride (<i>Velofahren und Reisen</i>)
DWV	Average weekday traffic (<i>durchschnittlicher Werktagsverkehr</i>)
EBL	Inhabitants, Employees, Overnight stays (<i>Einwohner, Beschäftigte, Logiernächte</i>)
ETH	Swiss Federal Institute of Technology in Zurich (<i>Eidgenössische Technische Hochschule Zürich</i>)
FABI	Project to fund and expand the rail infrastructure (<i>Finanzierung und Ausbau der Bahninfrastruktur</i>)
HGVAnG	Federal Act of 18 March 2005 on the Connection of Eastern and Western Switzerland to the European High-Speed Rail Network (<i>Bundesgesetz vom 18. März 2005 über den Anschluss der Ost- und der Westschweiz an das europäische Eisenbahn-Hochleistungsnetz</i>)
IRL	Institute for Spatial and Landscape Development (<i>Institut für Raum- und Landschaftsentwicklung</i>)
NEAT	New Railway Link through the Alps (<i>Neue Eisenbahn-Alpentransversale</i>)
ÖV	Public transport (<i>öffentlicher Verkehr</i>)
P+R	Park and ride (<i>Parken und Reisen</i>)
ROT	Rate of transformability (<i>Abschätzung der Transformierbarkeit</i>)
SBB	Swiss federal Railways (<i>Schweizerische Bundesbahnen</i>)
SNF	Swiss National Science Foundation (<i>Schweizerischer Nationalfonds zur Förderung der wissenschaftlichen Forschung</i>)
STEP	Strategic development programme (<i>Strategisches Entwicklungsprogramm</i>)
UVEK	Federal Department of the Environment, Transport, Energy and Communications (<i>Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation</i>)
W+P	Wüest and Partner (<i>Wüest und Partner</i>)
ZEB	Future development of the rail infrastructure (<i>Zukünftige Entwicklung der Bahninfrastruktur</i>)

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